Final Report
Iowa Highway Research Board
Project HR-360

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

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TECHNICAL REPORT TITLE PAGE

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8. ABSTRACT

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

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

- PavePrep, Contech Construction Products Inc.
- ProGuard, Phillips Fiber Corporation

The data indicated a statistically significant decrease in reflective crack formation in the ProGuard fabric sections compared to control. There was little evidence of a similar effect from the PavePrep fabric sections compared to control. However, the rate of cracking (the rate of formation of new cracks) for both fabrics and control tended to be similar after three years. The benefits of using these fabrics (possible delay of some crack formation by two years) on this project did not outweigh the costs of up to $4200.00 per mile.

9. KEY WORDS Asphalt Cement Concrete (ACC) Asphalt Overlay Reflective Cracking Engineering Fabric	**10. NO. OF PAGES** 14

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INTRODUCTION

An asphalt cement concrete (ACC) overlay is the most common rehabilitative effort used to maintain the serviceability of older pavements. A major problem in durability of this ACC overlay comes from reflective cracking, that is, cracks in the overlay that are caused by cracks in the underlying pavement. These cracks tend to open, and also allow water to enter and strip the ACC in the overlay leading to accelerated deterioration at the crack. The ACC overlay between the cracks remains durable, but the life of an overlay is governed by the weakest link.

There have been many efforts to control reflective cracking in ACC overlays. Interlayers of such things as fabric, rock and asphalt rubber have been tried with varying levels of success. Two crack retarding materials were evaluated in this project.

- PavePrep®, manufactured by Contech Construction Products Inc.
- ProGuard®, manufactured by Phillips Fiber Corporation

Both products consist of a thick asphalt mastic membrane sandwiched between polymer fabric layers. In each case, the fabric on one side is woven and on the other side it is nonwoven.

The product GlasGrid® was initially included in this research. GlasGrid® is a knitted, glass fiber strand grid. It was withdrawn from the research project at the request of the GlasGrid® representative.

OBJECTIVE

The purpose of this research is to evaluate the effectiveness of two engineering fabrics in retarding reflective cracking through an ACC overlay.

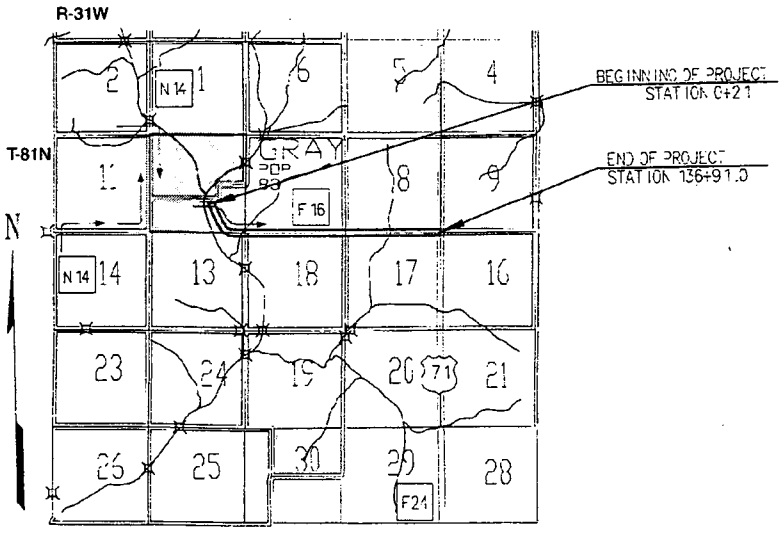
PROJECT LOCATION AND DESCRIPTION

The project is located in Audubon County on county route F16 from the corporate limits of the town of Gray east 2.6 miles to US 71. A map of the location is shown in Figure 1.

