CRACKING AND SEATING TO RETARD REFLECTIVE CRACKING - FREMONT COUNTY

FINAL REPORT
IOWA HIGHWAY RESEARCH BOARD
PROJECT HR-279

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Highway Division

Iowa Department of Transportation

Final Report
Iowa Highway Research Board
Research Project HR-279

CRACKING AND SEATING TO RETARD REFLECTIVE CRACKING - FREMONT COUNTY

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Performed in cooperation with the Fremont County Secondary Road Dept.

8. ABSTRACT

The concept of cracking and seating a portland cement concrete (pcc) pavement prior to laying an asphalt cement concrete (acc) surface in order to reduce reflection cracking has been around since the 1950s. With the advent of improved cracking equipment, this method gained renewed interest in the 1970s and 1980s.

This project incorporated six test sections of which four were cracked and seated (C & S) prior to being overlaid. Fremont County decided to utilize only a 0.9 m (3 ft.) cracking pattern based on a 30 m (100 ft.) trial test section. Pavement cracking appeared to be effective in reducing primarily longitudinal reflectance cracking, but only marginally successful in the reduction of transverse reflective cracking.

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Crack and seat, break and seat bituminous overlay, reflective cracking	22

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DISCLAIMER

INTRODUCTION

The Iowa Counties have placed over 8,000 km (5000 mi.) of portland cement concrete (pcc) pavement since 1959. The older pavements are now receiving major rehabilitation work and within the next five to ten years many more miles of pavement will require rehabilitation. The most common procedure is to overlay the pavement with 5 to 8 cm (2 to 3 in.) of asphalt cement concrete (acc).

The major problem with acc overlays is reflective cracking from the underlying joints and cracks in the pcc pavement. Horizontal movement of the pavement creates high tensile stresses in the overlay at the cracks and joints. The acc during low temperatures is relatively stiff and cannot withstand the high induced stresses.

Several techniques have been tried in an effort to reduce and distribute the temperature induced stresses. Interlayers of asphalt rubber, fabric, rock, and open-graded bituminous mixes are among the methods tried in order to retard reflective cracking. Another technique is cracking and seating the pcc pavement prior to an overlay. The numerous cracks created in the old slab allow the contraction and expansion of the concrete to occur at more locations. The result is less movement at each crack or joint in the pcc pavement which may reduce cracking in the overlay. The seating of the broken pieces prevents rocking of the slab which may induce reflective cracking.

The cracking and seating procedure was first reported in the 1950's. With the advent of improved equipment, cracking and seating has gained renewed interest. Pavement breakers today can attain production rates up to 8,300 m² (10,000 sq. yd.) per day. The cost of cracking and seating has been relatively low and the results have generally been encouraging. If cracking and seating can retard reflective cracking, it would be of much benefit to the counties and the Iowa DOT.

OBJECTIVE

The original objective of the proposed research was to evaluate the effect of various sizes of cracking and seating (C & S) of pcc pavement prior to resurfacing on reflective cracking and structural rating. However, only a 91 cm (3 ft.) cracking size was selected at the discretion of the county engineer.

PROJECT DESCRIPTION

The project was a 3.2 km (2 mi.) section of county trunk route J46, commencing at the intersection of M16, 3.2 km (2 mi.) south of Farragut in Fremont County, then east to the intersection of M18 (Figure 1). The road was originally paved 6.7 m (22 ft.) wide, with 18 cm (7 in.) of pcc in 1969. There was substantial quarter point cracking in both lanes and some transverse cracking. The 1986 average daily traffic of 400 vehicles per day was considered in the design of the test sections. The 1992 average daily traffic was 560 vehicles per day, a 40 percent increase.

