

FIELD EVALUATION OF ENGINEERING FABRICS FOR ASPHALT CONCRETE RESURFACING AUDUBON COUNTY

**CONSTRUCTION REPORT
IOWA HIGHWAY RESEARCH BOARD
PROJECT HR-360**

APRIL 1994

Highway Division



**Iowa Department
of Transportation**

Construction Report
Iowa Highway Research Board
Project HR-360

Field Evaluation of Engineering Fabrics
for Asphalt Concrete Resurfacing - Audubon County

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April 1994

TECHNICAL REPORT TITLE PAGE

1. REPORT NO.	2. REPORT DATE
HR-360	April 1994

3. TITLE AND SUBTITLE	4. TYPE OF REPORT & PERIOD COVERED
Field Evaluation of Engineering Fabrics for Asphalt Concrete Resurfacing - Audubon County	Construction Report 8-93 to 4-94

5. AUTHOR(S)	6. PERFORMING ORGANIZATION ADDRESS
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7. ACKNOWLEDGEMENT OF COOPERATING ORGANIZATIONS

Audubon County Board of Supervisors

8. ABSTRACT

An ACC overlay is most often the rehabilitative effort used to maintain the serviceability of either an ACC or PCC pavement. The major problem in durability of this ACC overlay comes from reflective cracking. These cracks usually open, allowing water to enter the unsealed crack and strip the ACC in the overlay. The stripping of the ACC allows accelerated deterioration at the crack.

Two engineering fabrics were evaluated in this project in order to determine their effectiveness in reducing reflective cracking. These two materials are:

- PavePrep, Contech Construction Products Inc.
- Pro-Guard, Phillips Fiber Corporation

A 4.2 km (2.6 mi.) roadway in Audubon County was selected for the research project. The roadway was divided into eight test sections. Four of the test sections are conventional resurfacing. The other four sections are split between the two engineering fabrics (two Pro-Guard and two PavePrep). A 75 mm (3 in.) thick overlay was placed over the entire project.

9. KEY WORDS	10. NO. OF PAGES
Asphalt Concrete Asphalt Overlay Reflective cracking Engineering fabric	24

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DISCLAIMER

The contents of this report reflect the views of the authors and do not necessarily reflect the official views of the Iowa Department of Transportation. This report does not constitute any standard, specification or regulation.

INTRODUCTION

An ACC overlay is most often the rehabilitative effort used to maintain the serviceability of either an ACC or PCC pavement. The major problem in durability of this ACC overlay comes from reflective cracking. These cracks usually open, allowing water to enter the unsealed crack and strip the ACC in the overlay. The stripping of the ACC allows accelerated deterioration at the crack. The ACC overlay between the cracks remains durable, but the life of the overlay is governed by the weakest link.

There have been many efforts to control reflective cracking through ACC overlays. Interlayers of fabric, rock, and asphalt rubber have been tried with moderate success. Two materials were evaluated in this project.

- PavePrep, Contech Construction Products Inc.
- Pro-Guard, Phillips Fiber Corporation

PavePrep is a high density mastic that is comprised of a woven polyester fabric on top and a nonwoven fabric on bottom. Pro-Guard also consists of two layers of fabric (a nonwoven and a high modulus scrim) with an asphalt mastic between the fabric layers.

The product GlasGrid was withdrawn from the research project at the request of the GlasGrid representative. The representative felt GlasGrid would be ineffective because of the initial roadway condition.

OBJECTIVE

The purpose of this research is to evaluate the effectiveness of Pro-Guard and PavePrep engineering fabrics in preventing reflective cracking through ACC overlays.

Project Location and Description

The project is located in Audubon County on F16 from the town of Gray east 4.2 km (2.6 mi.) to US 71. A map of the location is shown in Figure 1, page 10.

The existing ACC pavement was 6.7 m (22 ft.) wide and was built in 1957. The original structure was a 150 mm (6 in.) pavement designed under the supervision of ISU Professor Ladis Csanyi and Robert M. Nady. It was resurfaced in 1970 with a 75 mm (3 in.) asphalt overlay. It has also received a slurry leveling course and a seal coat since that time. The existing ACC pavement exhibited transverse cracking at approximately 12.2 m (40 ft.) spacings and some quarter point cracking. These cracks were depressed and varied in width. The ADT is approximately 250 vehicles.

