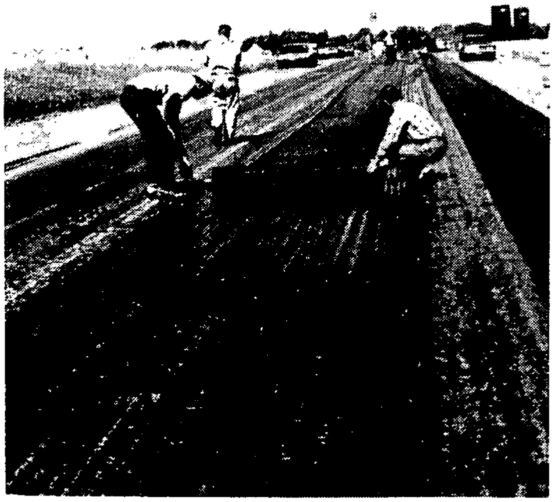
PREVENTION OF REFLECTION CRACKING IN ASPHALT OVERLAYS WITH STRUCTOFORS, PETROMAT, AND CEREX



IOWA HIGHWAY RESEARCH BOARD

Project HR-158
Final Report

HIGHWAY DIVISION
May 1977

PREVENTION OF REFLECTION CRACKING IN ASPHALT OVERLAYS WITH STRUCTOFORS, PETROMAT, AND CEREX

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ABSTRACT

This report presents construction methods and results using three reinforcing fabrics to prevent reflection cracking in an asphalt overlay.

The original highway in the rural area was Portland Cement Concrete 20 feet wide. It was widened by adding 2 feet of asphaltic concrete 10 inches deep on each side prior to resurfacing. Data are presented for the widening joint and transverse cracks in the rural area and for the random cracking in the urban area.

Prevention of Reflection Cracking in Asphalt Overlays With Structofors, Petromat, and Cerex

INTRODUCTION

One of the most persistent problems with asphaltic concrete resurfacing is that cracks almost always appear in an overlay wherever cracks existed in the underlying pavement. This is generally referred to as reflection cracking. Highway engineers have tried to eliminate reflection cracking in the asphaltic concrete overlays of Portland Cement Concrete pavements for many years.

The Federal Highway Administration, in "Informational Memorandum CMPB-16-70, Subject: National Experimental and Evaluation Program Reducing Reflection Cracking in Bituminous Overlays," encouraged states to incorporate reflection crack reducing treatments into a bituminous overlay project.

BACKGROUND

Iowa Highway 89 was a Portland Cement Concrete highway through the town of Woodward in Dallas County. The rural section was built in 1942 and the urban section was built several years before. Iowa 89 carries approximately 2000 vehicles per day in the rural area and 2650 to 3050 vehicles per day in the urban sections. The rural section was widened and then both rural and urban sections were resurfaced with three inches of asphaltic concrete in 1971.

A portion of the highway was used to experiment with three reinforcing materials at the designated locations shown in Figure 1. The reinforcing fabrics were placed between the widened highway and the asphaltic concrete overlay. Both rural and urban areas were included in the experimental construction.

The rural area was a Portland Cement Concrete pavement 20 feet wide which was widened to 24 feet by placing asphaltic concrete in a trench 2 feet wide and 10 inches deep along each side before resurfacing (Figure 2). The urban area was a Portland Cement Concrete pavement with curb and gutter but no center joint. There was a wide meandering crack in the middle third of the pavement and numerous cracks leading from it.

EXPERIMENTAL MATERIALS

Three different materials were used in an effort to prevent reflection cracking. Structofors is a polyester fiber fabric manufactured in Holland and distributed in the United States by American ENKA Corporation of Enka, N.C. The material specifications furnished by the manufacturer are:

Strength	5 tons/yd.
Weight	7.5 oz./sq.yd.
Mesh size	0.4 inches
Width	63 inches

The material cost for this project was $1.25 per square yard.

