IMPROVED ASPHALT SURFACES AND ASPHALT RESURFACING PERFORMANCE THROUGH CRACK MAINTENANCE

Iowa Highway Research Board
Project HR-213
Final Report

April 1987

Highway Division
Iowa Department of Transportation

Final Report
for
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ABSTRACT

In 1980, a Vangard High Pressure Water Blaster capable of providing 10 gallons of water per minute at 2000 psi was purchased to evaluate water blasting as a crack cleaning method prior to crack filling on asphalt concrete pavements. After some initial trials demonstrated its effectiveness of removing dirt, debris and vegetation, it was included in joint and crack maintenance research on Iowa 7 in Webster County.

The objective of the research was to evaluate six crack preparation methods and seven "sealant" materials. The cleaning and sealing was performed in the spring of 1983. Visual evaluations of the performance were made in the fall of 1983 and spring of 1985. Compressed air and/or high pressure water did not adequately prepare cracks less than 3/8 inch wide. Routing or sawing was necessary to provide a sealant reservoir. The water blaster was more effective than compressed air in removing dirt, debris and vegetation but this did not yield significant improvement in sealant adhesion or longevity.

Periodic crack filling is necessary on ACC surfaces throughout the remaining life of the pavement.

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INTRODUCTION

In 1980 a Vangard High Pressure Water Blaster Model 1020G was purchased to evaluate water blasting as a crack cleaning method prior to crack filling for maintenance or prior to resurfacing.

The Model 1020G is trailer mounted with a water tank mounted on the same trailer. The pump is driven by a Wisconsin engine and is capable of delivering 10 gallons of water per minute at 2000 psi.

Comparative trials of the water blaster and conventional compressed air cleaning were developed for three routes scheduled for future resurfacing or crack maintenance. Due to project scheduling, lack of manpower and changes in priorities an adequate evaluation was not obtained. One conclusion from a visual evaluation was that the water blaster was much quicker and more effective in removing dirt, debris and vegetation from cracks or joints than compressed air.

At the 1982 Pavement and Shoulder Maintenance Workshop at Denver, Colorado, participating States were asked to develop experimental projects to field test selected pavement and shoulder maintenance activities. Iowa chose to develop a project to evaluate crack maintenance on bituminous surfaced pavements. The use of the high pressure water blaster was included in this project.

LOCATION OF 1983

EXPERIMENTAL CRACK SEALING PROJECT

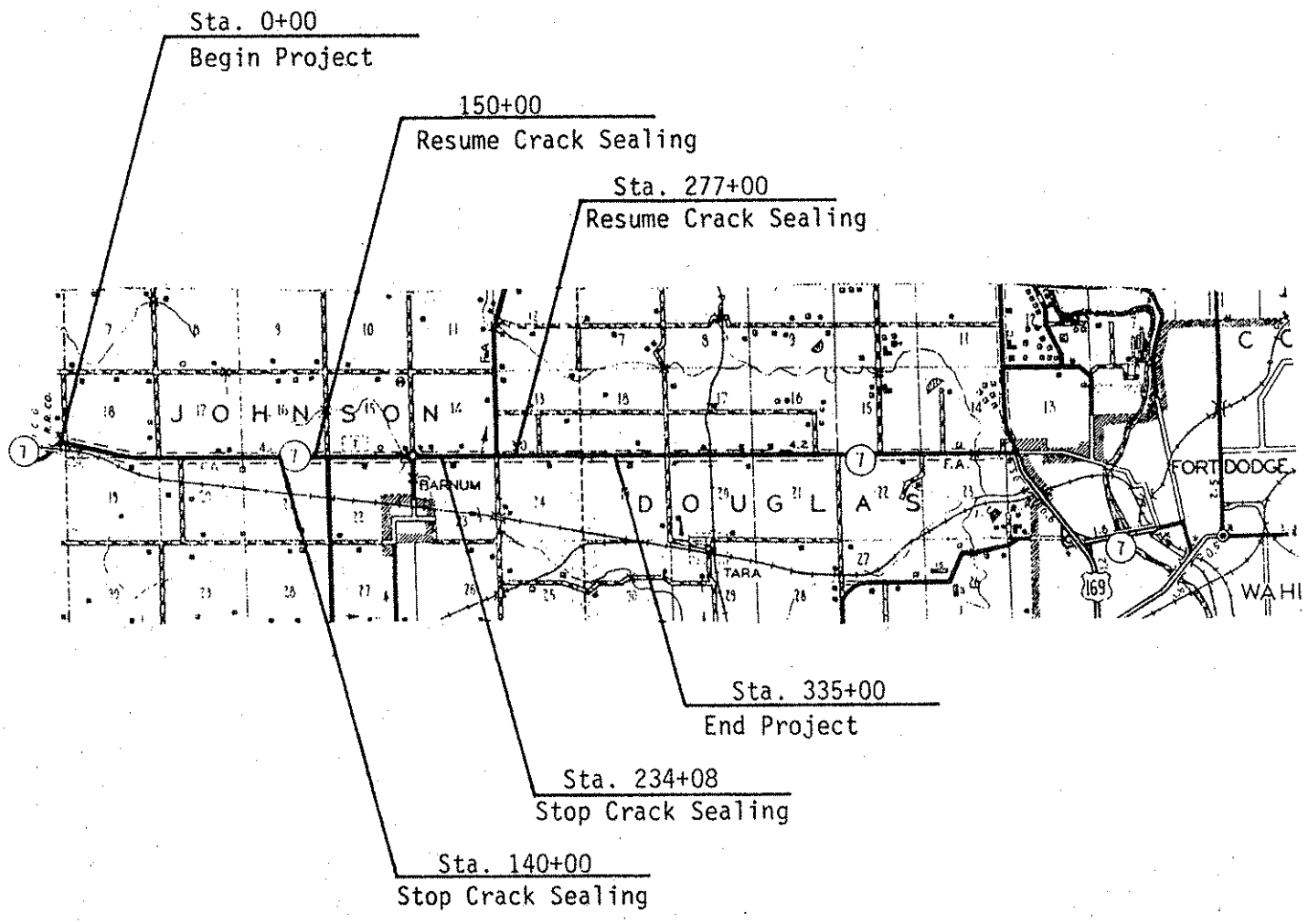

Figure 1

The location selected for the project is on Iowa 7 in Webster County from the Calhoun County line east 6.345 miles (Figure 1). This location was selected because there are alternating sections of full depth asphalt cement concrete pavement (hereafter referred to as unit 90) and portland cement concrete pavement widened and resurfaced with asphalt cement concrete (hereafter referred to as unit 80). The unit 90 sections consist of six inches of soil-lime subbase, six inches of asphalt-treated base and three inches of asphalt cement concrete surface. The unit 80 sections consist of a nominal 8.5 inches of portland cement concrete widened to 24 feet with asphalt cement concrete and resurfaced with 3 inches of asphalt cement concrete. The shoulders are 10 feet wide and surfaced with six inches of crushed limestone.