This project consisted of a 75 mm (3 in.) thick ACC overlay. The mix design is in Appendix C, page 16. The test sections are listed in Table 1, page 3.

TABLE 1 TEST SECTION LAYOUT				
TEST SECTION	EASTBOUND	WESTBOUND	PRODUCT	TACK FOR FABRIC
1	STA 0+21 TO STA 20+00	STA 0+21 TO STA 20+00	PAVEPREP	S.A.*
2	STA 20+00 TO STA 40+00	STA 20+00 TO STA 40+00	PRO-GUARD	AC-20
3 & 4	STA 40+00 TO STA 68+00	STA 40+00 TO STA 68+00	NONE	----
5	STA 68+00 TO STA 88+00	STA 68+00 TO STA 79+40	PAVEPREP	S.A.*
	-----	STA 79+40 TO STA 88+00	NONE	----
6	STA 88+00 TO STA 99+55	STA 88+00 TO STA 108+00	PRO-GUARD	AC-20
	STA 99+55 TO STA 108+00	-----	NONE	----
7 & 8	STA 108+00 TO STA 136+91	STA 108+00 TO STA 136+91	NONE	----

* S.A. - SELF ADHESIVE ENGINEERING FABRIC

PRECONSTRUCTION WORK

A detailed crack survey was conducted on May 4, 1993 from Station 0+21 to Station 136+91. The crack survey will be used to record the location where engineering fabric was applied and to chart reflective cracking. A brief summary of the crack survey is given in Appendix D, page 19. Preconstruction average structural ratings were determined using the Iowa DOT Road Rater (Appendix D, page 19).

CONSTRUCTION

Audubon County awarded the contract for construction of the project to Henningsen Construction. A copy of the contract is given in Appendix B, page 12.

The contractor began construction on August 17, 1993. The first day consisted of surface patching. The surface patching was

conducted in accordance with Article 2212.04A of the 1992 Standard Specifications.

On August 18, the surface patching was completed. A thunderstorm occurred about 30 minutes after the surface patching was completed.

Work on August 19 was delayed until 10 AM because of the wet road conditions from the previous day's rain. Placement of the engineering fabric began in the westbound lane at Station 108+00.

The engineering fabric was placed in compliance with the manufacturers recommendations. The joints where the fabric was placed were blown free of all loose debris. The self-adhesive PavePrep was easy to apply. A 508 mm (20 in.) wide roll was placed in a single width directly over the crack (Appendix E, page 21, photo 1). The fabric was then pressed to the surface with a rubber tire roller. Pro-Guard required the use of an AC-20 tack coat. The tack coat was applied the full length of the crack and approximately 600 mm (24 in.) in width. The fabric was then applied to the AC-20 tack coat (Appendix E, page 21, photo 2). The fabric measured 508 mm (20 in.) in width and was placed in a single width directly over the crack. A rubber tire roller pressed the engineering fabric to the road surface. The placement of Pro-Guard was a more time consuming process due to the application of the AC-20.

The location of the engineering fabric was plotted on the crack survey. Sand was placed on the AC-20 that was exposed in the process of placing the Pro-Guard (Appendix E, page 22, photo 3 & 4). This was done in order to reduce the tracking of the AC-20 when the lane was open to traffic.

On August 20 the placement of engineering fabric was completed for the project with no change in the procedure. Sand was again placed on the AC-20 in order to reduce tracking when the lane was open to traffic. Note that both manufacturers approved of opening the roadway to traffic while the engineering fabric was on the roadway. The traffic applies additional pressure to the fabric. This additional loading helps to ensure a good bond between the roadway and the engineering fabric.

The contractor started paving on August 21. The asphalt was placed in two 38 mm (1.5 in.) lifts. Paving started in the westbound lane at the intersection of F16 and US 71, Station 136+91. The westbound lane was completed and paving started at Station 0+21 of the eastbound lane. Paving for the first day stopped at Station 28+46 in the eastbound lane. The paving process began by cleaning the roadway and placing a tack coat in accordance with Article 2303.17 of the 1992 Standard Specifications (Appendix E, page 23, photo 5). A lift of 38 mm (1.5 in.) was then placed and compacted in accordance with Article 2303.12, Class 1C of the 1992 Standard Specifications (Appendix E, page 23, photo 6 and page 24, photo 7).