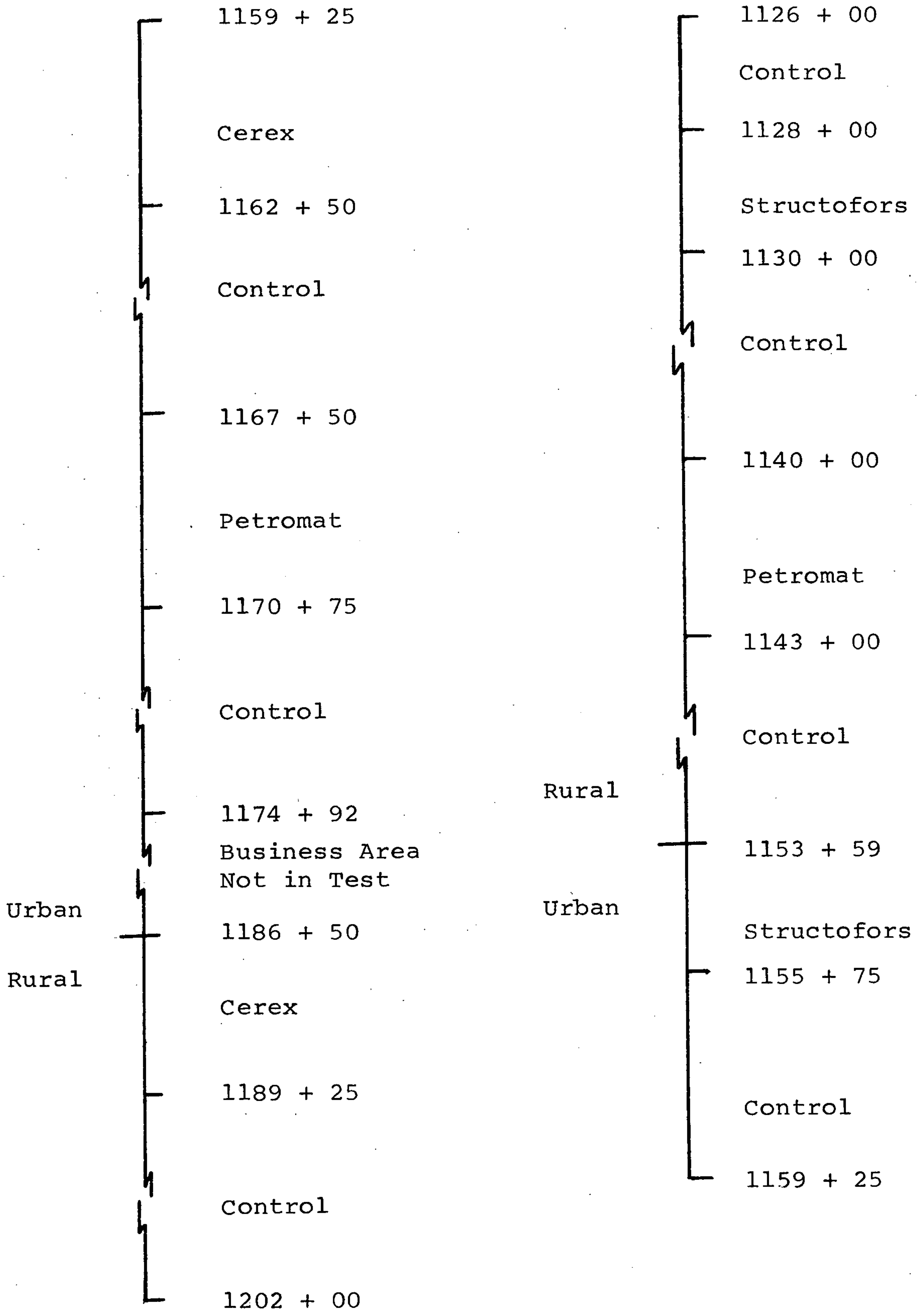

Figure 1: Location of Test Sections

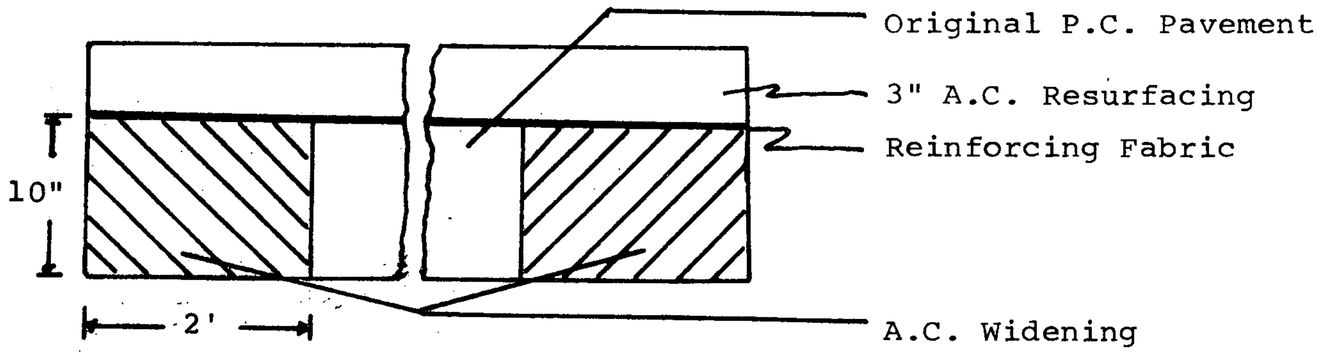

Figure 2: Widened and Resurfaced Section

Petromat is a nonwoven polypropylene fabric manufactured by Phillips Petroleum Company. The properties of Petromat as listed by the manufacturer are:

Tensile strength: 50 lbs. min. per inch of width
Elastic recovery, at 15 lb., wet or dry min: 100%
Weight: 3-5 oz./sq. yd.
Color: Black

The material was 75 inches wide and cost $0.46 per square yard for this project. Other widths are available.