Unit 90 pavements generally exhibit a greater crack interval and have greater seasonal movement at the cracks. Unit 80 pavements normally exhibit closer crack intervals and less seasonal movement at each crack.

OBJECTIVE

The objective of the project was to evaluate six crack preparation methods and seven "sealant" materials on each type of pavement.

PROJECT DESCRIPTION AND SUMMARY

Preparation Method

Reference No. (For Attached Tabulation)

1. No preparation
2. Blow with compressed air

3. Clean with high pressure water (2000 psi) and air dry
4. Rout with Crafco router and blow with compressed air
5. Saw with Cimline crack saw and blow with compressed air
6. Saw with Cimline crack saw, blow with compressed air and install backer rope

Cracks less than 1/2 inch wide were routed or sawed so that the reservoir was 1/2-inch wide.

Sealant Materials

Reference No.

1. CRS-2 emulsion
2. Crafco - asphalt/rubber - Does not meet any ASTM specification
3. Prismo - asphalt/rubber - Does not meet any ASTM specification
4. Maxwell Products' Elastoflex-4 - Meets ASTM D 1190 except it exceeds the maximum flow
5. Allied, Product 9001 - Meets ASTM D 1190
6. W. R. Meadows, Hi-spec - Meets ASTM D 3405
7. W. R. Meadows, Soft Seal - Exceeds the requirements of ASTM D 3405

Equipment used for experimental project:

1 - Cimline melter/applicator
1 - Air compressor
2 - Crafco routers
1 - Cimline crack saw
1 - High-pressure washer (2000 psi)
1 - Light duty truck (1-ton)
2 - Medium duty trucks
2 - Pickups
1 - Bituminous oil distributor

TABLE I
Tabulation of Costs

By - Unit Type, Preparation Method and Material Type

Section Number	Location Start Sta.	Location Stop Sta.	Lane	Unit Type	Preparation Method	Sealant Material	Feet of Crack	Preparation Equip. Cost/ft.	Preparation Labor Cost/ft.	Preparation Total Cost/ft.	Sealing Equip. Cost/ft.	Sealing Labor Cost/ft.	Sealing Total Cost/ft.	Traffic Control Cost/ft.	Materials Cost/ft.	Total Cost/ft.
1	0+00	15+00	EB	90	4	2	624	0.194	0.141	0.335	0.097	0.11	0.207	0.126	0.139	0.807
2	0+00	15+00	WB	90	5	2	528	0.096	0.093	0.189	0.038	0.074	0.112	0.056	0.073	0.430
3	15+00	32+00	EB	90	2	2	372	0.168	0.079	0.247	0.081	0.132	0.213	0.079	0.158	0.697
4	15+00	32+00	WB	90	3	2	708	0.023	0.021	0.044	0.029	0.056	0.085	0.028	0.041	0.198
5	32+00	45+00	EB	80	4	2	672	0.024	0.023	0.047	0.024	0.047	0.071	0.023	0.087	0.228
6	32+00	45+00	WB	80	5	2	624	0.065	0.063	0.128	0.049	0.086	0.135	0.047	0.047	0.357
7	45+00	60+00	EB	80	2	2	696	0.058	0.028	0.086	0.023	0.056	0.079	0.028	0.042	0.235
8	45+00	60+00	WB	80	3	2	636	0.048	0.031	0.079	0.032	0.062	0.094	0.031	0.069	0.273
9	60+00	75+00	EB	80	4	3	552	0.128	0.011	0.199	0.044	0.062	0.106	0.036	0.121	0.462
10	60+00	75+00	WB	80	5	3	588	0.137	0.10	0.237	0.034	0.05	0.084	0.10	0.114	0.535
11	75+00	90+00	EB	80	4	4	660	0.061	0.040	0.101	0.024	0.059	0.083	0.042	0.218	0.444
12	75+00	90+00	WB	80	5	4	660	0.113	0.094	0.207	0.024	0.048	0.072	0.042	0.218	0.539
13	90+00	105+00	EB	80	4	5	732	0.041	0.040	0.081	0.022	0.043	0.065	0.039	0.166	0.351
14	90+00	105+00	WB	80	5	5	756	0.085	0.130	0.215	0.040	0.071	0.111	0.084	0.161	0.571
15	105+00	120+00	EB	90	4	3	732	0.177	0.054	0.231	0.041	0.054	0.095	0.057	0.125	0.518
16	105+00	120+00	WB	90	5	3	516	0.309	0.127	0.436	0.059	0.076	0.135	0.114	0.178	0.863
17	120+00	140+00	EB	90	4	4	1104	0.090	0.038	0.128	0.037	0.062	0.099	0.029	0.159	0.415
18	120+00	140+00	WB	90	5	4	696	0.087	0.106	0.193	0.023	0.046	0.069	0.070	0.184	0.516
19	150+00	165+00	EB	90	4	5	384	0.089	0.115	0.204	0.026	0.064	0.09	0.065	0.211	0.570
20	150+00	165+00	WB	90	5	5	456	0.146	0.165	0.311	0.035	0.071	0.106	0.050	0.178	0.645
21	165+00	185+00	EB	90	4	6	936	0.043	0.049	0.092	0.032	0.058	0.09	0.026	0.133	0.321
22	165+00	185+00	WB	90	5	6	732	0.152	0.094	0.246	0.042	0.074	0.116	0.054	0.136	0.552
23	185+00	205+00	EB	90	2	6	528	0.057	0.028	0.085	0.038	0.074	0.112	0.046	0.142	0.385
24	185+00	205+00	WB	90	3	6	828	0.073	0.036	0.109	0.044	0.075	0.119	0.036	0.093	0.354
25	205+00	220+00	EB	90	1	1	324	0	0	0	0.025	0.024	0.099	0.024	0.016	0.089
26	205+00	220+00	WB	90	2	1	324	0.062	0.024	0.086	0.025	0.024	0.049	0.045	0.024	0.204
27	220+00	234+00	EB	90	3	1	228	0.027	0.030	0.057	0.027	0.030	0.057	0.030	0.029	0.173
28	220+00	234+00	WB	90	6	7	324	0.249	0.242	0.491	0.143	0.242	0.385	0.151	0.469	1.496
29	277+00	290+00	EB	80	4	6	840	0.036	0.035	0.071	0.031	0.056	0.087	0.033	0.193	0.384
30	277+00	290+00	WB	80	5	6	900	0.090	0.071	0.161	0.045	0.076	0.121	0.009	0.208	0.499
31	290+00	305+00	EB	80	2	6	792	0.020	0.019	0.039	0.038	0.068	0.106	0.037	0.142	0.324
32	290+00	305+00	WB	80	3	6	744	0.019	0.017	0.036	0.041	0.072	0.113	0.040	0.151	0.340
33	305+00	320+00	EB	80	1	1	552	0	0	0	0.011	0.012	0.023	0.009	0.009	0.091
34	305+00	320+00	WB	80	2	1	624	0.055	0.027	0.082	0.023	0.023	0.047	0.031	0.013	0.173
35	320+00	335+00	EB	80	3	1	696	0.029	0.028	0.057	0.046	0.017	0.063	0.092	0.023	0.185
36	320+00	335+00	WB	80	6	7	1080	0.155	0.123	0.278	0.168	0.254	0.422	0.103	0.469	1.272