The existing ACC pavement was 22 feet wide and was built in 1957 as part of a research project (described below). The original structure was a 6 inch ACC pavement, placed over a granular surfaced roadway built in 1937. Resurfacing was performed in 1970 with a 3 inch asphalt overlay. There was also at least one slurry leveling course and at least one seal coat prior to the current project. The existing pavement exhibited transverse cracking at approximately 40 foot spacings, some quarter point cracking, and some alligator cracking. These cracks were often depressed and varied in width. The road experiences an average daily traffic of approximately 250 vehicles.

In 1957, the pavement was placed under an Iowa Highway Research Board sponsored project HR-58. This project explored the use of ungraded locally available gravel and loess in a very lean ACC mix. It also experimented with a method of mixing the asphalt with the aggregate using an atomization and paddle-mixing process. A seal coat was placed in 1958 to alleviate surface ravelling in the experimental pavement.

Figure 1



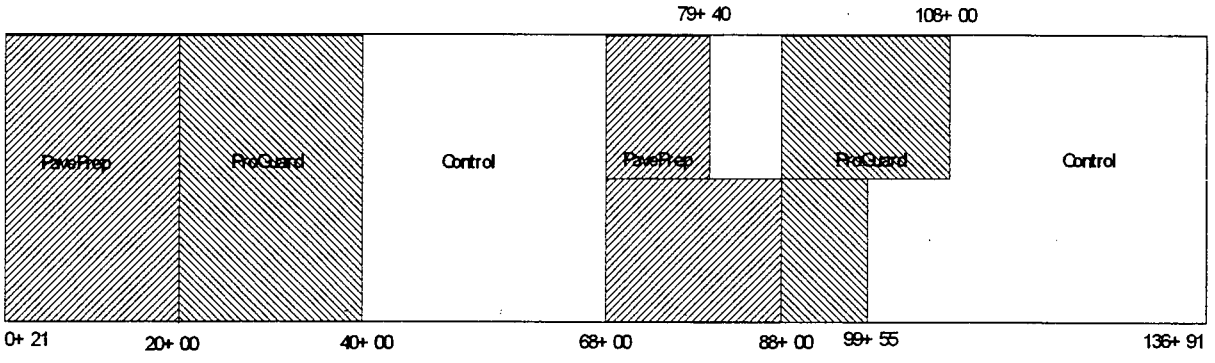
This research project consisted of a three inch thick ACC overlay. The test sections are listed in Table 1 and shown in Figure 2. Longitudinal subdrains were also installed during this project.

Table 1
Test Section Layout

Test Section	Eastbound	Westbound	Product	Tack
1	STA 0+21 TO STA 20+00	STA 0+21 TO STA 20+00	PavePrep	S.A.*
2	STA 20+00 TO STA 40+00	STA 20+00 TO STA 40+00	ProGuard	AC-20
3 & 4	STA 40+00 TO STA 68+00	STA 40+00 TO STA 68+00	None	----
5	STA 68+00 TO STA 88+00	STA 68+00 TO STA 79+40	PavePrep	S.A.
	-------	STA 79+40 TO STA 88+00	None	----
6	STA 88+00 TO STA 99+55	STA 88+00 TO STA 108+00	ProGuard	AC-20
	STA 99+55 TO STA 108+00	-------	None	----
7 & 8	STA 108+00 TO STA 136+91	STA 108+00 TO STA 136+91	None	----

* S.A. - Self Adhesive Engineering Fabric

Figure 2
Test Sections



PRECONSTRUCTION WORK

A detailed crack survey was conducted on May 4, 1993 from Station 0+21 to Station 136+91. This crack survey was used to record the location where engineering fabric was applied and to chart reflective cracking.

CONSTRUCTION

Audubon County awarded the contract for construction of the project to Henningsen Construction, which began construction on August 17, 1993. The first day's work consisted of surface patching. Surface patching was conducted in accordance with Article 2212.04A of the 1992 Standard Specifications. The surface patching was completed on August 18. Placement of the engineering fabric began in the westbound lane at Station 108+00 on August 19.