Cerex is spunbonded nylon manufactured by Monsanto Chemical Company. The Cerex used on this project was rated at 2½ ounces per square yard and the rolls were 60 inches wide. Cerex is available in several weights. Physical properties of Cerex as reported by the manufacturer are:

Weight per sq. yd.	Average Thickness	Grab Tenacity	Trapezoid Tear
2 oz.	14 mils	56 lbs.	25 lbs.
3 oz.	20 mils	87 lbs.	39 lbs.

The material cost for this project was $0.479 per square yard.

CONSTRUCTION

Before placement of the fabric, all cracks in the existing pavement were cleaned and filled with an asphalt mix. Just prior to placing the fabric, the Portland Cement Concrete surface received an emulsion tack coat of 0.30 gallons per square yard which appeared quite thick (Figure 3). The fabric was then placed the full 24-foot width of the widened pavement in the rural area. The Cerex was placed with a 3-inch lap, the Petromat with a 4-inch lap, and the Structofors with a 7-inch lap. The lap joints were sealed with emulsion using a hand held wand (Figure 4). In the urban area, the fabric was not placed across the existing crack between the pavement and the curb and gutter section.

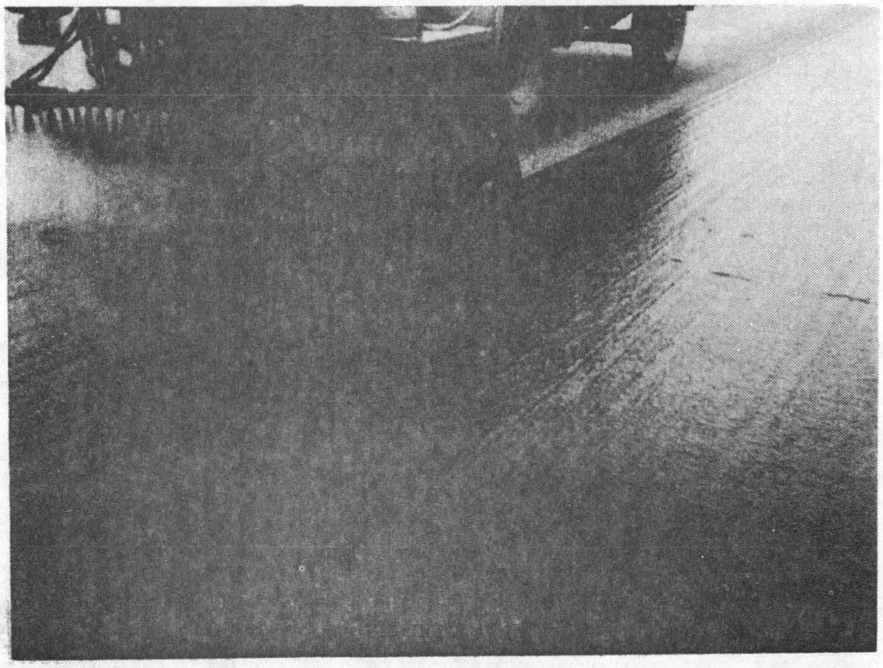

Figure 3: Applying Tack Coat

Figure 4: Sealing Lapped Fabric Joints

All fabrics on the project were placed by hand because of convenience on a project this small (Figure 5). The use of vehicle-mounted spool holders would facilitate fabric application on a larger project. Wrinkles in the fabric were eliminated by cutting with scissors. No adverse effect was observed.

On a Wednesday, Cerex was placed in the urban area and Petromat was placed in both the rural and urban areas. The Petromat was placed, covered with sand, and rolled with a pneumatic roller as the asphalt could not be laid because of a plant breakdown. Traffic was then allowed over the Petromat.