Crew Size:

Six people were needed when air cleaning and not routing; eight people were needed when water cleaning or when routing and air cleaning. In addition, two people were needed for traffic control for each type of preparation.

Discussion:

All work was accomplished between April 22, 1983, and May 23, 1983. Crack cleaning with the water blaster on this project was very quick and effective in removal of dirt, debris and vegetation. By visual observation it yielded a cleaner crack than cleaning with compressed air. These observations supported the findings of the earlier comparative trials. All cracks in the unit 90 sections were filled to within approximately two inches of the surface with CRS-2 emulsion prior to the crack sealing project.

Due to the inexperience of the crew in handling the materials and equipment used in this project and the numerous concepts involved, it was not appropriate to establish a range of accomplishment or unit costs to be used as a standard. Costs shown in Table I are relative to this project only and should be used for comparison only.

EVALUATION

The initial review of crack filling and crack sealing work on this experimental project was made on September 26, 1983, approximately four months after installation was completed. The results were presented at the Denver Pavement and Shoulder Maintenance Workshop sponsored by the

FHWA. The final review of this experimental project was completed on March 29, 1985.

Weather conditions the first summer after installation were abnormally hot and dry. We feel such weather conditions contributed to the initial satisfactory performance of all the materials used for this project except materials which exhibited excessive flow into cracks.

Section 1:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Preparation by Crafco Router. Sealed with Crafco Overflex sealant material.

1983 Review: All transverse and longitudinal cracks were filled. Crack sealant was well bonded to both sides of the crack and performing satisfactorily with the exception of some depression of the pavement surface in a super elevated curve. The depression was allowing shoulder stone to enter the crack.

1985 Review: Most of the cracks in this section had either failed in cohesion or adhesion. At some locations sealant material was no longer evident.

Section 2:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Sealant reservoir was formed with a Cimline crack saw. Crafco Overflex sealant material was used.

1983 Review: Cracks were well sealed with apparent bond to both sides. At the time of this review, there was no visual difference between Section 2 and Section 1.

1985 Review: Most of the cracks in this section had failed in either cohesion or adhesion. Traffic action had removed some sealant from the cracks.

Section 3:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Compressed air cleaning. Crafco Overflex sealant material.

1983 Review: Crack sealant appeared to be well bonded to both sides of the crack and performing satisfactorily.

1985 Review: Crack sealant material has failed.

Section 4:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Cleaning with a 2000 psi high pressure water blaster with compressed air drying. Crafco Overflex sealant material was used.

1983 Review: Sealant appeared to be well bonded to both sides of the crack and was performing in a satisfactory manner.

1985 Review: Sealant had failed entirely throughout the section.

Section 5:

Pavement Type: Composite pavement; Crack Treatment: Crack preparation was accomplished with a Crafco router and cleaning with air. Sealant material was Crafco Overflex sealant. Sealant material was squeegeed with a narrow squeegee immediately after application.

1983 Review: Sealant performance was excellent. There was no evidence of any depression in any routed cracks.

1985 Review: Bonding of sealant in moving cracks had failed. At some locations sealant material was no longer present in the cracks.

Section 6:

Pavement Type: Composite pavement; Crack Treatment: Crafco Overflex sealant material was used. Crack was prepared using a Cimline crack saw followed with air cleaning.

1983 Review: Sealed cracks were performing in an acceptable manner.

1985 Review: Sealant appeared to be performing at a higher level than the sealant in Section 5 (prepared with a Crafco router). Some evidence of bond failure was noted in moving cracks.

Section 7:

Pavement Type: Composite pavement; Crack Treatment: Cracks were cleaned with compressed air and sealed with Crafco Overflex sealant material. Crack width prior to cleaning ranged from 1/8 inch to 1/2 inch.

1983 Review: There was no evidence of bond failure. There were areas where the sealant material had slumped down into the crack, resulting in a visible depression.

1985 Review: A high percentage of the sealant material had failed in either adhesion or cohesion.

Section 8:

Pavement Type: Composite pavement; Crack Treatment: Existing crack widths ranged from 1/8 inch to 1/2 inch. Cracks were cleaned with high pressure water

and dried with compressed air. Crafco Overflex sealant material was used.