On August 23 the paving resumed at Station 28+46 in the eastbound lane. The first lift was completed for the entire project. A second lift began at Station 136+91 of the westbound lane. Paving stopped at Station 2+84 in the westbound lane.

On August 24, paving began at Station 136+91 of the eastbound lane. Once the eastbound lane was completed, the paving operation moved to Station 2+84 of the westbound lane. The westbound lane was paved from Station 2+84 to Station 0+21, completing the paving operation.

From September 2 to September 7 the subdrains were installed on the project.

From September 13 to September 15 the type "B" granular shoulders were placed on the project.

The guardrails and rumble strips were installed from September 20 to September 24. This completed the project.

Two minor problems occurred during the construction process.

There were some mud balls in the aggregate. This created a need to closely monitor the asphalt mix in order to ensure that the pavement was not harmed by the mud balls. The occurrence of these mud balls decreased as the project proceeded. The second problem was caused by the contractor trying to temporarily

shoulder the road too soon after paving by pulling dirt onto the edge of the slab. This caused cracking along the roadway edge in the westbound lane. To repair the damage, a 0.3 m (1 ft.) wide section was milled along the pavement edge from Station 136+91 to approximately Station 110+00. After milling, the area was filled with asphalt concrete and rolled with a small vibratory roller.

TESTING

The Iowa Department of Transportation and Audubon County will jointly evaluate the research for at least 5 years, with the bulk of the testing to be done by Iowa DOT personnel. Table 2 shows the testing schedule.

TABLE 2 TEST SCHEDULE						
TEST	CONSTRUCTION YEAR 1993	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Road Rater	X	X	X	X	X	X
Profilometer		X		X		X
Crack Survey	X	X	X	X	X	X

PROJECT COSTS

The project cost \$327,792.04. The contract can be found in Appendix B, page 12.

DISCUSSION

The project looks good after one winter. Since construction, some cracking has occurred in all the test sections, but no formal crack survey has been performed.

One more type of evaluation procedure should be implemented. The cracks should be cored in order to find the mode of failure for the engineering fabrics when they do reflect cracks. This is to determine if the failure is caused by the fabric tearing, stretching or debonding.

Also, the fact that GlasGrid was not used on the project is unfortunate. Since GlasGrid is a more inelastic material, its behavior and modes of possible failure differ from Pro-Guard and PavePrep.

ACKNOWLEDGEMENT

Research project HR-360 was sponsored by the Iowa Highway Research Board and the Iowa Department of Transportation. Partial funding for this project was from the Secondary Road Research Fund in the amount of \$30,290.

The authors would like to extend their thanks to the Audubon County Board of Supervisors. We would also like to thank Henningsen Construction and those employees of Audubon County that participated in the construction and inspection of the project.