The engineering fabric was placed in compliance with the manufacturers' recommendations. Joints where the fabric was to be placed were blown free of all loose debris. The self-adhesive PavePrep was applied directly to the surface. A 20 inch wide roll was placed in a single width directly over the crack (see photographs in the Appendix). The fabric was then pressed to the surface with a rubber tire roller. ProGuard required the use of an AC-20 tack coat. The tack coat was applied the full length of the crack and approximately24 inches in width, and the fabric was placed over the tack coat. The fabric measured 20 inches wide and was placed in a single width directly over the crack. This fabric was also pressed to the surface with a rubber tire roller. The placement of ProGuard was a more time consuming process due to the application of the tack coat.

After placement, the location of the engineering fabric was plotted on the crack survey. Sand was placed on any tack coat that was exposed in the process of placing the ProGuard, in order to reduce the tracking of the AC-20 when the lane was open to traffic. Engineering fabric placement was completed on August 20. Note that both manufacturers approved of opening the roadway to traffic while the engineering fabric was on the roadway prior to paving. The traffic applied additional pressure to the fabric which helped to ensure a good bond between the underlying surface and the engineering fabric.

The contractor began paving on August 21. This process began with cleaning of the roadway and placing a tack coat in accordance with Article 2303.17 of the 1992 Standard Specifications. The ACC was placed in two 1.5 inch lifts. Each lift was placed and compacted in accordance with Article 2303.12, Class 1C of the 1992 Standard Specifications. Paving started in the westbound lane at the intersection of F16 and US 71, Station 136+91. The first lift in the westbound lane was completed and paving started at Station 0+21 in the eastbound lane. Paving for the first day stopped at Station 28+46 in the eastbound lane.

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

On August 24, paving began at Station 136+91 of the eastbound lane. Once the eastbound lane was completed, the paving operation moved to Station 2+84 of the westbound lane where the second lift was completed for that lane.

From September 2 to September 7, subdrains were installed on the project; from September 13 to September 15, type "B" granular shoulders were placed on the project; and the guardrails and rumble strips were installed from September 20 to September 24, completing the project.

Two minor problems occurred during the construction process. There were some mud balls in the aggregate. This created a need to closely monitor the asphalt mix in order to ensure that the pavement was not harmed by the mud balls. The occurrence of these mud balls decreased as the project proceeded. The second problem was caused by the contractor trying to temporarily shoulder the road too soon after paving by pulling dirt onto the edge of the slab. This caused cracking along the roadway edge in the westbound lane. To repair the damage, a one-foot wide section was milled along the pavement edge from Station 136+91 to approximately Station 110+00. After milling, the area was filled with ACC and rolled with a small vibratory roller.

TESTING

The Iowa Department of Transportation and Audubon County evaluated the project through 1998. Table 2 shows the original testing schedule. For the purposes of this report, only the crack survey data was evaluated.

Table 2
Test Schedule

Test	Construction 1993	1994	1995	1996	1997	1998
Road Rater	X	X	X	X	X	X
Profilometer		X		X		X
Crack Survey	X	X	X	X	X	X

DISCUSSION

The objective of this research was to evaluate the ability of these two engineering fabrics to retard the formation of reflective cracks in the ACC overlay. The two major areas of investigation under this objective were (1) to compare (five years after paving) the amount of cracking on treated and control sections and (2) to try to determine the failure mechanism for cracking that did occur through the fabrics. In terms of the second investigation, the fact that GlasGrid was not used on the project is unfortunate. GlasGrid is a more inelastic material. As such its behavior and modes of possible failure would very likely differ from ProGuard and PavePrep.

Comparison of Crack Retarding Effects

Comprehensive crack surveys were performed each year through 1998. The final results are shown in Figures 3, 4 and 5.

Figure 3 graphs the data from a pooled comparison between the two fabrics and control, showing mean and distribution data. Each data point is a ratio for one location of the amount of cracking after five years to the amount of cracking before the overlay. These data indicate a statistically significant difference (at a five percent level) in the average for the ProGuard compared to control.