1983 Review: Cracks appeared to be well sealed with good bond. No slumping of material into cracks was noted in this area.

1985 Review: A high percentage of the joint sealant had failed in either adhesion or cohesion. There was no visible difference between Sections No. 8 and No. 7.

Section 9:

Pavement Type: Composite pavement; Crack Treatment: Cracks were routed with a Crafco router and cleaned with air. Crack width prior to routing ranged from 1/8 inch to 1/2 inch. Prismo rubber asphalt joint filler was used. Sealant material was placed with a Cimline crack filler. Sealant was squeegeed with a narrow squeegee immediately after placement.

1983 Review: Material was well bonded to the side of the cracks and generally appeared to be performing in an acceptable manner. A few areas where the sealant had slumped down into the wider cracks were noted.

1985 Review: Bonding of sealant at all of the moving cracks had failed. This section appeared to be performing in a similar manner to Section No. 10.

Section 10:

Pavement Type: Composite pavement; Crack Treatment: Crack width prior to preparation ranged from 1/8 inch to 1/2 inch. Cracks were prepared by sawing with a Cimline crack saw followed by air cleaning. Prismo rubber asphalt joint filler was used.

1983 Review: Performance was very similar to Section 9.

1985 Review: Bonding of sealant had failed at all moving cracks. It appeared the sealant, in some areas, may have been performing slightly better than in the routed section. This is attributed to the uniform

width of sealant reservoir due to use of a saw as opposed to the tapered reservoir created by the router.

Section 11:

Pavement Type: Composite pavement; Crack Treatment: Crack width prior to sealing ranged from 1/8 inch to 1/2 inch. Cracks were routed with a Crafco router and blown clean with compressed air. Elastoflex 4 was used as a sealant.

1983 Review: Sealant material was very soft at this time. Sealant had slumped in some cracks, with aggregate becoming embedded in the material.

1985 Review: Sealant had failed in some of the wider working cracks. In the majority of the smaller, non-moving cracks, the sealant appeared to be performing adequately.

Section 12:

Pavement Type: Composite pavement; Crack Treatment: Existing cracks ranged from 1/8 inch to 1/2 inch in width. Cracks were sawed with a Cimline crack saw. Prior to sealing, cracks were blown clean with compressed air. Elastoflex 4 sealant material was used.

1983 Review: Sealant performance was very similar to Section 11.

1985 Review: Sealant performance was similar to Section 11.

Section 13:

Pavement Type: Composite pavement; Crack Treatment: Cracks were routed with a Crafco router and cleaned with compressed air. Allied 9001 joint sealant was used.

1983 Review: The sealant material was soft and was not entrapping any aggregate. Material at the time of this review was performing satisfactorily.

1985 Review: Estimate approximately 30% of the treated cracks had failed in bond. The material in Section 13 appears to be performing similar to material installed in Section 14.

Section 14:

Pavement Type: Composite pavement; Crack Treatment: Existing crack widths ranged from 1/8 inch to 1/2 inch. Cracks were prepared with a Cimline crack saw and cleaned with compressed air. Allied 9001 crack sealant material was used.

1983 Review: Performance of this material was identical to Section 13.

1985 Review: Estimated failure rate to be somewhat less than 30%. This may be related to the rectangular reservoir created with a crack saw, as opposed to the tapered reservoir created by the router.

Section 15:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Crack widths ranged from 1/8 inch to 3/4 inch. Cracks were routed with a Crafco router and cleaned with compressed air. Prismo crack sealant was used.

1983 Review: Joints appear to be well sealed with the exception of some locations of excessive flow into the crack after the initial sealing operation. Depressions up to a 3-inch depth were noted. Cracks at these locations, however, appeared to be well sealed.

1985 Review: All sealant had failed.

Section 16:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Existing cracks ranged in widths from 1/8 inch to 3/4 inch. Cracks were routed with a Cimline crack saw and blown clean with compressed air. Prismo crack sealer material was used.

1983 Review: Performance of the material was the same as in Section 15.

1985 Review: All sealant had failed.

Section 17:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Existing cracks ranged from 1/8 inch to 3/4 inch in width. Cracks were prepared

by routing with a Crafco router and cleaned with compressed air. Elastoflex 4 sealant material was used.

1983 Review: The sealant material had remained very soft and pliable. There appeared to be no sealant failure at this time. Sealant had slumped down or flowed into the cracks to the extent that in most of the cracks, the top of the sealant is 3 inches below the surface of the pavement at some locations. This material was very soft and was entrapping aggregate in the material. At locations where the crack sealant has slumped, the crack appeared to be well sealed.

1985 Review: 100% of the sealant in the larger moving cracks had failed. It is believed the primary reason for failure is due to flow into the bottom of the crack. The non-moving shallow cracks in these sections remained well sealed.

Section 18:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Routed with a Cimline crack saw and cleaned with compressed air. Elastoflex 4 joint sealant material was used.

1983 Review: Performance was the same as Section 17.

1985 Review: Performance was the same as Section 17.

Section 19:

Pavement Type: Full depth asphalt pavement; Crack treatment: Existing crack widths ranged from 1/8 inch to 3/4 inch. Routing was done with a Crafco router. Cracks were cleaned with compressed air. Allied 9001 joint sealant was used.

1983 Review: Sealant material had remained very soft and pliable and appeared to be well bonded to the sides of the crack. Material had not entrapped aggregate. Up to 1 1/2 inches of slumping into some of the wider cracks was noted.

1985 Review: All sealant in the larger moving cracks had failed. Failure is due to the flow of the material to the bottom of the crack, or removal of the sealant material by traffic action indicating adhesion failure. Most of the non-moving cracks appeared to have remained well sealed.

Section 20:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Cracks were routed with a Cimline crack saw and cleaned with compressed air. Allied 9001 was used as a sealant.

1983 Review: Performance was identical to Section 19.

1985 Review: Performance was identical to Section 19.

Section 21:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Cracks were routed with a Crafco router and cleaned with compressed air. W. R. Meadows Hi-Spec joint sealer was used.