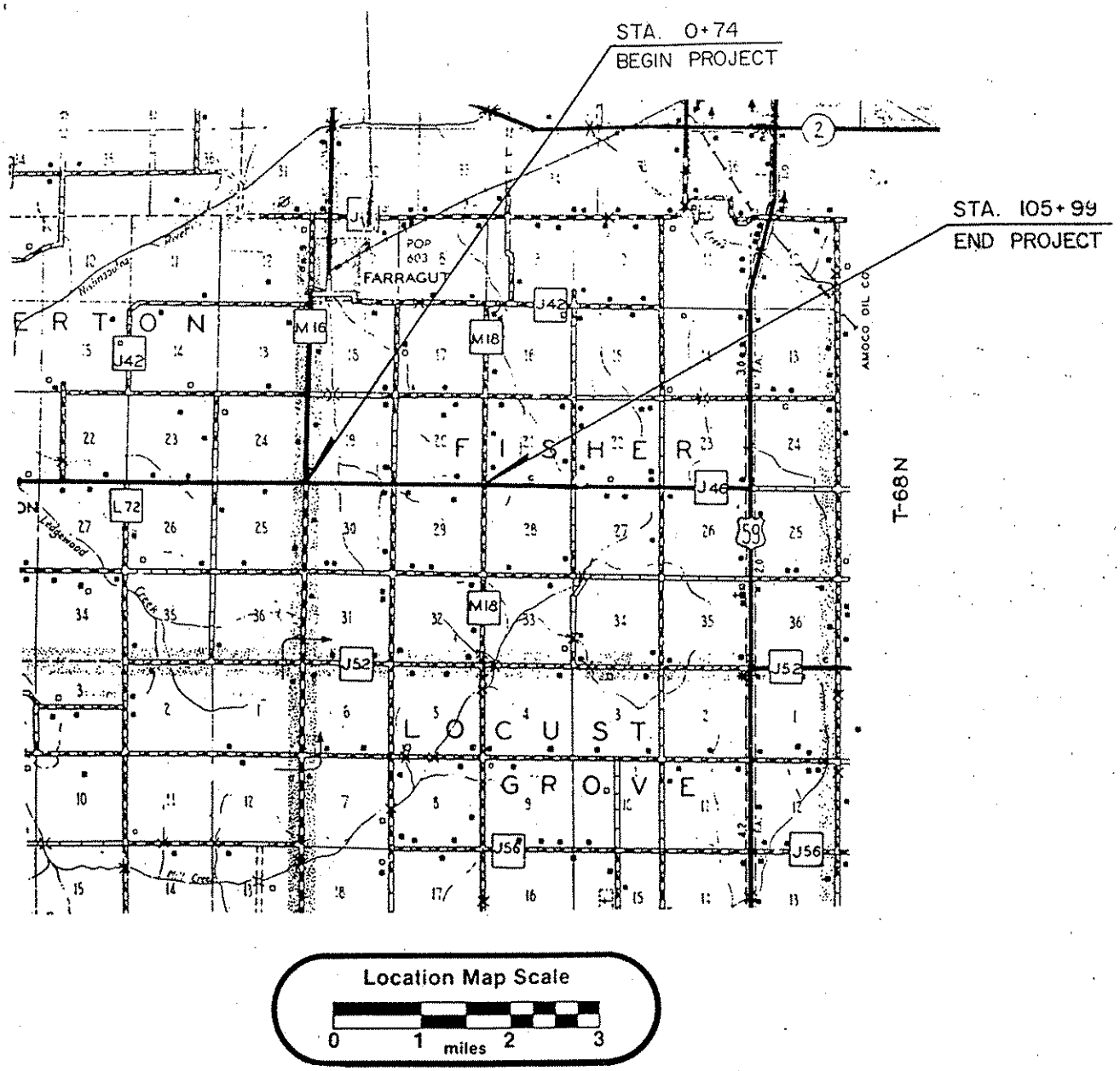
STA. 0+74
BEGIN PROJECT
STA. 105+99
END PROJECT
FARRAGUT
POP 603
F I S H E R
L O C U S T
G R O V E
T-68 N
AMOCO OIL CO
Location Map Scale
0 1 miles 2 3

Figure 1

CONSTRUCTION

There were 6 experimental sections. The first four sections were 638 m (2095 ft.) in length and sections 5 and 6 were 319 m (1047.5 ft.) long. Several different binder and surface thicknesses were used.

Section	Sta. to Sta	Crack Spacing	Binder Thickness	Surface Thickness
1	0+74 to 21+70	91 cm (3.0 ft.)	3.8 cm (1.5 in.)	3.8 cm (1.5 in.)
2	21+70 to 42+65	91 cm (3.0 ft.)	3.8 cm (1.5 in.)	3.8 cm (1.5 in.)
3	42+65 to 63+60	91 cm (3.0 ft.)	6.5 cm (2.5 in.)	3.8 cm (1.5 in.)
4	63+60 to 84+55	91 cm (3.0 ft.)	3.8 cm (1.5 in.)	3.8 cm (1.5 in.)
5	84+55 to 95+02.5	None	3.8 cm (1.5 in.)	3.8 cm (1.5 in.)
6	95+02.5 to 105+50	None	0"	5.1 cm (2.0 in.)

The letting was May 13, 1986 and the contract (Appendix A) was awarded to Henningsen Construction Co., Inc. of Atlantic, Iowa. The cracking of the pavement was sub-contracted to Antigo Construction, Inc. of Antigo, Wisconsin.

CRACKING

Antigo Construction started on August 28, 1986 with a guillotine type Wirtgen hammer. A test section was set up at the beginning of the project. The contractor started with a 60 cm (2 ft.) spacing and a 30 cm (12 in.) hammer drop, but it created too many longitudinal cracks with spalling of the concrete. The spacing was changed to 90 cm (3 ft.) with a 30 cm (12 in.) drop. This combination was satisfactory and was continued for the entire project. The contractor made two passes per lane on each of the

four test sections. A third pass was used where longitudinal quarter point cracking existed. The four sections took approximately 7 hours to complete.

SEATING

On September 3, 1986, the contractor moved in a 45,000 kg (50 ton) roller. The roller was loaded with 36,000 kg (40 ton) of sand and three passes per lane were made on each of the four cracked sections to properly seat the fractured pavement pieces (Figure 2).