Figure 3
Crack Survey Results

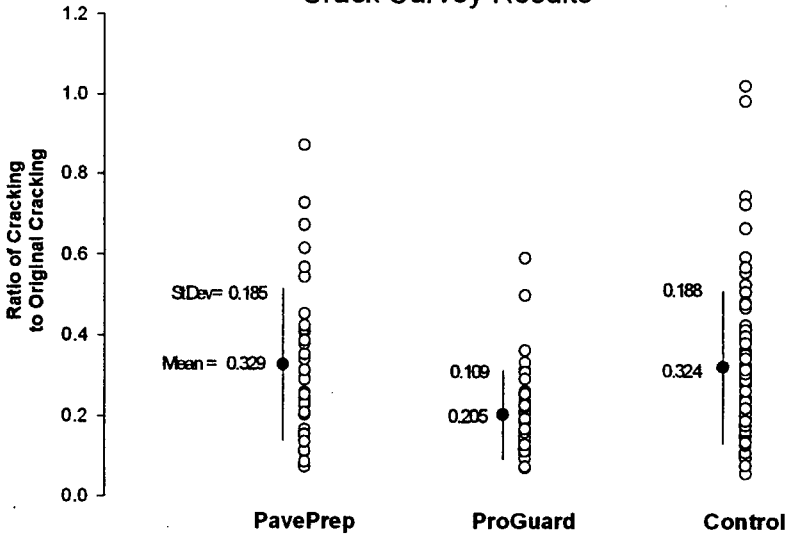