Appendix A
Figures

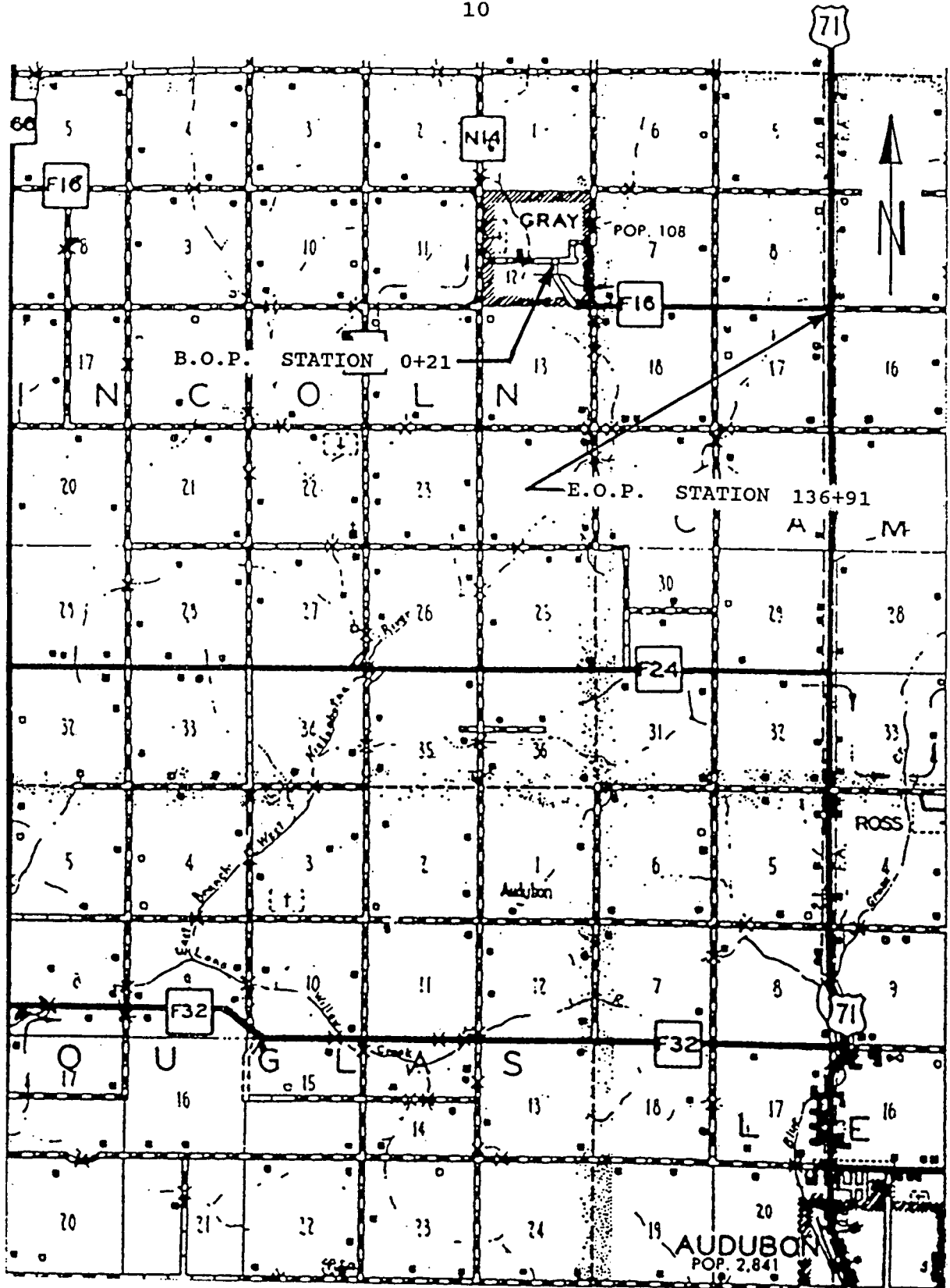


Figure 1

Appendix B
Contract

CONTRACT PRICES

Proposal ID Number: 930945

CONTRACT NUMBER 36075

Bid Order Number: 73

Contractor's Number: 00018775

County: AUDUBON

Page Number: 1

Project Number: SN-3327(2)--51-05

Type of Work: ASPH CEMENT CONC RESURFACING

Line Number	ITEM	Item Quantity and Units	Unit Price		Amount	
			Dollars X,XXX,XXX	Cents XXXX	Dollars XX,XXX,XXX	Cents XX
0010	BASE, CLEANING & PREPARATION OF	2.589 MILES	500.0000		1,294.50	
0020	PRIMER OR TACK-COAT BITUMEN	2408.000 GALLONS	0.8100		1,950.48	
0030	ASPHALT CEMENT	381.000 TONS	130.0000		49,530.00	
0040	BASE, TYPE B CLASS 1 ASPHALT CEMENT CONCRETE	5792.000 TONS	20.2400		117,230.08	
0050	ASPHALT CEMENT CONCRETE, TYPE B WEDGE, LEVEL OR STRENGTH. COURSE	9.500 TONS	22.0000		209.00	
0060	SHOULDERS, GRANULAR, TYPE B	2406.000 TONS	16.2600		39,121.56	
0070	SUBDRAIN, LONGITUDINAL, (SHOULDER) 4 IN. DIA.	4568.000 LINEAR FT.	3.8700		17,678.16	
0080	SUBDRAIN OUTLET, CORRUGATED METAL PIPE, 6 IN. DIA.	14.000 ONLY	150.0000		2,100.00	
0090	SAMPLES	1.000 LUMP SUM	250.0000		250.00	
0100	TRAFFIC CONTROL	1.000 LUMP SUM	250.0000		250.00	
0110	FABRIC REINFORCEMENT	6252.000 SQ. YDS.	8.2500		51,579.00	
0120	PATCHES, SURFACE	80.000 TONS	75.0000		6,000.00	
0130	GUARDRAIL, END ANCHORAGES, BEAM, RE-52	8.000 ONLY	300.0000		2,400.00	
0140	GUARDRAIL, FORMED STEEL BEAM	500.000 LINEAR FT.	8.0000		4,800.00	
0150	GUARDRAIL, POSTS, BEAM	105.000 ONLY	40.0000		4,200.00	