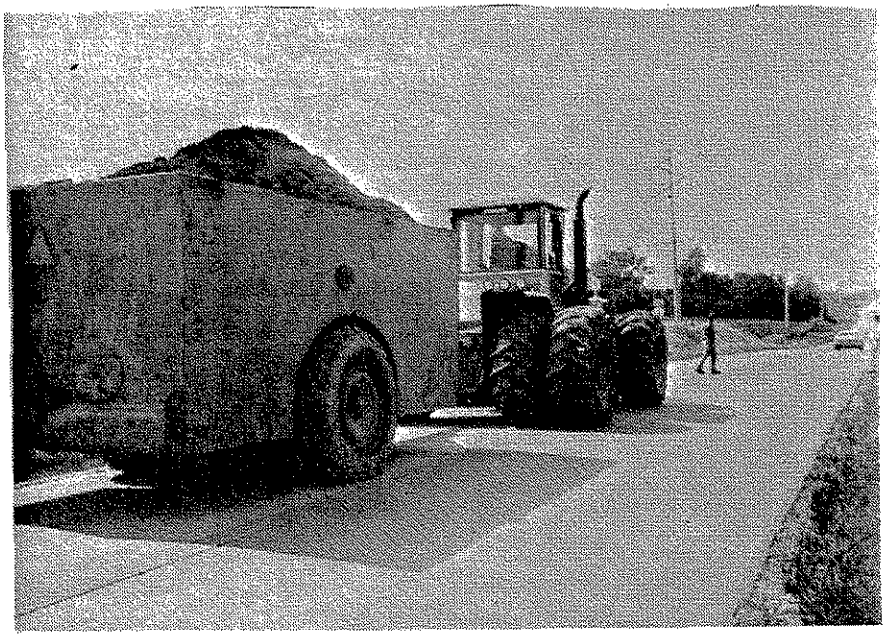

Figure 2
Bros Proof Roller Used For Seating

ACC OVERLAY

On September 17, 1986, Henningsen Construction Co., Inc. moved paving equipment in and started paving on September 18. Each day of operation the base was cleaned using a power sweeper which removed all loose material prior to placement of the tack coat and acc course. The contractor had no difficulty in changing to the various depths of the acc courses. The paving operation was completed on September 22. Shoulder work began on October 15 and the project was completed on October 18, 1986.

CRACK SURVEY

A detailed crack survey of the underlying pcc pavement was conducted, as were annual surveys since the completion of the project in 1986. Table I shows the comparison between sections of total meters of cracks and joints per road station.

Table I
Total Meters of Cracks and Joints
Per Road Station

Section	Transverse	Longitudinal
1	20	68
2	19	57
3	22	84
4	18	52
5	20	66
6	20	67

The annual crack surveys were analyzed and the percentage of reflected cracks/joints as well as the percentage of new cracks per road station were determined.

Figure 3 indicates that section 3 experienced the least severity of reflective transverse cracking. This was expected with section 3 having the thickest acc overlay (10 cm or 4 in.) among all the test sections. It also follows that section 6 with only a 5 cm (2 in.) surface thickness exhibited the highest degree of new cracking, a four-fold increase over that of section 3.

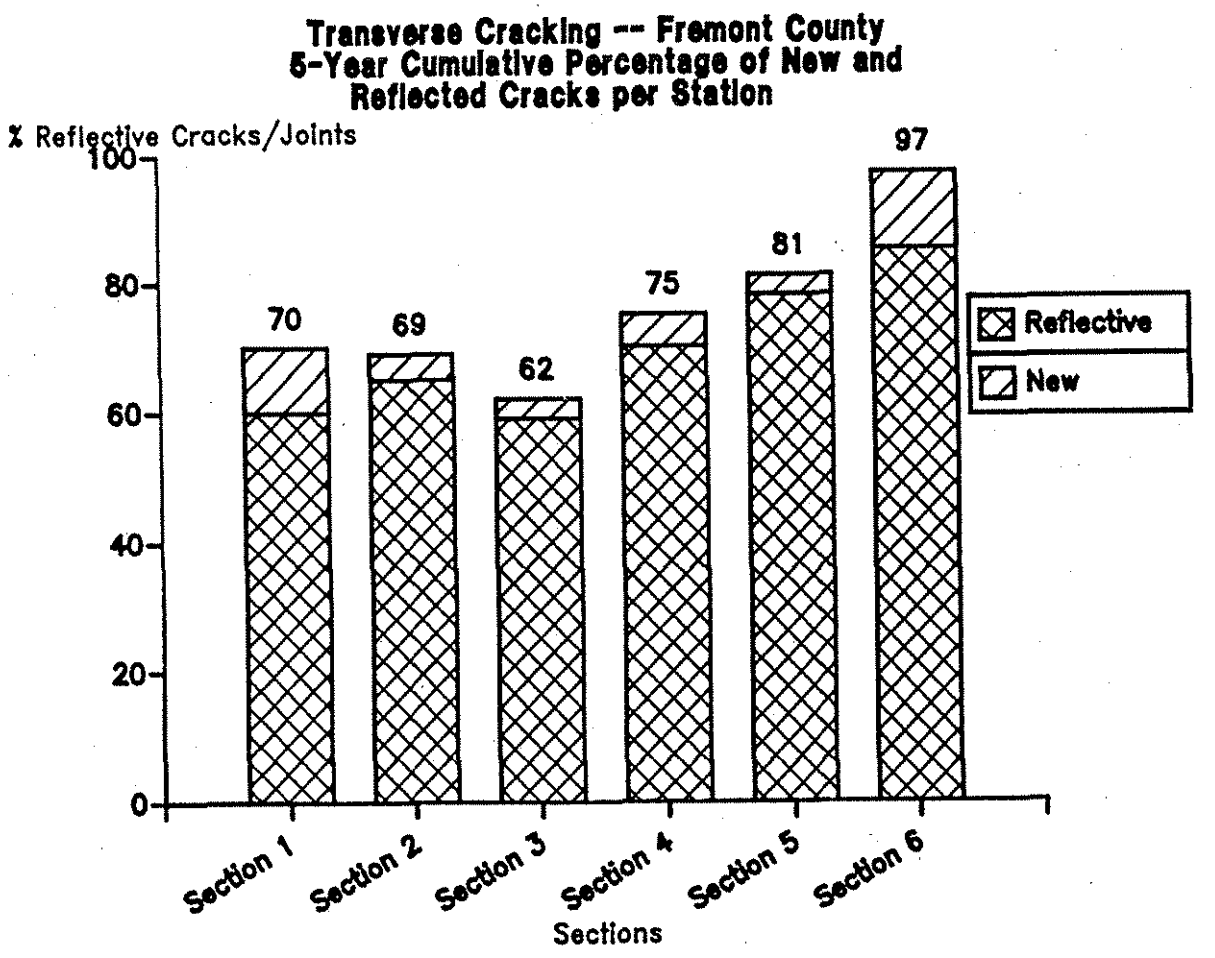

Figure 3

Figure 4 also indicates that section 3 experienced the least severity of reflective longitudinal cracking. It is interesting to note the sizeable increase in the percentage of new cracks per road station for several of the test sections, notably section 1. Granted, the crack and seat procedure creates many new longitudinal cracks in the pavement by the force of the guillotine hammer. However, section 3 exhibited far less new cracking than the other C & S sections with identical cracking sizes. Again, overlay thickness may be the prime reason for this difference.