1983 Review: This sealant material appeared to be as soft as the Allied 9001 material. Entrapment of aggregate into the surface of the sealant material was not noted. Sealant material appeared to be performing very well. At some locations the material had flowed 1/2 inch below the pavement surface.

1985 Review: A high percentage of the sealant has failed in adhesion. Shallow non-moving cracks had remained well sealed.

Section 22:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Cracks were routed with a Cimline crack saw and blown clean with compressed air. W. R. Meadows Hi-Spec joint sealer was used.

1983 Review: Performance of this material was identical to Section 21.

1985 Review: Performance of this section was identical with Section 21.

Section 23:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Existing cracks ranging from 1/8 inch to 1/2 inch in width were blown clean with compressed air. W. R. Meadows Hi-Spec joint sealant was used.

1983 Review: The sealant material had remained soft and generally well bonded to the surfaces and/or crack edges, but there were many areas where cracks appeared to be not well sealed. Failure resembles cohesion failure.

1985 Review: Sealant material had failed entirely.

Section 24:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Cracks ranging in width from 1/8 inch to 1/2 inch were cleaned with high pressure water and dried with compressed air. W. R. Meadows Hi-Spec sealant material was used.

1983 Review: Sealant material had remained soft and generally well bonded to the surface, but there are many areas where the cracks did not appear to be well sealed (estimate sealing on 5% of the total lineal feet).

1985 Review: 100% of the sealant had failed.

Section 25:

Pavement Type: Full depth asphalt pavement; Crack Treatment: No preparation. CRS-2 emulsion was used to fill cracks ranging from 1/8 inch to 3/8 inch in width. Tight squeegee work was not done.

1983 Review: There was little evidence of the crack filling effort at this time. Cracks remained open in many areas. There was no evidence of the filler material which was placed.

1985 Review: No evidence of filler material.

Section 26:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Cracks ranging in width from 1/8 inch to 3/8 inch were cleaned with compressed air. CRS-2 emulsion was used to fill cracks. Tight squeegee work was not done.

1983 Review: This section showed little evidence of the emulsion filling. Cracks were still open or filled with dirt and granular material.

1985 Review: There was little evidence of the emulsion filling.

Section 27:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Cracks ranging from 1/8 inch to approximately 1/2 inch in width were cleaned with high pressure water blast and dried with compressed air. CRS-2 emulsion was used to fill the cracks. Material was placed with a wand and was not tight squeegeed.

1983 Review: Approximately 75% of the total lineal feet of cracks filled did not appear to have been filled.

1985 Review: There was no evidence of crack filling.

Section 28:

Pavement Type: Full depth asphalt pavement; Crack Treatment: Cracks were routed with a Cimline crack saw and blown clean with compressed air. W. R. Meadows Sof Seal sealant material was used with a backer rope. Sand blasting was not done.

1983 Review: Cracks appear to be well sealed with the exception of some evidence of bond failure along the edge for short lengths in some cracks. This may have been due to the incomplete removal of saw slurry residue from the side of the sealant reservoir.

1985 Review: Estimate bonding in approximately 90% of the sealant in these cracks had failed. Material was still present in the routed cracks.

Section 29:

Pavement Type: Composite pavement; Crack Treatment: Cracks were routed with a Crafco router and blown dry with compressed air. W. R. Meadows Hi-Spec sealant was used. Material was placed with a wand and was not tight squeegeed.

1983 Review: Sealant appeared to be performing well. The sealant remained very soft and pliable. Foreign material had not become embedded in the sealant.

1985 Review: Estimate approximately 90% of the sealant was performing very well. The routed crack (longitudinal crack) at the base widening unit location showed some bond failure. This was attributed to the application of an emulsion sand-blotted strip seal over this joint. Bond failure may have occurred due to early application of traffic over the strip seal.

Section 30:

Pavement Type: Composite pavement; Crack Treatment: Cracks 1/8 inch to 1/2 inch in width were routed with a Cimline crack saw and cleaned with compressed air. W. R. Meadows Hi-Spec sealant material was used. Material was placed with a wand and tight squeegeed.

1983 Review: The sealant material appeared to be performing very well. There were no areas of failure evident. Material had remained very soft and pliable, but has not entrapped any foreign aggregate in the sealant surface.

1985 Review: Estimate approximately 90% of the sealant material placed was still functioning very well.

Section 31:

Pavement Type: Composite pavement; Crack Treatment: Cracks ranging from a 1/8 inch to 1/2 inch in width were cleaned with compressed air only. W. R. Meadows Hi-Spec sealant material was used.

1983 Review: The irregularity of the crack width resulted in an irregular width and depth of sealant reservoir and left the impression there were some areas which might fail, but at that time failure was not evident. The sealant material was very soft and pliable and appeared to be well bonded to the sides of the cracks.

1985 Review: Estimate approximately 90% of the sealant has failed in either bond or in cohesion.

Section 32:

Pavement Type: Composite pavement; Crack Treatment: Cracks ranging in width from 1/8 inch to 1/2 inch were cleaned with high pressure water blasting and dried with compressed air. W. R. Meadows Hi-Spec sealant material was used.

1983 Review: Observations were very similar to Section 31.

1985 Review: Observations were similar to Section 31.

Section 33:

Pavement Type: Composite pavement; Crack Treatment: CRS-2 emulsion was used to fill cracks ranging in width from 1/8 inch to 1/2 inch. There was no preparation.

1983 Review: There was little evidence of any crack filling having been done except at the location where the widening joint has been routinely

sealed with a squeegee operation, and in those areas where emulsion had completely filled the crack.

1985 Review: There was no evidence of crack filling.

Section 34:

Pavement Type: Composite pavement; Crack Treatment: CRS-2 emulsion was used to fill cracks ranging in width from 1/8 inch to 1/2 inch. Cleaning was done with compressed air prior to crack filling.

1983 Review: Observations were similar to those in Section 33.

1985 Review: There was no evidence of any crack filling.

Section 35:

Pavement Type: Composite pavement; Crack Treatment: Cracks ranging in width from 1/8 inch to 1/2 inch were filled with CRS-2 emulsion following water blasting and drying with compressed air.