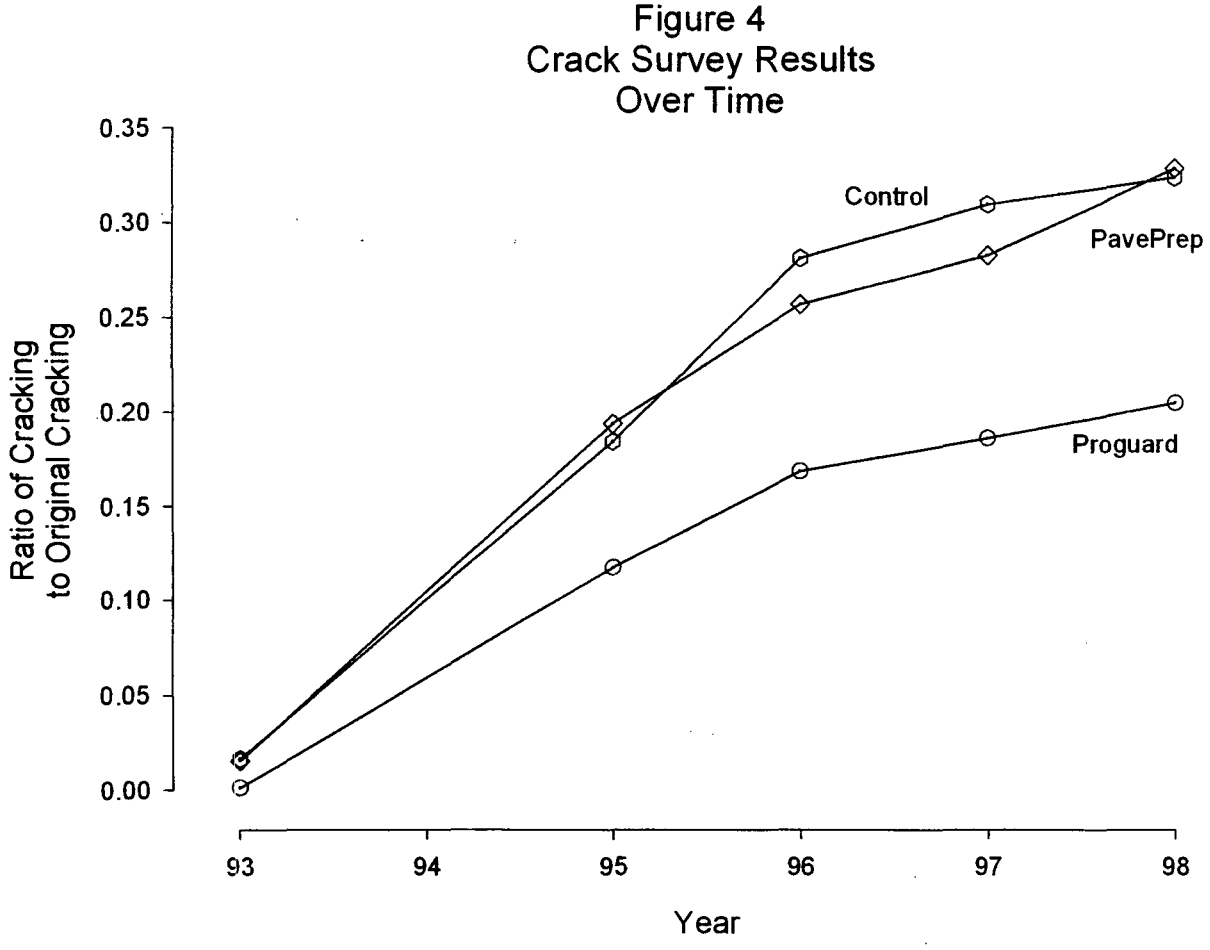