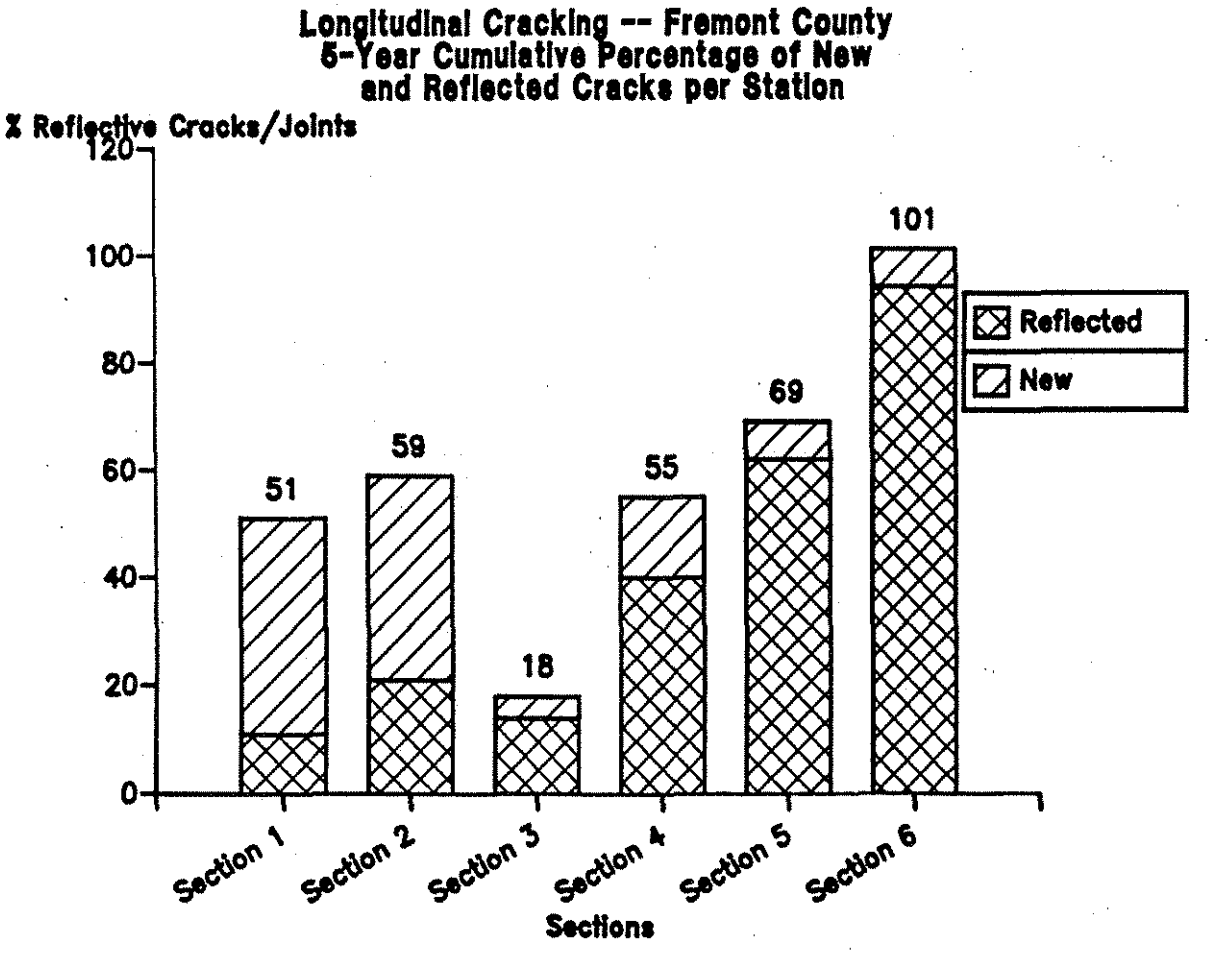

Figure 4

ROAD RATER SUMMARY

Road Rater™ testing was conducted annually on the entire project. The Road Rater is a dynamic deflection measuring device used to determine the structural adequacy of pavements. The differences in pavement structural ratings among test sections are given in Table II and shown in Figure 5.