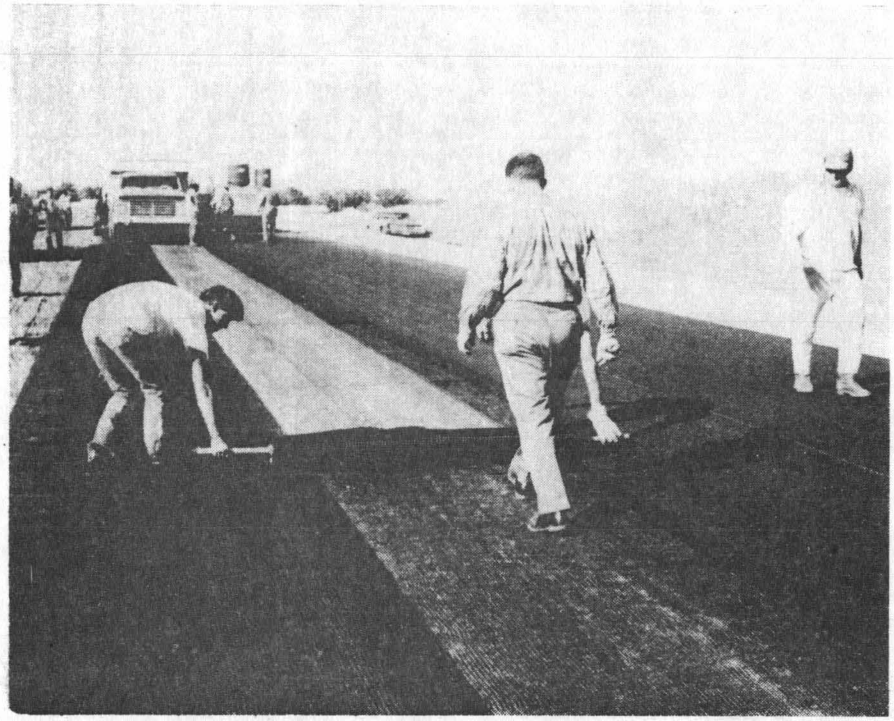

Figure 5: Placing Fabric

The Cerex was placed late the same afternoon and while the Cerex was being covered with sand and rolled with a pneumatic roller, a light rain began to fall. After sanding and rolling, traffic was allowed to drive over the Cerex. The next morning, bubbles had appeared in the rain-covered Cerex (Figure 6). The sand was swept from the Cerex with a rotary broom to facilitate drying. As the sun shone on the Cerex, the bubbles disappeared and the fabric shrank and adhered to the tack coat. No adverse effects were observed.

On Friday, the Cerex and Petromat which had been placed on the pavement Wednesday, were swept with a rotary broom to remove the sand cover, and asphalt was laid over them. The

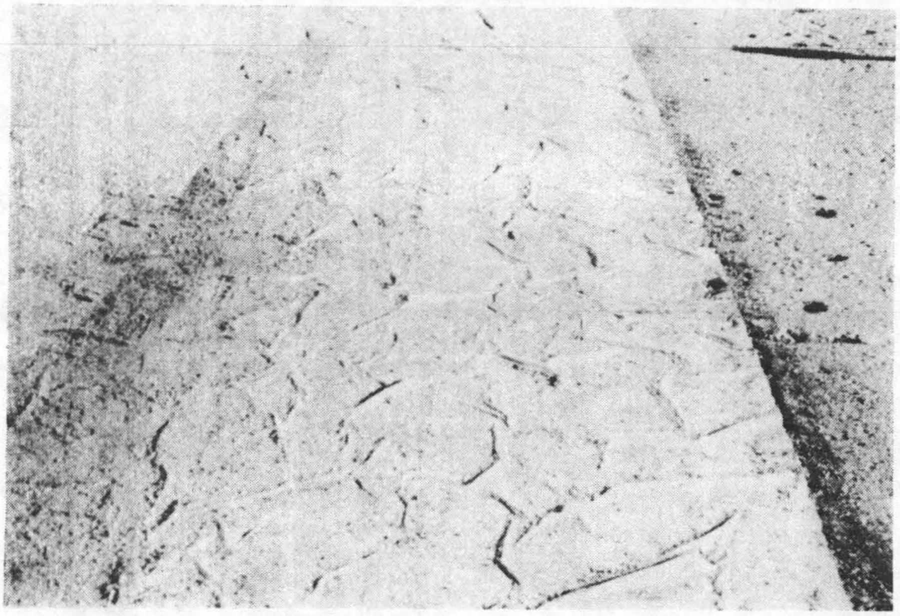

Figure 6: Bubbles in Cerex After Rain

traffic of nearly 2 days did not affect the appearance of the fabrics and no adverse effects were observed.

The Cerex in the rural area was overlaid with asphaltic concrete the same day it was placed.

The Structofors was placed and overlaid on the same day and no problems were encountered.

EVALUATION

To evaluate the effectiveness of fabrics for the prevention of reflection cracking, the Portland Cement Concrete was surveyed before resurfacing and the location of the cracks drawn to scale. Annual crack surveys of the asphaltic concrete overlay were conducted for 5 years.

The widening joint and transverse cracks were the only reflection cracking considered in the rural area. There were no longitudinal cracks in the original pavement. Further, the lap joint in the 2-lift asphaltic concrete overlay made it impossible to evaluate centerline joint reflection.