Figure 4 shows the crack data over time for each year after paving. Each point on this graph is the mean of all the data for that section, in that year. As a point of reference, note that the data from Figure 3 is contained in the final three data points of this graph. The slopes of the lines in this graph indicate that the ProGuard treated sections developed cracks more slowly during the first three years compared to the PavePrep and control sections. During the last two years of study, the rates of crack formation appear similar across all three sections.



A different approach is used in Figure 5 (next page). Here the data are displayed with cracking rates for both before and after overlay (note marginal distributions of the data on the top and right hand axes). The purpose of these plots is to indicate a correlation between the amount of cracking before and after overlay. If the fabric was effectively retarding reflective cracks, there would not be a slope to the plot (in other words, more cracks before the overlay does not result in more cracks after overlay). If there is a correlation, the plotted points will tend to slope from lower left to upper right.

Although there is a lot of scatter and a low correlation (R^2 between 0.1 and 0.2) the fitted lines have a positive slope in each case. Note that the slope for the ProGuard is lower than that for the PavePrep or control (keeping in mind the caveat of the low correlation values).

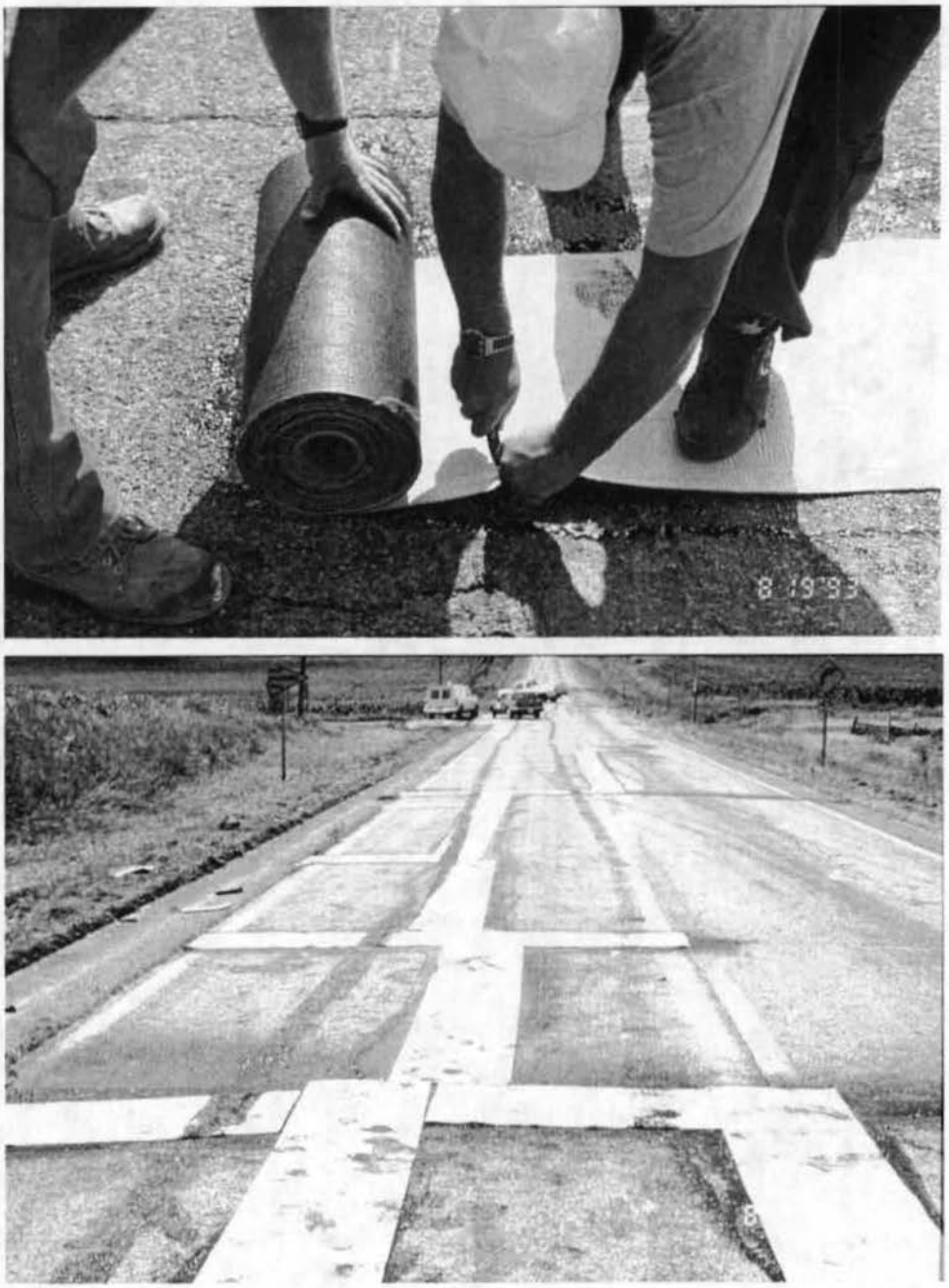
ACKNOWLEDGEMENT

Research project HR-360 was sponsored by the Iowa Highway Research Board and the Iowa Department of Transportation. Partial funding for this project was provided by the Secondary Road Research Fund.