Table II
Road Rater

Section	1987	1988	1989	1990	1991	1992
1	3.48	2.79	2.49	2.69	2.08	2.65
2	3.32	2.69	2.66	2.98	2.34	2.82
3	3.89	2.73	2.64	3.24	2.59	3.24
4	3.38	2.32	2.32	2.47	2.13	2.64
5	3.17	3.05	2.81	3.47	2.93	3.36
6	3.17	2.75	2.46	3.02	2.08	3.18

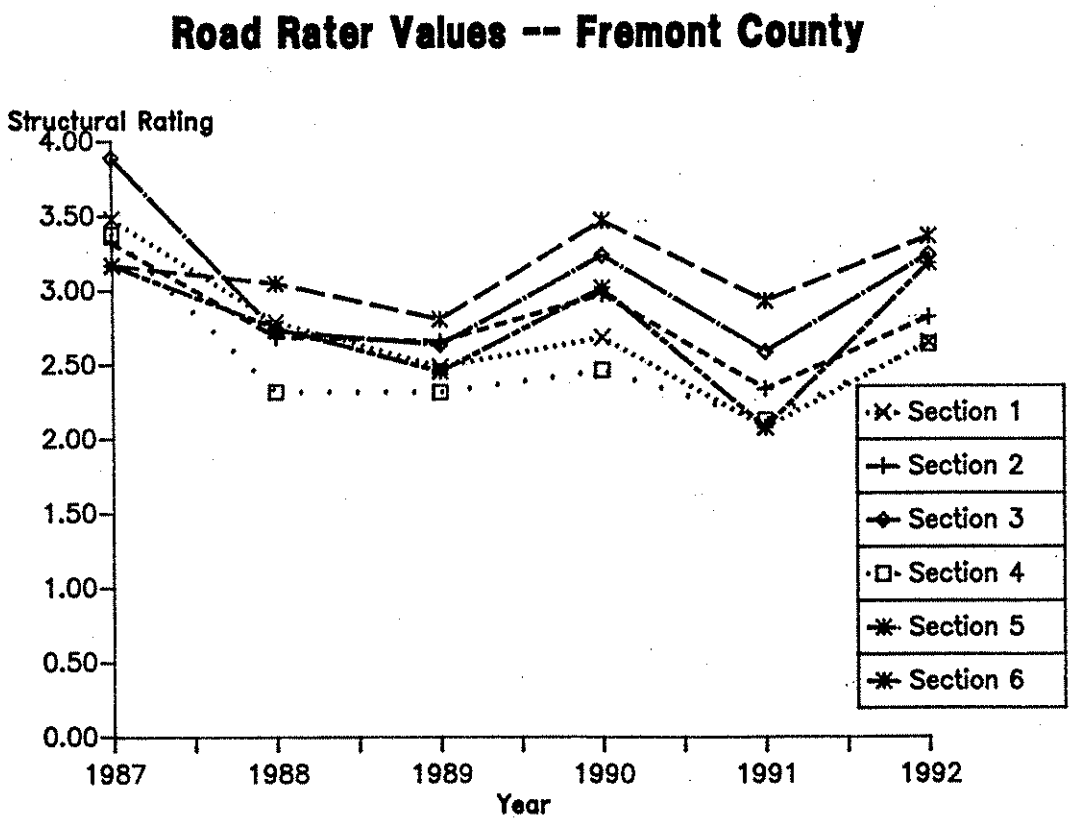

Figure 5

As expected, the 10 cm (4 in.) overlay in section 3 shows a high structural rating in comparison to all the other sections with thinner overlays, except for the non-C & S section 5. This indicates that a 8 cm (3 in.) acc overlay of pcc pavement possesses approximately the same level of structural capacity as the 10 cm (4 in.) acc overlay of the C & S section 3. The fluctuation in structural ratings from year to year may be explained by the fact that annual testing is performed in the outside wheeltrack during the months of April and May when the roadway exhibits the greatest instability. Thus, the structural rating can vary from one year to the next depending upon the amount of moisture in the soil at the time of testing. For the most part, a high structural rating will correspond with a thicker overlay.

Deflection measurements were taken both before and after the C & S process to determine the loss, if any, in structural capacity (Table III).

Table III
Road Rater Values

Section	Before C & S	After C & S
1	3.07	2.49
2	3.24	2.54
3	3.08	2.32
4	2.82	2.47

An analysis of the four C & S sections indicated an average 20 percent reduction in structural capacity as a result of this process.

SUMMARY AND CONCLUSIONS

One potential method of reducing reflection cracking in acc overlays is that of cracking and seating. The purpose of this research project was to evaluate the effect of cracking and seating a pcc pavement prior to resurfacing to reduce reflection cracking.

This research resulted in the following conclusions:

1. The crack and seat sections with a 8 cm (3 in.) acc overlay exhibited an average 10 percent reduction in new and reflective transverse cracking per road station after 6 years when compared to control section 5 with the same overlay thickness.

2. The crack and seat sections with a 8 cm (3 in.) acc overlay exhibited an average 14 percent reduction in new and reflective longitudinal cracking per road station after 6 years when compared to control section 5 with the same overlay thickness.

3. There was a substantial increase in new longitudinal cracking in all the C & S sections except section 3, which has a 10 cm (4 in.) acc overlay. The control section 5 exhibited the least severity of new longitudinal and transverse cracking in comparison to all other 8 cm (3 in.) acc overlaid sections.

4. The C & S procedure resulted in an average 20 percent loss of pavement structural capacity prior to overlaying. Additional data from other C & S projects may or may not verify this result.

RECOMMENDATIONS

1. The C & S procedure should be used on pavements built on relatively dry subgrades.

2. Slab pieces should be cracked no larger than 0.9 m (3 ft.) in size to obtain adequate shear transfer due to aggregate interlock. The optimum size of cracking will vary somewhat for different subgrades and subbases under the existing pavement.

3. A minimum acc overlay thickness of 10 cm (4 in.) coupled with 60 to 90 cm (2 to 3 ft.) cracked slab pieces should be considered when using the C & S method. Thicker lifts of acc may further reduce the amount of reflective cracking.