0160	GUARDRAIL, SPECIAL POST AND ADAPTER UNIT, RE-37	11.000 ONLY	200.0000		2,200.00	
0170	GUARDRAIL, SPECIAL POST AND ADAPTER UNIT, AS PER PLAN	3.000 ONLY	100.0000		300.00	
0180	OBJECT MARKER, TYPE 3	8.000 ONLY	60.0000		480.00	
0190	OBJECT MARKER, TYPE 2	16.000 ONLY	20.0000		320.00	
0200	DELINEATORS, SINGLE WHITE	12.000 ONLY	20.0000		240.00	
0210	MOBILIZATION	1.000 LUMP SUM	5000.0000		5,000.00	

CONTRACT PRICES

Proposal ID Number: 930945

CONTRACT NUMBER 36075

Bid Order Number: 73

Contractor's Number: 00018775

County: AUDUBON

Page Number: 2

Project Number: SN-3327(2)--51-05

Type of Work: ASPH CEMENT CONC RESURFACING

Line Number	ITEM	Item Quantity and Units	Unit Price		Amount	
			Dollars X,XXX,XXX	Cents XXXX	Dollars XX,XXX,XXX	Cents XX
	(CONTINUED)					
0220	PERMANENT TAPE MARKING	45.020 STAS.	162.0000		7,293.24	
0230	PAINTED PAVEMENT MARKING	123.450 STAS.	13.0500		1,611.02	
0240	EMBANKMENT-IN-PLACE	1111.000 CUBIC YDS.	5.0000		5,555.00	
0250	FLAGGERS	20.000 DAYS	135.0000		2,700.00	
0260	PILOT CARS	10.000 DAYS	200.0000		2,000.00	
0270	RUMBLE STRIP PANEL	3.000 ONLY	500.0000		1,500.00	
		***** TOTAL FOR CONTRACT			\$327,792.04	
					(LAST PAGE)	

Appendix C
Mix Design

FORM 955

IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OFFICE OF MATERIALS
PROPORTIONS & PRODUCTION LIMITS FOR AGGREGATES

COUNTY: AUDUBON PROJECT NO.: SN-3327(2)--51-02 DATE: 08/11/93
PROJECT LOCATION: COUNTY RD. FROM HWY 71 WEST TO GRAY
TYPE OF MIX: B CLASS OF MIX: 1 COURSE: BINDER-SURFACE MIX SIZE: 1/2"
CONTRACTOR: HENNINGSEN CONSTR. TRAFFIC: 215 A.D.T.