Rural Area

Widening Joint

The effectiveness of reinforcing fabrics in preventing reflection of the widening joint is shown in Figure 7. The widening joint in the control section began to reflect through the asphalt overlay almost immediately after construction.

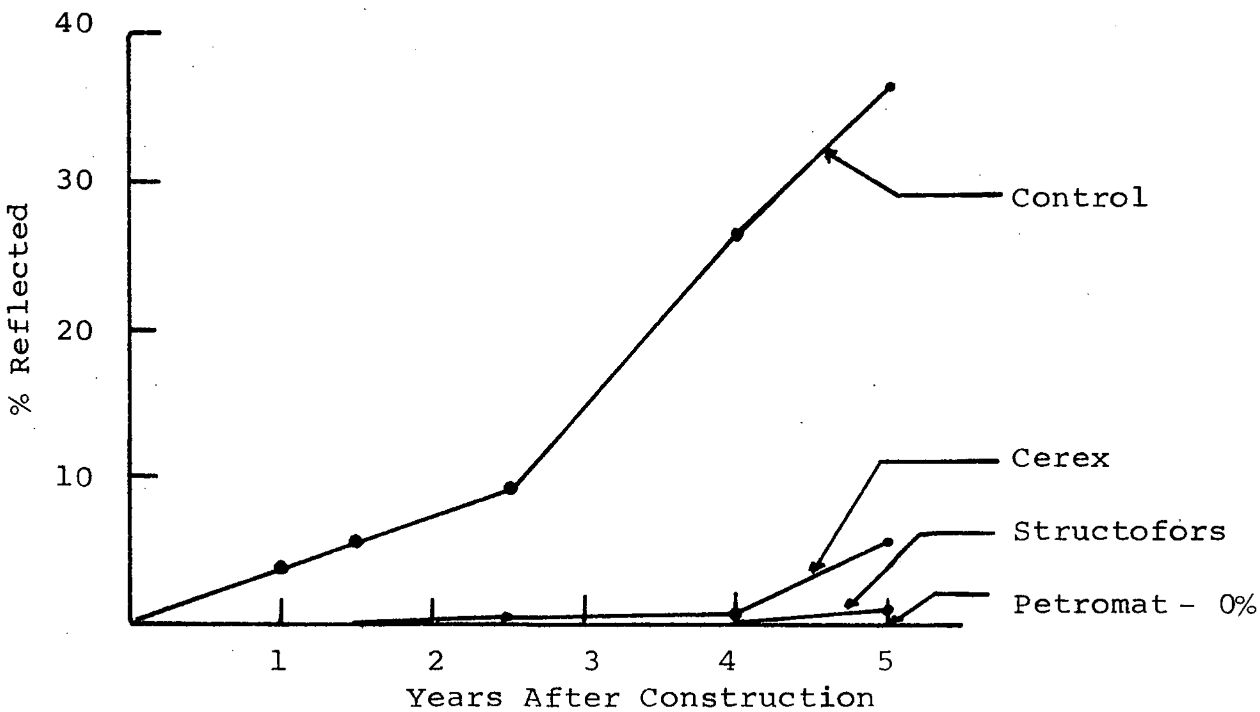

Figure 7: Rural Widening Joint Reflected

After 2½ years, 9% of the widening joint had reflected through the asphalt overlay in the control section, and 5 years after construction, over 1/3 of the widening joint in the control section has reflected through the asphalt overlay.

The Cerex significantly reduced reflection cracking of the widening joint. Five years after construction, less than 6% of the widening joint reinforced with Cerex had reflected as compared to more than 1/3 in the control section.

Structofors and Petromat were even more effective in preventing reflection of the widening joint. No significant reflection cracking of the widening joint was observed in either section 5 years after construction.

Transverse Cracking

The effectiveness of the reinforcing fabrics in preventing transverse crack reflection is illustrated in Figure 8. The control section again shows the greatest percentage of reflection cracking. The first year after construction, 27% of the transverse cracking in the Portland Cement Concrete reflected through the asphalt overlay. Of the transverse reflection cracking occurring 5 years after construction (51%), more than 1/2 occurred in the first year.