ACKNOWLEDGEMENT

The author wishes to extend appreciation to the Fremont County Board of Supervisors and the Iowa DOT for their support in developing and conducting this project. Thanks also go to Fremont County personnel for the extra effort put forth; the Henningsen Construction Company and the Antigo Construction Company, Inc. for their cooperation; and Vernon Marks and Kathy Davis of the Iowa DOT Materials Research Office for their assistance in preparation of this report.

REFERENCES

1. Allen, Harvey S., Crack Reflectance of Bituminous Overlaid PCC Pavement, Final Report, Minnesota Department of Transportation, August 1981.

2. Carpenter, Samuel H. and Darter, Michael I., Field Performance of Crack and Seat Projects, Transportation Research Record 1215, January 1989.

3. Crawford, Campbell, Cracking & Seating PCC Pavements Prior to Overlaying With Hot Mix Asphalt, National Asphalt Paving Association, Riverdale, MD, 1989.

4. Shrum, Gary K., Cracking and Seating PCC Pavement Prior to Resurfacing to Retard Reflective Cracking--Fremont County, Construction Report, Iowa Highway Research Board, 1987.

Appendix A

Contract

FORM 650019 8-77 H-384

CONTRACT

NO. 25952

TYPE OF WORK ASPH. CEMENT CONC. RESURF. PROJECT NO. FM-36(9)--55-36

MILES 1.990 COST CENTER 801000 OBJECT 860

COUNTY FREMONT

ON SECONDARY ROAD J46 FROM THE JCT OF SECONDARY ROAD M16, AT THE SW CORNER OF SECTION 19-68-40, EAST NEARLY 2 MILES.

THIS AGREEMENT MADE AND ENTERED BY AND BETWEEN THE COUNTY OF FREMONT, IOWA

PARTY OF THE FIRST PART, AND

HENNINGSEN CONST., INC. & T.G. HENNINGSEN LTD. OF ATLANTIC, IOWA 187

PARTY OF THE SECOND PART,

WITNESSETH, THAT THE PARTY OF THE SECOND PART, FOR AND IN CONSIDERATION OF $ ****170,844.62 PAYABLE AS SET FORTH IN THE SPECIFICATIONS CONSTITUTING A PART OF THIS CONTRACT, HEREBY AGREES TO CONSTRUCT VARIOUS ITEMS OF WORK AND, OR, VARIOUS MATERIALS OR SUPPLIES IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS THEREFORE, AND IN THE LOCATIONS DESIGNATED IN THE NOTICE TO BIDDERS, AS FOLLOWS

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	1.990	MILES	500.00	995
2	ASPHALT CEMENT CONCRETE, TYPE B BINDER COURSE, MIXT. SIZE 3/4 IN.	2,160	TONS	15.75	34,020
3	ASPHALT CEMENT CONCRETE, TYPE B SURFACE COURSE, MIXT. SIZE 3/4"	2,152	TONS	15.75	33,894
4	PRIMER OR TACK-COAT BITUMEN	2,482	GALS.	.88	2,184
5	ASPHALT CEMENT	259	TONS	137.34	35,571
6	SAMPLES		LUMP SUM		750
7	TRAFFIC CONTROL		LUMP SUM		2,500
8	CRACKING AND SEATING OF P.C.C. PAVEMENT, AS PER PLAN	20,487	SQ. YDS.	.80	16,389
9	REMOVAL OF ASPHALT CEMENT CONCRETE SURFACING	726	SQ. YDS.	4.00	2,90
10	SHOULDERS, GRANULAR SURFACING OF	2,060	TONS	12.93	26,635
11	MOBILIZATION		LUMP SUM		15,000
12	STOCKPILED MATERIALS	1	ONLY	1.00	1
				GRAND TOTAL	$170,844

PARTY OF THE SECOND PART CERTIFIES BY HIS SIGNATURE ON THIS CONTRACT, UNDER PAIN OF PENALTIES FOR FALSE CERTIFICATION, THAT HE HAS COMPLIED WITH 324.17(8) OF THE 1975 CODE OF IOWA AS AMENDED IF APPLICABLE

SAID SPECIFICATIONS AND PLANS ARE HEREBY MADE A PART OF AND THE BASIS OF THIS AGREEMENT, AND A TRUE COPY OF SAID PLANS AND SPECIFICATIONS IS NOW ON FILE IN THE OFFICE OF THE PARTY OF THE FIRST PART UNDER DATE OF JUNE 19, 1986

THAT IN CONSIDERATION OF THE FOREGOING, THE PARTY OF THE FIRST PART HEREBY AGREES TO PAY THE PARTY OF THE SECOND PART, PROMPTLY AND ACCORDING TO THE REQUIREMENTS OF THE SPECIFICATIONS THE AMOUNTS SET FORTH, SUBJECT TO THE CONDITIONS AS SET FORTH IN THE SPECIFICATIONS.

THE PARTIES HERETO AGREE THAT THE NOTICE AND INSTRUCTIONS TO BIDDERS, THE PROPOSAL FILED HEREIN, THE GENERAL SPECIFICATIONS OF THE IOWA DEPARTMENT OF TRANSPORTATION FOR 1984 TOGETHER WITH SPECIAL PROVISIONS ATTACHED, TOGETHER WITH THE GENERAL AND DETAILED PLANS, IF ANY, FOR SAID PROJECT FM-36(9)--55-36 TOGETHER WITH SECOND PARTY'S PERFORMANCE BOND, ARE MADE A PART HEREOF, AND TOGETHER WITH INSTRUMENT CONSTITUTE THE CONTRACT BETWEEN THE PARTIES HERETO.