MATERIAL	IDENT #	% IN MIX	PRODUCER & LOCATION
RAP	ABC3-0035	15	FROM HWY 92 6.17% AC
3/4" STONE	SWI3-27-1	10	SCHILDBERG JEFFERSON A01004
1/2" STONE	SWI3-27-2	32	SCHILDBERG JEFFERSON A01004
SAND	SWI3-27-3	43	HALLETT MATLS. VALLEY A15508
TYPE AND SOURCE OF ASPHALT CEMENT: AC-5 KOCH ASPHALT OMAHA			

GRADATION OF INDIVIDUAL AGGREGATE SAMPLES (Typical, Target, or Average)

MATERIAL	SIEVE ANALYSIS -% PASSING											
	1-1/2	1	3/4	1/2	3/8	4	8	16	30	50	100	200
RAP	100	100	100	99	97	78	61	48	37	24	15	12
3/4" STONE	100	100	100	58	16	4.5	4.2	4.0	3.8	3.6	3.2	2.7
1/2" STONE	100	100	100	100	97	52	20	11	8.2	7.2	6.5	5.9
SAND	100	100	100	100	100	93	81	68	48	20	3.5	0.8

PRELIMINARY JOB MIX FORMULA TARGET GRADATION

TOLERANCE	100	100	100	92/100	7	7	6	5	3			
COMB GRADING	100	100	100	96	90	69	51	40	29	15	6.1	4.2
SURFACE AREA C.	TOTAL				0.02	0.04	0.08	0.14	0.30	0.60	1.60	
S.A. SQ. FT./LB.	27.55				+2.0	1.4	2.0	3.2	4.1	4.4	3.6	6.8

PRODUCTION LIMITS FOR AGGREGATES APPROVED BY THE CONTRACTOR/PRODUCER

SIEVE SIZE	15.00%		10.00%		32.00%		43.00%		MIN	MAX
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
1-1/2"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
3/4"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
1/2"	92.0	100.0	49.0	60.0	100.0	100.0	100.0	100.0		
3/8"	90.0	100.0	9.0	23.0	90.0	100.0	100.0	100.0		
#4	71.0	85.0	0.0	11.0	45.0	59.0	86.0	100.0		
#8	55.0	67.0	0.0	10.0	14.0	26.0	75.0	87.0		
#30	32.0	42.0	0.0	8.0	3.0	13.0	43.0	53.0		
#200	9.0	15.0	0.0	3.0	3.0	7.0	0.0	1.5		

COMMENTS: COPIES: AMES, SAMSON, AUDUBON CO., HENNINGSEN, SCHILDBERG, SWI, HALLETT, REYNA, JOHNSON, ATL. LAB., FILE

The above data is furnished for informational purposes only. The Contracting Authority makes no representations as to accuracy, either express or implied, which are to be construed to relieve the Contractor from the responsibility to comply with the specifications.

Signed *Larry Schocmink*
Contractor/Producer

Signed *William G. ...*
Dist. Matls. Engr.

IOWA DEPARTMENT OF TRANSPORTATION
 OFFICE OF MATERIALS
 TEST REPORT - ASPHALT MIX DESIGN
 LAB LOCATION - ATLANTIC

MATERIAL.....: TYPE B CLASS 1
 INTENDED USE.: BINDER & SURFACE-RECYCLED
 PROJECT NO....: SN-3327(2)--51-05
 LAB NO.....:4BD3-12
 SIZE.....:3/4"
 SPEC.NO.....:5060
 DATE REPORT.:08/13/93
 CONTRACTOR...: HENNINGSEN
 COUNTY.....: AUDUBON
 PROJ.LOCATION: FROM US 71 WEST TO GRAY
 VOID

 AGG. SOURCES ...3/4 & 1/2 STONE, SCHILDBERGS-JEFFERSON
 SAND, HALLETT-VALLEY
 RAP FROM HWY 92
 VOID

JOB MIX FORMULA-COMBINED GRADATION

1 1/2"	1 "	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
100.0	100.0	100.0	96.0	90.0	69.0	51.0	40.0	29.0	15.0	6.1	4.2
TOLERANCE :		100	92-100+4	-7	+6	-7	+6	-5			+3