The transverse reflection cracking in the Structofors-reinforced section was 23% after 1 year, and little additional reflection cracking was observed. Five years after construction, about 1/4 of the cracking in the Portland

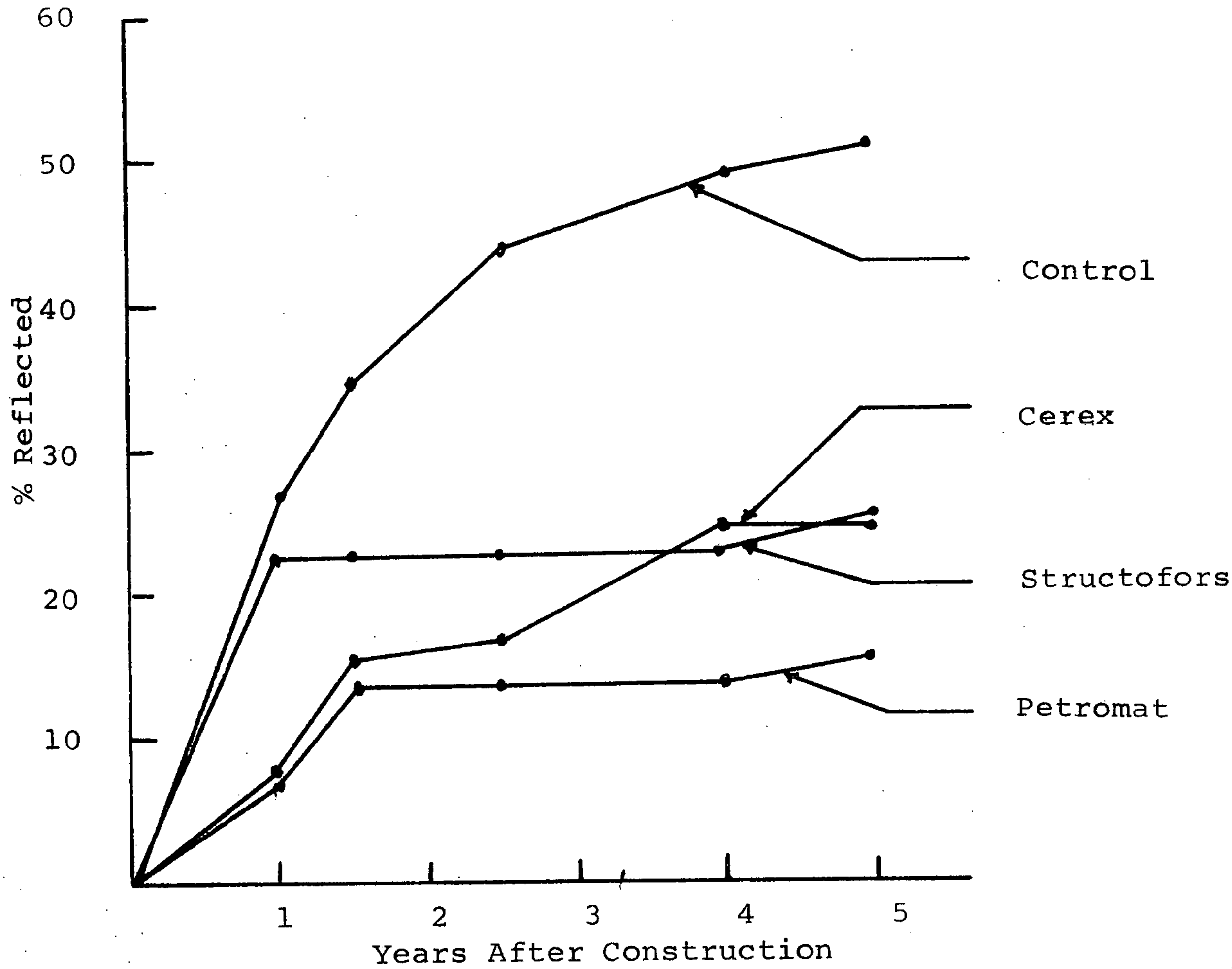

Figure 8: Rural Transverse Cracking Reflected

Cement Concrete had reflected through the asphalt overlay. Again, most of the reflection cracking occurred early in the life of the overlay.

The transverse crack reflection occurred at a slower rate in the Cerex-reinforced section. One year after construction, the Cerex-reinforced section reflected 8% as compared to 23% in the Structofors-reinforced section. After 5 years, both had reflected about 1/4 of the cracking in the original pavement. Although long-term benefits (5 years) are no greater with Cerex, there appears to be short term advantages.

The transverse reflection cracking in the Petromat-reinforced section was less than in the control section and in the other two fabric-reinforced sections for all time periods considered. The reflection cracking occurred at nearly the same rate as in the Cerex-reinforced section during the first 1½ years after construction. At that time, the Petromat-reinforced section reflected about 14% and the Cerex-reinforced section reflected about 15% of the original cracking in the Portland Cement Concrete base. There was a small amount of additional reflection cracking in the Petromat-reinforced section after 5 years. It increased to about 16%, while in the Cerex-reinforced section, about 1/4 of the original transverse cracks reflected through the asphaltic concrete overlay.