1983 Review: There was little evidence crack filling material was placed except in longitudinal widening joint where repeated sealings with CRS-2 emulsion had kept that joint full.

1985 Review: There was no evidence of crack filling.

Section 36:

Pavement Type: Composite pavement; Crack Treatment: Cracks were routed with a Cimline crack saw and cleaned with compressed air. No sand blasting was done. W. R. Meadows Sof Seal material was used.

1983 Review: Sealant appeared to be performing satisfactorily.

1985 Review: There was excessive pavement breakup in this section and the pavement surface was raveling extensively. Bonding of most of the crack sealer had failed. Traffic action had removed some sealant from the prepared cracks.

CONCLUSIONS

The use of a CRS-2 emulsion is appropriate for use on an aged ACC surface. A typical surface would exhibit secondary cracking adjacent to transverse cracks and longitudinal cracks, with shrinkage cracking beginning to become apparent in the wearing surface. Cracks should be properly cleaned before applying the emulsion to the crack. Multiple crack fillings will be necessary throughout the remaining life of the aged ACC surface and should be scheduled periodically. Special provision SP-589, Maintenance Cleaning and Filling Cracks on ACC Surfaces (Appendix A), was developed to accomplish crack filling by contract. These procedures are also used by our maintenance forces.

The water blaster was more effective than compressed air in cleaning dirt, debris and vegetation from cracks. Unfortunately, the cracks that were more effectively cleaned with the water blaster yielded no

significant improvement in sealant adhesion or longevity over other methods of cleaning.

Air blowing and/or high pressure water cleaning does not appear to be an adequate preparation method for preparing cracks less than 3/8" wide when using a "high type" hot pour sealant. Routing or sawing should be done to provide a sealant reservoir. Specification 1021 (Appendix B) for Crack Cleaning and Sealing (ACC surfaces) was developed as a result of this project and is appropriate for contract sealing of cracks on "newer" ACC surfaces. Procedures in this supplemental specification are also followed by Iowa DOT maintenance forces for in-house sealing work.

Resultant weathering and deterioration of the asphalt surface will result in a need to begin crack filling (CRS-2) procedures as outlined above.

Materials meeting Iowa Department of Transportation specification 4136.02A are specified on contracts for sealing. Material meeting this specification is also purchased by the Department for use by maintenance forces.

TABLE II
EVALUATION SUMMARY

Section	Pave.Type *Unit No.	Sealant	Cleaning **Method	Bond Condition 4 Months	2 Years
1	90	Crafco	Air**	Well Bonded	Failed
2	90	Crafco	Air**	Well Bonded	Failed
3	90	Crafco	Air	Well Bonded	Failed
4	90	Crafco	Water	Well Bonded	100% Failed
5	80	Crafco	Air**	Excellent	Failed
6	80	Crafco	Air**	Acceptable	Failed
7	80	Crafco	Air	Good	High % Failed
8	80	Crafco	Water	Good	High % Failed
9	80	Prismo	Air**	Well Bonded	Failed
10	80	Prismo	Air**	Well Bonded	Failed
11	80	Elastoflex	Air**	Well Bonded	Adequate
12	80	Elastoflex	Air**	Well Bonded	Adequate
13	80	Allied	Air**	Satisfactory	30% Failed
14	80	Allied	Air**	Satisfactory	25% Failed
15	90	Prismo	Air**	Well Bonded	100% Failed
16	90	Prismo	Air**	Well Bonded	100% Failed
17	90	Elastoflex	Air**	Well Bonded	Large Cracks 100% Failed
18	90	Elastoflex	Air**	Well Bonded	Large Cracks 100% Failed
19	90	Allied	Air**	Well Bonded	Large Cracks 100% Failed
20	90	Allied	Air**	Well Bonded	Large Cracks 100% Failed
21	90	Hi-Spec	Air**	Well Bonded	High % Failed
22	90	Hi-Spec	Air**	Well Bonded	High % Failed
23	90	Hi-Spec	Air	Well Bonded	100% Failed
24	90	Hi-Spec	Water	5% Failed	100% Failed
25	90	CRS-2	None	100% Failed	100% Failed
26	90	CRS-2	Air	100% Failed	100% Failed
27	90	CRS-2	Water	75% Failed	100% Failed
28	90	SofSeal	Air**	Well Bonded	90% Failed
29	80	Hi-Spec	Air**	Well Bonded	10% Failed
30	80	Hi-Spec	Air**	Well Bonded	10% Failed
31	80	Hi-Spec	Air	Well Bonded	90% Failed
32	80	Hi-Spec	Water	Well Bonded	90% Failed
33	80	CRS-2	None	100% Failed	100% Failed
34	80	CRS-2	Air	100% Failed	100% Failed
35	80	CRS-2	Water	100% Failed	100% Failed
36	80	SofSeal	Air**	Satisfactory	100% Failed

*Pavement Type:
Unit 80 - Composite asphalt over Portland Cement
Unit 90 - Full depth asphalt

**Routed by Crafco router or Cimline saw

SP-589
Replaces SP-547

Iowa Department of Transportation

SPECIAL PROVISIONS
for
MAINTENANCE CLEANING AND FILLING CRACKS
ACC Surfaces

February 26, 1985

589.01 DESCRIPTION. This work is for cleaning and filling cracks in an existing pavement or paved shoulder. It involves filling large cracks and spalled areas with ACC, and filling smaller cracks with filler material. This type of work is intended primarily for existing pavements that are not to be resurfaced. If additional work is to be required, it will be defined elsewhere in the contract documents.

589.02 MATERIALS. Asphalt cement concrete shall be a hot mixture meeting requirements of Section 2203 (1/2- or 3/8-inch mixture size), or 2306, or better, or, subject to approval of the Engineer, a similar mixture from a commercial source. A cold premix mixture may be used with approval of the Engineer. The premix shall meet requirements of Section 4202, 4203, or 4204. The Engineer's approval of the use of a premix will be based on the availability of the specified hot mixture when this work is being done and the length of haul.