MATERIAL MIX.:	3/4 ST	1/2 ST	SAND	RAP	VOID
% AGGR.PROP.:	10.00	32.00	43.00	15.00	0.00

ASPHALT CEMENT SOURCE	KOCH MATERIALS--ACS		
APPROX. VISCOSITY	N/A		
% ASPHALT IN MIX	4.50	5.50	6.50
NO. OF MARSHALL BLOWS	50	50	50
MARSHALL STABILITY-LBS.	2250	2177	2187
FLOW - 0.01 IN.	9	9	10
SP.G. BY DISPLACEM'T(DENS.)	2.269	2.309	2.336
BULK SP.G. OF COMB. DRY AGG	2.579	2.579	2.579
SP.G. OF A.C. @ 77 F.	1.028	1.028	1.028
RICE SP.G.	2.444	2.411	2.379
% VOIDS-RICE.	7.16	4.23	1.81
% WATER ABSORPTION OF AGG.	1.52	1.52	1.52
%VOIDS IN MINERAL AGG.	15.98	15.39	15.31
%YMA FILLED WITH ASPHALT	52.13	69.77	85.93
CALC. ASPH. FILM THICKNESS	6.67	8.45	10.23
FILLER/BIT. AT REC. %A.C.	0.93	0.84	0.76

PERCENT ASPHALT TO START:	6.01	TEMP.	0
MINIMUM PERCENT ASPHALT:	5.83	WEIGHT	0
PERCENT ASPHALT TO ADD:	5.13	SLOPE	0.00
		INTERCEPT	0.00

A CONTENT OF 6.01 % ASPHALT IS RECOMMENDED TO START THE JOB.
 TRAFFIC.: 215 A.D.T.

COPIES: AMES, J HEGGEN, J ADAM, HENNINGSEN
 DISTRICT 4, W OPPELAL, SWI, AUDUBON COUNTY ENGR.

SIGNATURE William Cook

Appendix D
Preconstruction Testing

PRECONSTRUCTION CRACK SURVEY RESULTS

TEST SECTION	STATION	LINEAR FT OF CRACKS	LINEAR FT OF CRACKS PER STATION
1	STA 0+21 TO STA 20+00	2740	138
2	STA 20+00 TO STA 40+00	4740	236
3	STA 40+00 TO STA 48+00	2130	266
4	STA 48+00 TO STA 68+00	5420	271
5	STA 68+00 TO STA 88+00	5160	258
6	STA 88+00 TO STA 108+00	5640	282
7	STA 108+00 TO STA 116+00	2550	319
8	STA 116+00 TO STA 136+91	5420	259

* CONDUCTED MAY 4, 1993

AVERAGE STRUCTURAL RATING
HR 360
1993 PRECONSTRUCTION VALUES

TEST SECTION	EAST BOUND	WEST BOUND	COMBINED
1	3.14	2.31	2.75
2	3.05	1.56	2.35
3	2.26	1.37	1.82
4	3.18	1.66	2.47
5	3.40	1.80	2.54
6	2.59	1.95	2.29
7	2.04	2.17	2.11
8	2.56	2.10	2.33