Urban Area

The cracking in the urban area was not always in a longitudinal or transverse direction. There was a meandering crack in the middle third of the Portland Cement Concrete pavement with cracks leading from it in various directions (Figure 9). For this reason Figure 10 shows the total reflection cracking in the urban area.

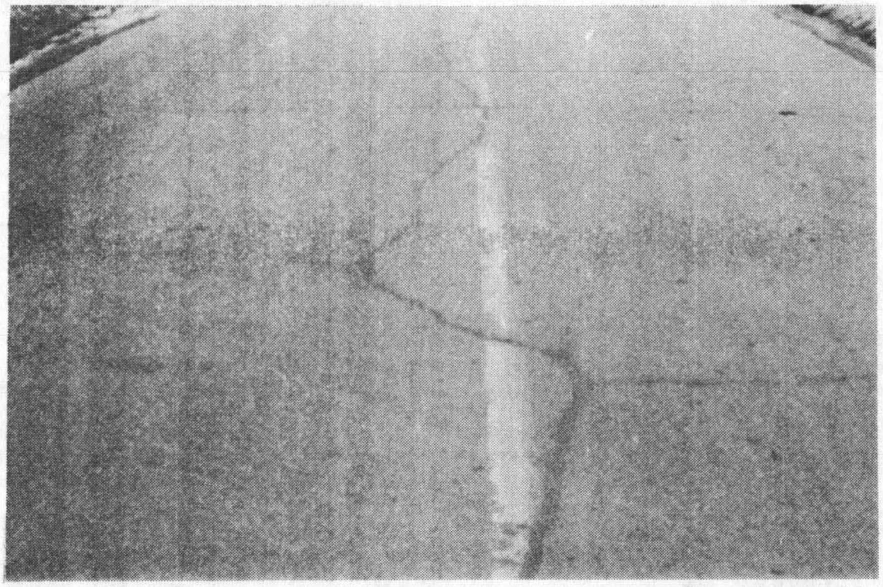

Figure 9: Meandering Crack in Urban Area

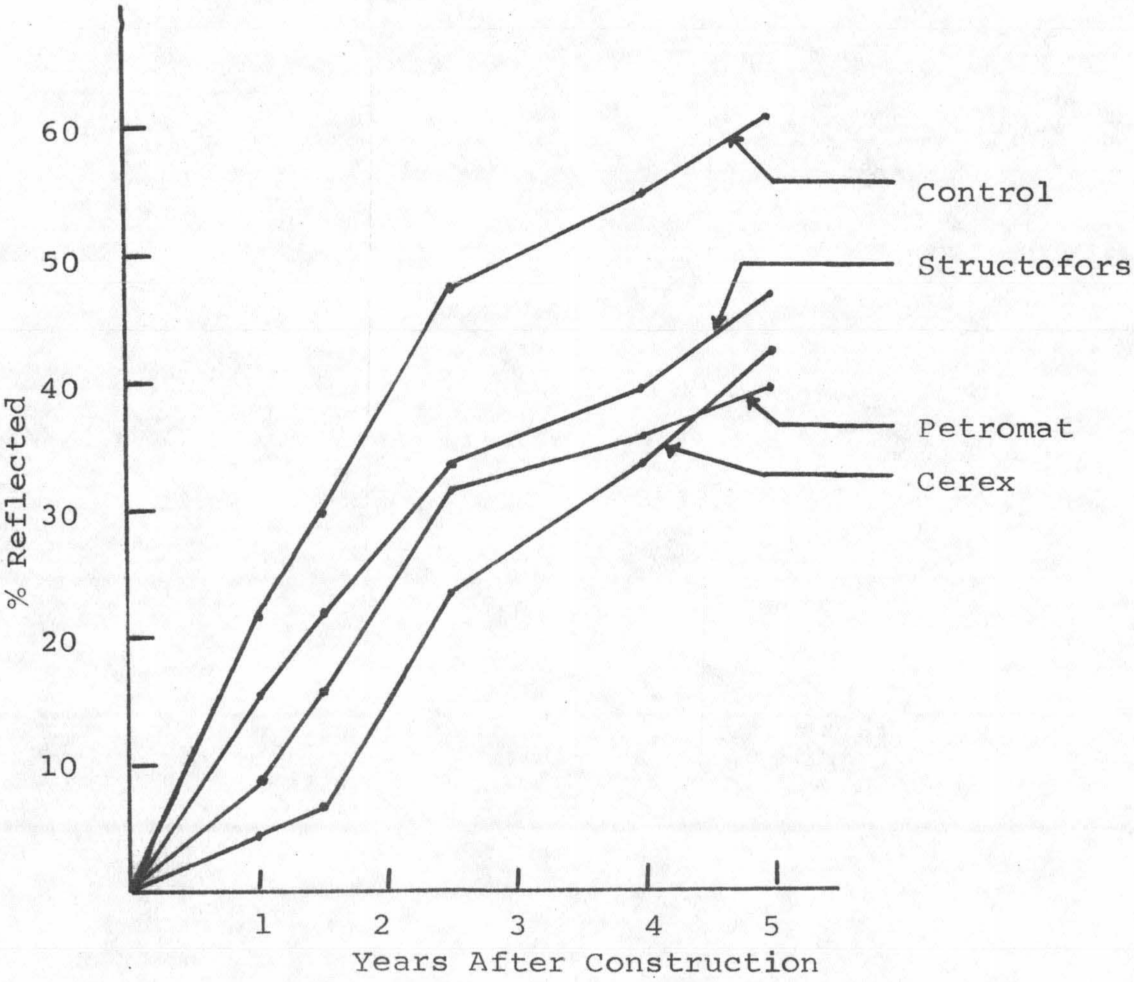

Figure 10: Urban Cracking Reflected

All three fabrics appeared to be effective in reducing reflection cracking. After 5 years, the differences between the fabric-reinforced sections are small, least reflection cracking being 40% and the most 47%, of the original pavement cracking. This is about 2/3 the rate of reflection cracking in the urban control section.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on 5 years service of the experimental construction.

The 3 reinforcing fabrics reduced reflection cracking when compared to the control section which was not reinforced.

The reflection cracking between the original Portland Cement Concrete pavement and the asphalt widening was nearly eliminated where reinforcing fabrics were placed. The transverse reflection cracking in the rural area was 1/3 to 1/2 that in the non-reinforced sections.

Vehicle traffic over the fabrics for about 2 days was not detrimental to the fabrics. Conventional track-type construction equipment did not tear or otherwise damage the fabrics.

Cerex and Petromat were not adversely affected by light rain between the placement of the fabrics and the placement of the asphalt overlay.

Parameters for future research using Cerex or Petromat on Portland Cement Concrete highways would be a greater truck count (Iowa 89 carries only about 5% trucks), fabric width necessary to control the widening crack, and whether cracks would be generated from the edges of the fabric when placed as a strip over the widening joint.