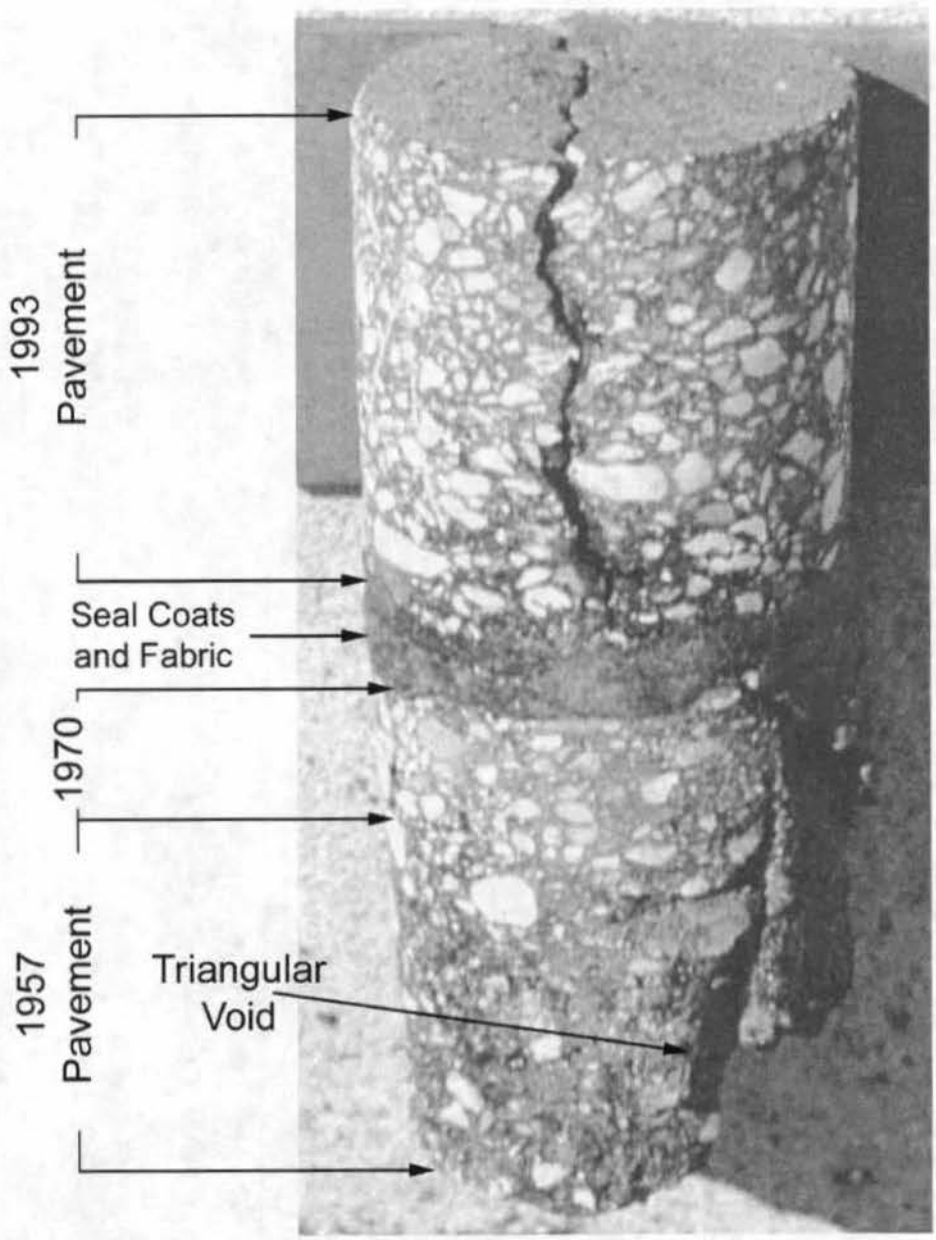
The author would like to extend thanks to the Audubon County Board of Supervisors. We would also like to thank Henningsen Construction and the employees of Audubon County that participated in the construction and inspection of the project.