THAT IT IS FURTHER UNDERSTOOD AND AGREED BY THE PARTIES OF THIS CONTRACT THAT THE ABOVE WORK SHALL BE COMMENCED OR COMPLETED IN ACCORDANCE WITH THE FOLLOWING SCHEDULE:

APPROX. OR SPECIFIED STARTING DATE OR NUMBER OF WORKING DAYS	SPECIFIED COMPLETION DATE OR NUMBER OF WORKING DAYS
30 WORKING DAYS	SEPT. 26, 1986

THAT TIME IS THE ESSENCE OF THIS CONTRACT AND THAT SAID CONTRACT CONTAINS ALL OF THE TERMS AND CONDITIONS AGREED UPON BY THE PARTIES HERETO.

IN WITNESS WHEREOF THE PARTIES HERETO HAVE SET THEIR HANDS FOR THE PURPOSE HEREIN EXPRESSED TO THIS AND THREE OTHER IDENTICAL INSTRUMENTS AS OF THE _____ DAY OF JUL 14 1986 19 ____

COUNTY OF FREMONT, IOWA

BY [signature]
PARTY OF THE FIRST PART

HENNINGSEN CONST., INC. & T.G. HENNINGSEN LTD.

BY [signature]
PARTY OF THE SECOND PART

Approved:

[signature] JUL 14 1986
Contracts Engineer Date
IOWA DEPT. OF TRANSPORTATION

Appendix B

1986 Project Supplemental Specifications

1986 SUPPLEMENTAL SPECIFICATIONS FOR CRACKING & SEATING PCC PAVEMENT FREMONT COUNTY PROJECT NO. HR-279

DESCRIPTION

This work shall consist of "cracking and seating" existing PCC pavement prior to resurfacing to retard reflective cracking in the overlay.

EQUIPMENT

The device to be used for "cracking" the concrete pavement shall be capable of producing the desired crack pattern while maintaining aggregate interlock in the fractured faces. The device shall provide the desired transverse crack without longitudinal cracking or excessive spalling of the concrete and shall provide a broad striking surface that does not punch holes nor disintegrate otherwise sound pavement by the impact of the breaking head. The energy transmitted to the pavement shall be controllable to induce as near vertical cracks as possible without conical cracking as would be developed by breaking for total removal.

The equipment to be used for "seating" the cracked concrete shall be a pneumatic tired roller with a suitable body for ballast loading with such capacity that the gross load may be varied from 30 to 50 tons.

CONSTRUCTION METHODS

Existing ACC overlay shall be removed from the concrete pavement surface where shown on the plans. Following removal of any existing ACC overlay, the existing PCC pavement shall be cracked to produce full depth, generally transverse, hairline cracks at the longitudinal spacing designated on the project plans. Care should be taken to prevent the formation of induced longitudinal cracks.

Before cracking operations begin, the engineer will designate a test section. The contractor shall crack the test section using varying energy and striking patterns until a satisfactory cracking pattern is established. This energy and striking pattern will then be required for the remainder of the project, varying only the spacing of the cracks as designated on the plans. If the engineer determines conditions have changed such that a satisfactory cracking pattern is no longer being produced, adjustments shall then be made to the energy and/or cracking pattern. When cracking the test section, the contractor shall furnish and apply water to dampen the pavement following cracking to enhance visual determination of the cracking pattern. The

contractor shall furnish and apply water to a check section each day to verify that the specified crack pattern is being maintained.

Following cracking, the concrete shall be rolled until the concrete pieces are assured of being seated.

The pavement shall be cleaned by power sweeping and air blowing with 100 psi nominal air pressure prior to placement of the tack coat and ACC leveling course. Cleaning shall include removing all loose material from joints, cracks and bituminous patched areas. If the pavement is opened to traffic after the cracking operation but prior to placement of the first ACC course, the contractor shall maintain the surface for traffic by sweeping, patching, etc., as needed.

MEASUREMENT AND PAYMENT

The completed work as measured for PCC pavement cracking and seating will be paid for at the contract unit price for the following contract item.

Pay Item	Pay Unit
PCC pavement cracking and seating	Square yard

Payment for PCC pavement cracking and seating includes cracking the existing concrete pavement, assuring the seating of the cracked pavement by use of a roller, cleaning the surface prior to overlay and maintaining the cracked pavement in suitable condition for use by traffic if required.

Appendix C

1992 Crack and Seat Specification

Section 2216. Cracking and Seating Concrete Pavement

2216.01 DESCRIPTION.

This work shall consist of cracking and seating existing PCC pavement, prior to resurfacing with ACC. Associated work may include removal of an existing ACC overlay if present, subdrain construction, ACC resurfacing, and shoulder work.

2216.02 EQUIPMENT.

Cracking equipment shall be capable of producing the desired cracking pattern by providing a broad striking surface. Equipment that punches holes in the pavement or results in excessive spalling of otherwise sound sections shall not be used. A blade or spade type breaker is recommended and may be required.

Seating equipment shall be a roller meeting requirements of either Paragraph A or B, as follows:

A. The roller shall be a pneumatic tired roller consisting of four rubber tired wheels equally spaced across the full width and mounted in line on a rigid steel frame in such manner that all wheels carry equal loads, regardless of surface irregularities. Roller tires shall be capable of satisfactory operation at a minimum inflation pressure of 100 psi, and tires shall be inflated to the pressure necessary to obtain proper surface contact pressure to satisfactorily seat pavement slabs. At the Contractor's option, tires may contain liquid.