Research is also recommended for asphaltic concrete highways to investigate the possibility of preventing the reflection of wheelpath deterioration, especially on highways with heavy wheel loads.

Although the results obtained using Structofors are comparable to those using Cerex and Petromat, further research using Structofors is not recommended because of the higher cost.

The Appendix shows detailed information for all three fabrics as well as the control sections.

ACKNOWLEDGEMENTS

This research was sponsored by the Iowa Highway Research Board, Highway Division, Iowa Department of Transportation.

Appreciation is extended to the personnel in the Atlantic Resident Construction Office for their cooperation and assistance in the construction of this project.

APPENDIX

TABLE I

RURAL CRACKING

Lineal Feet

Widening Joint

Time (Yrs)	Control	Cerex	Petromat	Structofors
Original	7068	550	600	400
Reflected				
1	258	0	0	0
1½	404	0	0	0
2½	1347	4	0	0
4	1870	4	0	0
5	2565	31	0	4

Transverse Cracking

Time (Yrs)	Control	Cerex	Petromat	Structofors
Original	4181	319	297	263
Reflected				
1	1128	25	20	60
1½	1449	49	40	60
2½	1841	53	40	60
4	2053	79	40	60
5	2129	79	46	66

TABLE 2

URBAN CRACKING

Lineal Feet

Time (Yrs)	Control	Cerex	Petromat	Structofors
Original	2774	775	857	625
		Reflected		
1	603	33	76	95
1½	822	51	136	137
2½	1310	181	270	211
4	1508	259	305	245
5	1675	326	340	291

TABLE 3

RURAL TRANSVERSE CRACKING

% Reflected

Time (Yrs)	Control	Cerex	Petromat	Structofors
1	27.0	7.8	6.7	22.8
1½	34.7	15.4	13.5	22.8
2½	44.0	16.6	13.5	22.8
4	49.1	24.8	13.5	22.8
5	50.9	24.8	15.5	25.1

TABLE 4

WIDENING JOINT

% Reflected

Time (Yrs)	Control	Cerex	Petromat	Structofors
1	3.7	–	–	–
1½	5.7	–	–	–
2½	19.1	0.7	–	–
4	26.5	0.7	–	–
5	36.3	5.6	–	1.0

TABLE 5

URBAN – TOTAL CRACKING

% Reflected

Time (Yrs)	Control	Cerex	Petromat	Structofors
1	21.7	4.3	8.9	15.2
1½	29.6	6.6	15.9	21.9
2½	47.2	23.4	31.5	33.8
4	54.4	33.4	35.6	39.2
5	60.4	42.1	39.7	46.6