APPENDIX
PHOTOGRAPHS

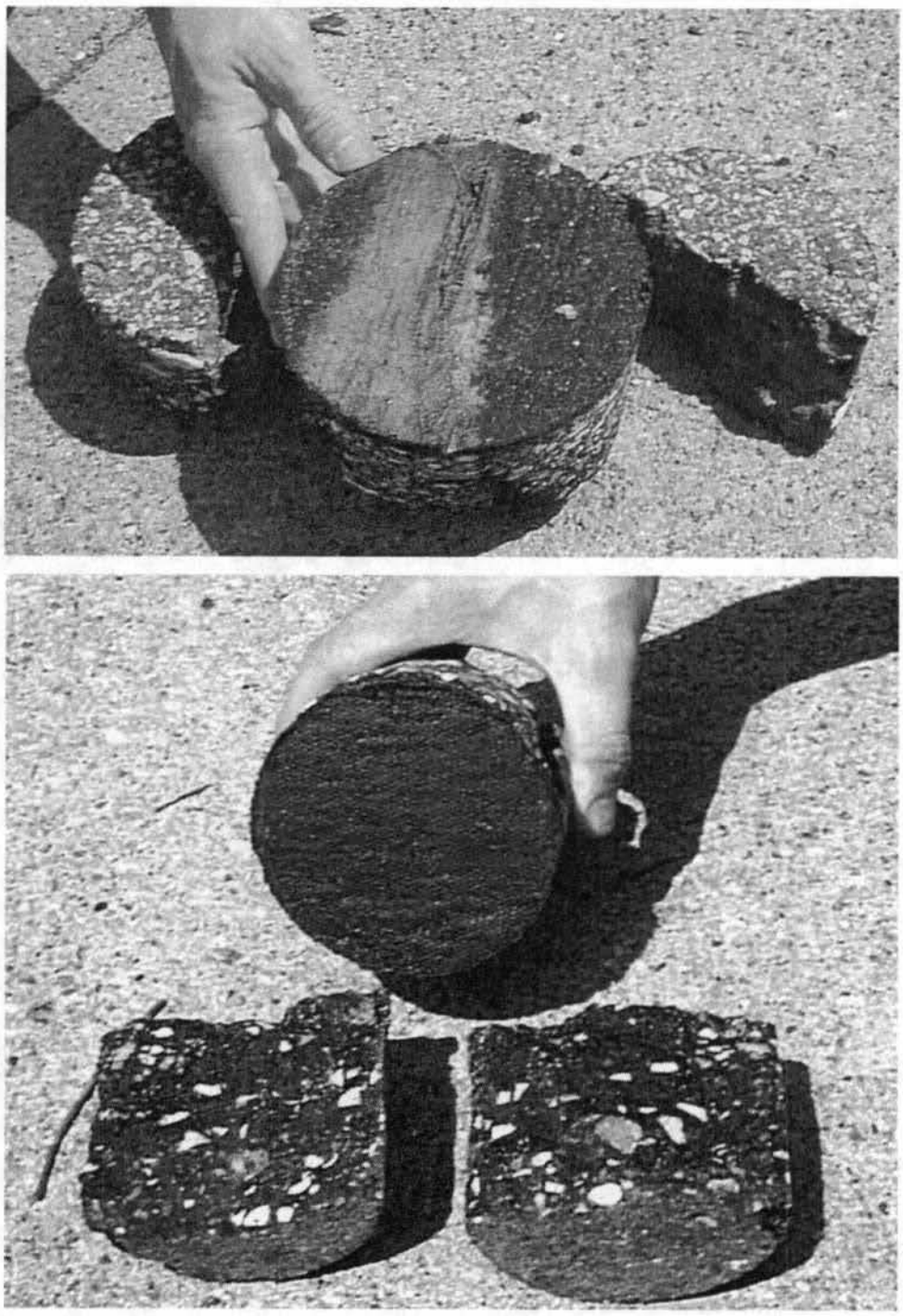
These photographs show the placement of PavePrep fabrics. Note that this fabric is self-adhesive so there is no tack coat underneath.



Placement of ProGuard fabric prior to spreading sand on exposed tack coat.



This is an average core showing all of the history of the pavements on this road. The bottom section is the lean mix with lots of fines. Notice the amount of material that has been lost due to raveling leaving a void. Above that is a section from the 1970 overlay which is also showing some loss of material. There follows a thinner section which is a combination of seal coat, tack coats and fabric. At the top is the three inch overlay from this research project.



These photographs are representative of the condition of the fabric from most of the cores removed from this project. Note that there was very little bond between the top two pieces and the remainder of the core. The lighter area on the top photograph is water staining. Also the fabric is in an oval shape with the long axis perpendicular to the crack and accordian-like wrinkles parallel to the crack (mostly visible in the top photograph). Most of the samples had limited distress in the top layer of fabric and were completely separated in the bottom layer and mastic layers.