Tack-coat material shall meet requirements of 2212.02C.

Filler material shall be emulsified asphalt meeting requirements of Section 4140, Grade CRS-2.

Blotting material shall be a sand meeting requirements of Section 4125 or 4112, or a similar sand approved by the Engineer.

589.03 EQUIPMENT. Equipment shall include the following:

A. High-pressure water equipment capable of delivering water with a pressure of 2,000 psi from a nozzle to the crack being cleaned.
B. High-pressure air capable of blowing sand and other foreign material from a crack.
C. Air chisel or hand tools to remove loose and spalled material adjacent to cracks.
D. Heating kettle or pressure distributor for applying filler material through a hand-operated wand or nozzle.

589.04 CLEANING AND FILLING. Cleaning may be done with high-pressure air or water equipment, except water blasting equipment will not be allowed when the temperature is below 32° F. In all cases, cleaning shall include removal of vegetation from the cracks. Cleaning methods other than those specified in this specification may be necessary to remove vegetation. Other methods shall be subject to approval of the Engineer.

When specifically required by the plans, a soil sterilant, such as Spike or an approved equal, shall be placed in the crack prior to placing the filler material.

For filling cracks, a hand-operated wand or pouring pot shall be used, which is capable of placing the filler material into the crack and filling to the adjacent surface. The nozzle or spout shall be small enough to place the filler material into the crack without soiling the adjacent surface.

All cracks filled with emulsion shall be tightly squeegeed with a narrow, 2-inch or less, V-shaped, rubber-edged squeegee, immediately after placement of the filler. Measures shall be taken to hold the filler in place, preventing run-out at pavement or shoulder edges and low areas; this may be done by use of a sand dam or an application of blotter material, in conjunction with the squeegee operation.

A. Cracks wider than 1-inch shall be made free of loose and spalled material within the opening and loose material adjacent to the opening and shall be cleaned with high-pressure water, blown free of water, tacked, and filled with hot mix. Loose and spalled material shall be removed with an air chisel, picks, or other hand tools.

The cracks shall be cleaned of loose and spalled material, old crack filler when deemed necessary by the engineer, sand, and other foreign debris by the use of high-pressure water. Cleaning shall continue until essentially all debris and loose materials have been removed to a depth of 3 inches within the crack opening.

The cleaned cracks shall be blown free of water.

The crack surfaces shall be lightly tacked with tack-coat material as a hand operation.

The cracks shall be filled with the hot mix specified, rodded and tamped into place and leveled with the adjacent surface. The mixture shall be warm and pliable when placed. This mixture shall be placed prior to filling cracks with emulsion. A thin application of emulsion shall be placed over the hot mix and tightly squeegeed.

B. Cracks 1/4-inch to 1-inch in width shall be cleaned with air pressure or high-pressure water sufficient to remove old crack filler when deemed necessary by the Engineer, sand, and other foreign debris. The depth of cleaning shall be at least 1 inch. The depth shall be to sound material, but a depth greater than 3 inches will not be required.

Cracks shall be filled with emulsion filler material. A hand-operated wand shall be used which is capable of placing the filler material into the crack and filling it to the adjacent surface. The nozzle attached to the wand shall be small enough to place filler material into the crack without soiling the adjacent surface.

C. Cracks less than 1/4-inch shall be cleaned sufficiently to remove old crack filler when deemed necessary by the Engineer, sand, and other foreign debris.

Cracks shall be filled with emulsion filler material.

D. Map-cracked areas shall be covered with emulsion filler material with a suitable hand-operated squeegee. The filler material shall be a thin, smooth application.

The filler material shall be promptly blotted with a light application of blotter material.

589.05 LIMITATIONS. On projects where a fog seal or other surface treatment is to be done in conjunction with this work, the crack filling shall be done first. Except when this work is in preparation for a seal coat or slurry seal, crack filling may not be allowed on pavements in the months of July and August if tracking or soiling of the pavement becomes a problem. Crack filling on paved shoulders will be allowed during this time.

When filling cracks with emulsion, sufficient time shall be allowed for the emulsion to flow to the bottom of the crack and to fill it completely full. In filling, a second pass may be necessary before leaving the work zone.

One additional filling (or refilling) will be necessary where the filler has settled into the crack opening. These areas will be identified by the Engineer.

The cleaned cracks need not be filled the same day they are cleaned. However, at the time of filling, cracks shall be free of standing water (to be determined by visual examination). Recleaning may be necessary if the openings become contaminated before being filled. The work may be done as a single, coordinated operation.

The work shall be conducted on only one lane of the pavement at a time, and in accord with the traffic-control plan and 1107.09. Use of a pilot car may be required.

Traffic shall be permitted to use the pavement during this construction, and all operations shall be so conducted as to provide a minimum of inconvenience to traffic.

The work schedule shall be adjusted so that all traffic lanes can be opened to public traffic at the end of the workday. All barricades and equipment shall be removed from the roadbed from 30 minutes before sunset to 30 minutes after sunrise. No work will be permitted on Sundays or holidays described in 1108.03.

589.06 **METHOD OF MEASUREMENT.** The Engineer will measure the work of maintenance cleaning and filling cracks, satisfactorily completed, as follows.

A. **Cleaning and Filling Cracks.**

1. **Pavement Maintenance.** The Engineer will calculate the number of miles of mainline pavement on which cracks were cleaned and filled. The calculations will be based on the centerline distance of mainline, two-lane pavement, corrected for mainline pavement of more than two lanes, including climbing lanes. At intersections, rest areas, and interchanges designated for cleaning and filling, the additional areas of widened pavement, ramps, storage lanes, turning lanes, paved medians and parking in rest areas will not be separately measured for pavement.
2. **Shoulder Maintenance.** The Engineer will calculate the number of miles of paved shoulders on which cracks were cleaned and filled. The calculations will be based on the centerline distance of the adjacent mainline pavement, a single measurement for shoulders on both sides of the pavement. At intersections, rest areas, and interchanges designated to be cleaned and filled, the additional areas of paved shoulders on ramps, gores, and turning lanes will not be measured separately for payment.