* CONDUCTED MAY 3, 1993 BY OFFICE OF MATERIALS ROAD RATTER

Appendix E
Photos



Photo 1: Placement of PavePrep



Photo 2: Placement of Pro-Guard

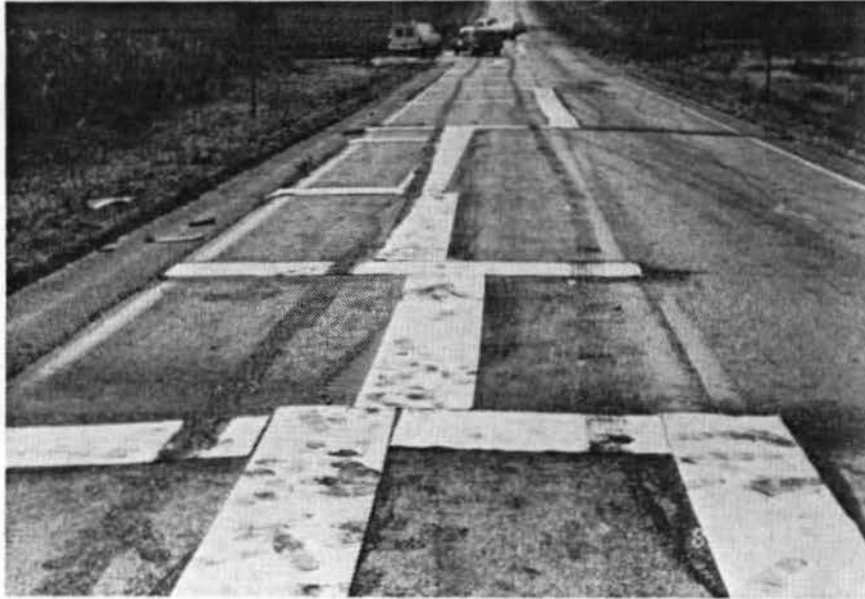


Photo 3: Tracking of Exposed AC-20

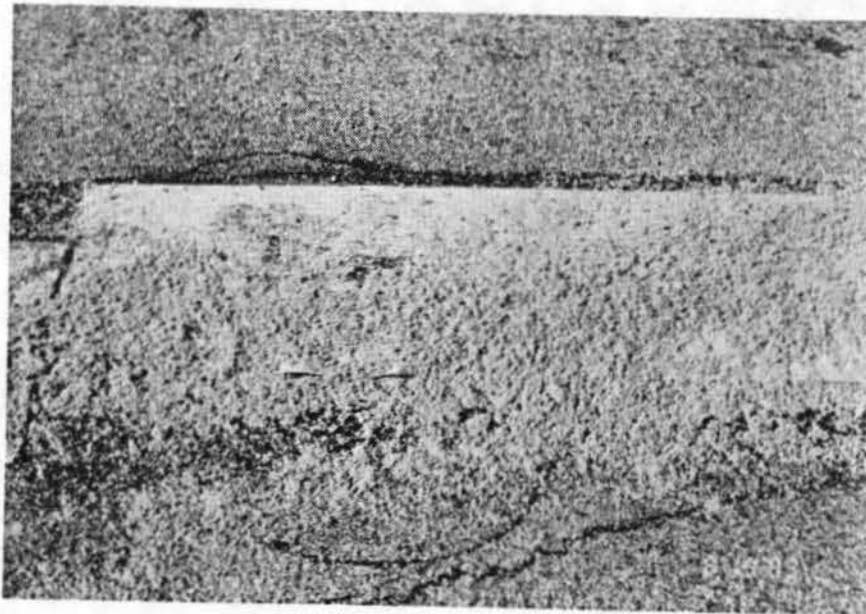


Photo 4: Sand Placed on Exposed AC-20



Photo 5: Application of Tack Coat for Paving

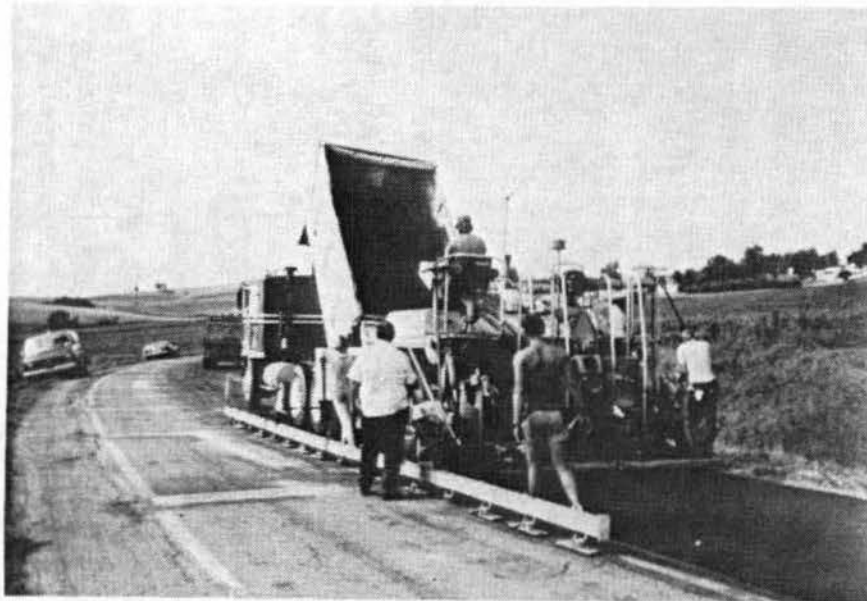


Photo 6: Placement of 38 mm (1.5 in.) Asphalt Concrete Lift



Photo 7: Paving and Rolling Equipment