The roller shall have a weight body suitable for ballasting to a gross load of 50 tons, and ballast shall be such that gross roller weight can be readily determined and so controlled as to maintain a gross roller weight of 50 tons. The roller shall be towed with a rubber tired prime mover.

B. The roller shall be a two axle, self propelled, pneumatic tired roller, provided the roller is equipped with no more than seven tires, and the requirements in Paragraph A, above, concerning tire inflation pressure, surface contact pressure, and 50 ton gross weight are met.

Miscellaneous equipment shall include a means to dampen cracked pavement with water, a source of compressed air with 100 psi. pressure, a rotary broom described in Article 2001.14, and various hand tools as needed.

2216.03 REMOVAL OF EXISTING ASPHALT CEMENT CONCRETE OVERLAY.

All asphaltic and other bituminous material existing on the pavement surface shall be removed from the area to be cracked before cracking. Removal shall be a continuous operation, but removal of asphaltic full depth patches is not required. Removal shall be to the underlying PCC pavement and in accordance with requirements of Section 2214, excluding Article 2214.05.

Foamed material in existing pressure relief joints shall be removed prior to removal of the ACC overlay.

Scarification shall be to the full width of the lane, with a suitable runout at the end, before the lane is opened to public traffic. Scarification shall be planned and done so as to leave no vertical drop-off at the center line or lane line overnight. Where an overnight drop-off

results from unforeseen conditions, the approaches shall be signed with a ROAD WORK AHEAD sign, and the drop-off shall be marked with vertical panels. The vertical panels shall be placed at 150 foot intervals in rural areas and at 50 foot intervals in urban areas, with a minimum of three vertical panels at each drop-off location.

Additional scarification of the existing PCC pavement may be required at bridge approaches and other fixed objects, as designated in the contract documents.

2216.04 PAVEMENT CRACKING.

The existing PCC pavement shall be cracked so as to produce full depth, generally transverse. hairline cracks at a nominal spacing designated in the contract documents. When not designated, the spacing shall be 1-1/2 feet to 3 feet. Induced cracking closer than 2-1/2 feet from an existing crack or joint or deteriorated concrete shall be avoided. Care shall be taken to prevent the formation of a continuous longitudinal crack.

When cracking operations begin, the Engineer will designate test sections of approximately 100 feet. The Contractor shall crack the test sections using varying energy and striking patterns until a satisfactory cracking pattern is established. This energy and striking pattern shall then be used for the remainder of the project unless the Engineer determines that a satisfactory cracking pattern is no longer being produced. Adjustments shall then be made to the energy and/or striking pattern as necessary to re-establish a satisfactory cracking pattern.

The Contractor shall furnish and apply water to the test area to dampen the pavement following cracking to enhance visual determination of the cracking pattern. The Contractor shall furnish and apply water to check stations, as directed by the Engineer, to verify that the specified crack pattern is being maintained. This will normally be once a day. Furnishing and applying this water will be incidental, and it will not be paid for separately.

Cracking equipment shall not be operated on a bridge, and areas in a bridge approach section or within 3 feet of a fixed object shall not be cracked.

Before opening to traffic, areas of cracked pavement shall be seated then cleaned of loose or spalled material by sweeping and by blowing joints and cracks with compressed air. This cleaning shall be repeated, as necessary, until the ACC resurfacing is placed.

2216.05 PAVEMENT SEATING.

Seating of the cracked pavement shall be done as shown in the contract documents and as required by the Engineer.

The cracked pavement shall be rolled until seating of the cracked pavement is assured to the satisfaction of the Engineer. The intentions are to weight the roller such that satisfactory seating can be reasonably assured by one complete coverage by the roller and to accomplish seating with a minimum damage to aggregate interlock at the cracks. The weight of the roller and the rolling pattern, including laps, will be established by the Engineer, based on one or more initial test sections.

2216.06 LIMITATIONS.

The Contractor shall use every reasonable means to protect persons and vehicles from injury or damage that might occur because the Contractor's operations. During the construction, the Contractor shall provide traffic control as required by the contract documents. Articles 1107.08 and 1107.09 shall also apply.

The road shall be kept open to traffic. Except when an accelerated work schedule is required, no work will be permitted on Sundays and holidays. The Contractor may restrict traffic to one lane from 1/2 hour after sunrise to 1/2 hour before sunset but shall permit traffic to pass safely at all times, except for occasional, unavoidable interruptions. Equipment shall not extend into a lane open to traffic except the minimum distance necessary to perform the required work in the closed lane.

This work should be carefully staged to minimize the time public traffic is to drive on pavement where the pavement work is only partially completed. The removal of existing ACC overlay shall not be started more than 2 weeks before the succeeding operation is scheduled to begin. The pavement cracking shall not be started more than 2 weeks before the overlay operation of the cracked and seated area is scheduled to begin.

Cracked and seated areas are to be overlaid with the full thickness of ACC, required by the contract, before a winter suspension.

The Contractor's attention is directed to Article 1105.12. If the operation of the seating roller over a culvert is to be restricted according to Paragraph G, this will be designated in the contract documents.

2216.07 METHOD OF MEASUREMENT.

The Engineer will calculate the area of cracking and seating, satisfactorily completed, from the length and the nominal width. For areas cracked and seated according to the contract documents, the quantity shown in the contract documents will be used.

2216.08 BASIS OF PAYMENT.

For the number of square yards of cracking and seating completed, the Contractor will be paid the contract price per square yard. This payment will be full compensation for cracking and seating and for furnishing all materials, equipment, and labor.