Between limits for which cleaning and filling is intended for either pavement or shoulders, no deductions will be made for bridges, intersections, or other interruptions where cracks are not to be cleaned and filled.

B. **ACC for Crack Filling.** The Engineer will compute the weight of hot mixture used for filling cracks larger than 1-inch, based on actual weight. Mixture wasted or otherwise not used in the work will be deducted, based on actual weights or estimates.

C. **Filler Material (Maintenance).** The Engineer will compute the volume of filler material placed, using the method described in 2307.06B. The total quantity will include the material placed in cracks and used to cover map-cracked areas.

Blotting material and tack-coat material will not be measured separately for payment.

589.07 **BASIS OF PAYMENT.** For the work of maintenance cleaning and filling cracks, the Contractor will be paid as follows:

A. **Cleaning and Filling Cracks (Pavement Maintenance) or (Shoulder Maintenance).** For the number of miles of pavement or shoulders on which the cracks were cleaned and filled, the Contractor will be paid the contract price per mile.

B. **ACC for Crack Filling.** For the number of tons of ACC used in filling cracks over 1-inch, the Contractor will be paid the contract price per ton.

C. **Filler Material (Maintenance).** For the number of gallons of filler material placed in cracks and joints, the Contractor will be paid the contract price per gallon.

These payments will be considered full compensation for cleaning the cracks, furnishing and placing the ACC and filler material and all blotting and tack-coat material that is necessary, and for furnishing all equipment and labor therefor, in accord with the plans and this specification.

Article 1109.03 shall not apply to these items.

Iowa Department of Transportation

SUPPLEMENTAL SPECIFICATION
for
CRACK CLEANING AND SEALING
(ACC Surfaces)

April 1, 1986

THE STANDARD SPECIFICATIONS, SERIES OF 1984, ARE AMENDED BY THE FOLLOWING ADDITIONS AND MODIFICATIONS. THESE ARE SUPPLEMENTAL SPECIFICATION, AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

1021.01 DESCRIPTION. This work shall consist of routing and cleaning of cracks in the asphalt cement concrete surface and sealing of the prepared cracks with a joint sealer.

1021.02 MATERIALS. The joint sealer shall be a material meeting requirements of 4136.02A. A hot-pour sealer will be required.

Backer rope used in conjunction with this sealer shall be made of cellulose, cotton, or plastic foam. The rope must withstand, without damage, the high temperatures inherent to these sealers. The rope shall be of a size that compression is required for installation in the crack so it maintains its position during the filling operation.

1021.03 EQUIPMENT.

A. Routing or sawing equipment shall be mechanical and power driven, capable of cutting the cracks to the required dimensions. Equipment designed to "plow" the cracks to dimension will not be permitted.

B. Air compressors shall provide moisture- and oil-free compressed air and shall be of sufficient size to blow sand and other foreign material from the crack prior to placing the sealant material.

C. Equipment used for heating and placing the premixed material shall be of the oil-jacketed, double-boiler type, capable of heating the material to 400 degrees F and pumping the material into the prepared cracks.

1021.04 CONSTRUCTION.

A. Class I Cracks. Cracks which have an average opening of 1/2 inch or less shall be routed or sawed to provide a minimum sealant reservoir of 1/2-inch width by a nominal 1-inch depth.

Backer rope may be used. If used, the depth of cleaning and routing or sawing shall be increased if necessary, and the backer rope shall be placed in the crack to a depth that will provide at least 5/8 inch clearance above the backer rope for the sealer. The backer rope shall be dry when placed.

B. Class II Cracks. Cracks which have an average opening greater then 1/2 inch will not require routing or sawing, but they shall be thoroughly cleaned of all foreign material to a depth necessary to accommodate the sealer material and the backer rope to be used.

Backer rope shall be placed in the crack to a depth that will provide at least 5/8 inch clearance above the backer rope for the sealer. The backer rope shall be dry when placed.

C. Prior to opening to traffic, asphalt cement concrete and foreign material resulting from crack preparation shall be removed from the roadway by brooming, compressed air, or other methods satisfactory to the Engineer.

D. Cracks shall be clean and dry prior to sealing. The entire crack reservoir shall be slightly overfilled with sealant and tightly squeegeed with a narrow V-shaped squeegee, immediately after placement of the sealant, and while still hot. The squeegee shall be operated within approximately 1 foot of the wand tip used to place the sealant. Sealant on the roadway surface in excess of 1/2 inch on each side of the crack edge will not be acceptable.

1021.05 LIMITATIONS. Crack cleaning and sealing shall be done only when the ambient air and pavement surface temperatures are above 40°F. When near this minimum, additional air blasting or drying time or both may be necessary to assure a satisfactory bond to the crack surfaces.

The work shall be conducted on only one lane of the pavement width at a time. When work encroaches on an adjacent lane, a flagger will be required at that location.

The work schedule shall be adjusted so that all barricades and equipment are removed from the roadbed from 30 minutes before sunset to 30 minutes after sunrise. No work will be permitted on Sundays or holidays described in 1108.03.

Articles 1107.08 and 1107.09 shall apply.

Lanes may be opened to traffic only after the sealer has set sufficiently so it will not pick up under traffic. Powder may be applied to the sealer, but only after the sealer surface has set so as to avoid penetration of the powder into the sealer.

Cracks shall be sealed within 3 working days after preparation.

1021.06 METHOD OF MEASUREMENT. The engineer will compute the lengths of Class I and Class II cracks satisfactorily cleaned and sealed. The lengths of transverse cracks will be computed from a count of these cracks and the nominal pavement width. Centerline cracks will be computed as a straight line from the beginning to the end of joint cleaning and sealing. Random cracks cleaned and sealed will be measured along the actual length.

1021.07 BASIS OF PAYMENT.

A. **Class I Routing and Sealing** will be paid for at the contract price per linear foot.

Payment shall be full compensation for all labor, equipment, materials, and incidentals required for crack routing, cleaning, and furnishing and placing sealant.

B. **Class II Cleaning and Sealing** will be paid for at the contract price per linear foot. Payment shall be full compensation for all labor, equipment, materials, including backer rope, and incidentals required for cleaning and furnishing and placing sealant.