GEOTEXTILE STRIPS
AS A
REFLECTIVE CRACK TREATMENT FOR AC OVER AC

Experimental Feature
Final Report
OR 88-03

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ABSTRACT

This report covers an experimental feature where a geotextile fabric was used in an attempt to retard reflective cracking over severe thermal cracks. The application evaluated here is different from previous geotextile use in Oregon. It is the first time that narrow strips of fabric have been used instead of continuous full-width fabrics. The cracks were covered with 24-inch wide strips of nonwoven geotextile fabric and then overlaid with 2-1/4 inches of dense graded polymer modified asphalt concrete.

One year after the overlay was constructed, many of the cracks have reflected through. There is no apparent difference in performance between the test section where geotextiles were placed and the control section where the cracks were left untreated.

ACKNOWLEDGEMENT

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TABLE OF CONTENTS

1.0 INTRODUCTION

This study evaluates paving geotextile strips used on a paving project in Oregon constructed in 1988. This project is located approximately 24.7 miles northwest of Ontario, in Malheur County and covers a section of Interstate 84 between "Farewell Bend" and "The North Fork of Jacobson's Gulch". The purpose of this study is to evaluate the effectiveness of a nonwoven polypropylene fabric to retard reflective cracking. Strips of geotextiles were used instead of continuous material because the cracks were spaced at approximately 50 feet. This was too far apart to warrant the expense of continuous or full width geotextile coverage. The use of 24-inch strips was relatively inexpensive ($2.00 per lineal foot) because the fabric was placed only where needed.

2.0 PAVEMENT AND TEST SECTION DESIGN

2.1 Pavement Design:

The pavement design summarized below was used throughout the 14.9-mile section of Interstate 84 that made up the 1988 paving project.

	Inside Lane	Outside Lane	Shoulder
"B" mix overlay (polymer mod.)	2-1/4"	2-1/4"	2-1/4"
fabric strips	on cracks	none	on cracks
"C" mix leveling	as needed	as needed	as needed
"B" mix inlay (polymer mod.)	none	2-1/2"	none
millout	none	2-1/2"	none

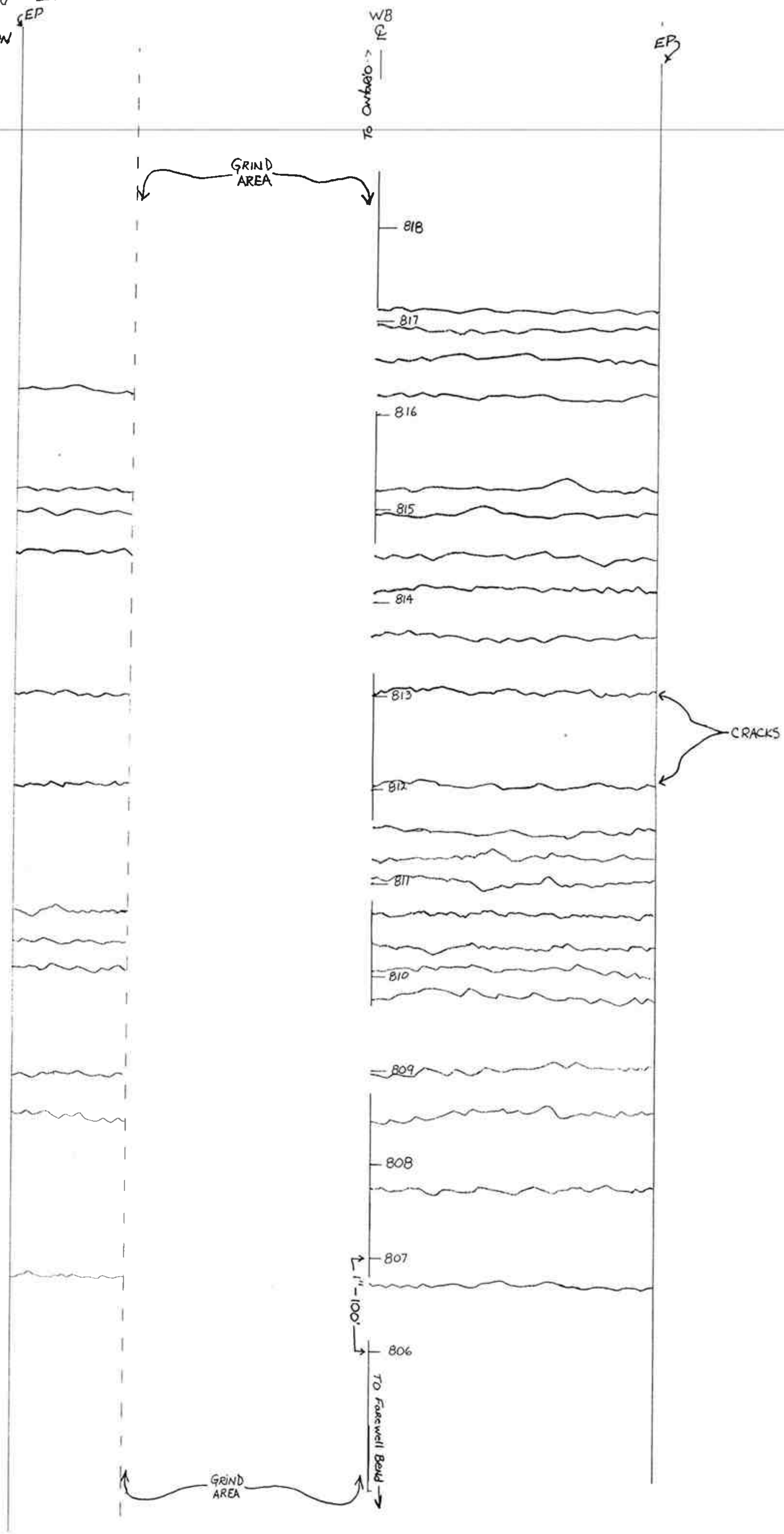
2.2 Test Section Design:

Prior to construction, two test sections were selected that were considered representative of the entire project. They were also selected to be comparable to each other in all factors that could affect the outcome of the evaluation. Section 1, the control, was constructed <u>without</u> geotextiles between Station 806 + 50 and Station 817 + 20. Section 2 was constructed <u>with</u> geotextile between Station 817 + 40 and Station 826 + 20. Both of these sections are in the westbound inside lane only. The crack maps in Figures 1 and 2 provide detailed information on the original pavement condition. Since the maps were made after the outside lane was milled out, the original condition of the outside lane is not shown. Because geotextiles were not placed in the milled out section, the missing information is not pertinent to this study.

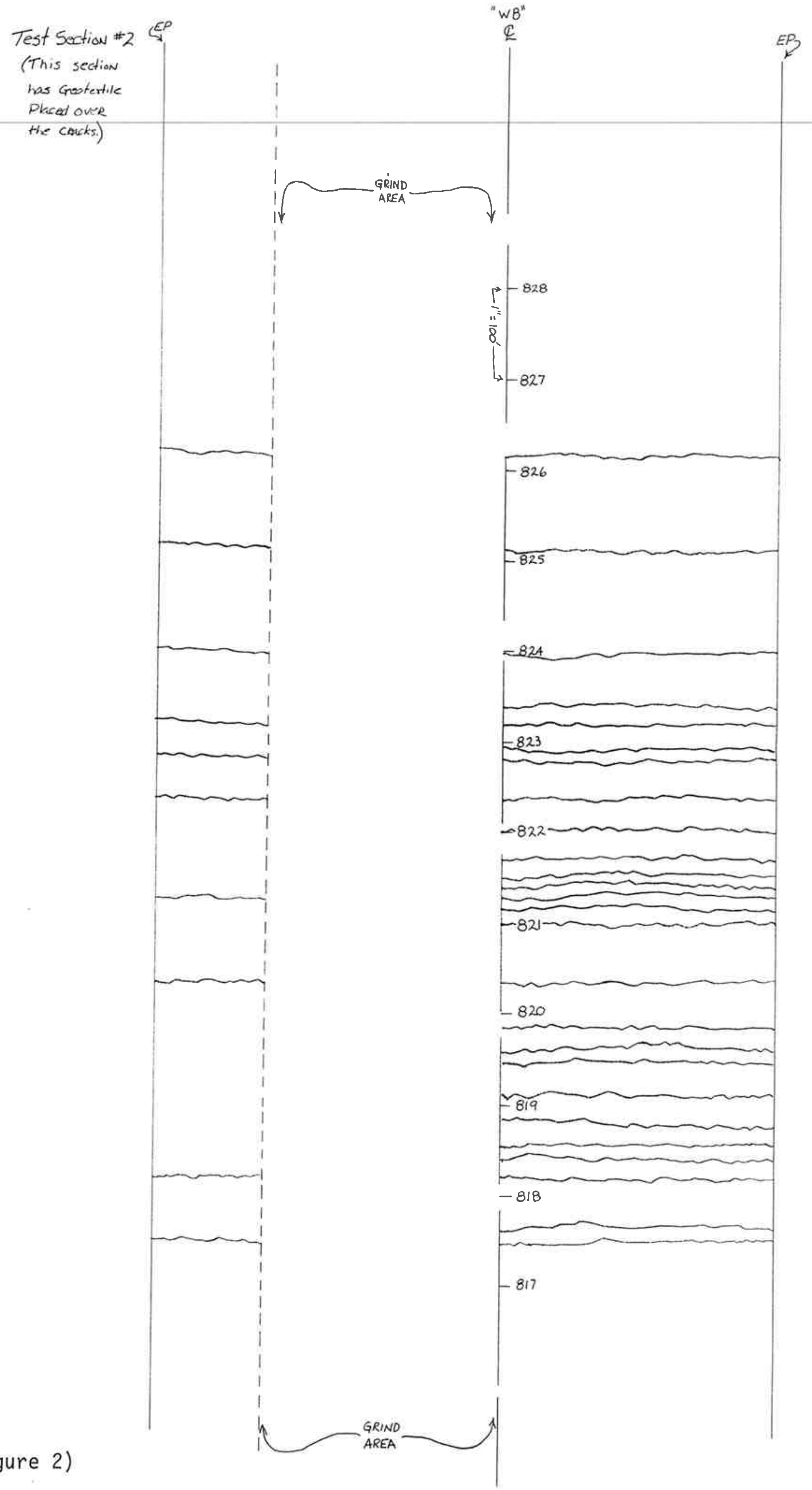
Both sections contained approximately the same lineal feet of cracks and are located on similar slopes to allow for the same amount of sun exposure. Hubs were used to monument a total of 23 cracks (508.2 ft.) in the control section and 26 cracks (537.4 ft.) in the section covered with geotextile.

Test Section #1

Control Section
(No Geotextile Placed in this section.)



(Figure 1)


Test Section #2
(This section has Geotextile Placed over the cracks.)
EP
"WB"
℄
EP
GRIND AREA
1" = 10'
828
827
826
825
824
823
822
821
820
819
818
817
GRIND AREA

(Figure 2)

3.0 SITE CONDITIONS

3.1 Traffic:

The ADT of 4300 consists of 37% heavy trucks. The projected 20 year traffic loading for this section was estimated at approximately 13.2 million ESALS. This section of Interstate 84 was originally constructed in 1955 and was upgraded to a four lane divided Interstate in 1974.

3.2 Pavement History:

The existing surface prior to this construction project was 14 years old. It consisted of two inches of asphalt wearing course and two inches of asphalt base course. Some patching had been placed. The base is 12 inches of plant mix bituminous base, over six inches of lime treated subgrade. Lime treatment was recommended because the soil type was classified as a silty clay with an R value of 7. Some of the sections constructed in 1974 were entirely new. While others were built over the existing alignment constructed in 1955. Both the test section and the control section in this study were in uniform areas constructed over new alignment.

Several different types of distress were observed prior the 1988 overlay. These include: shoving, raveling, rutting, transverse cracking and alligatoring cracking. The greatest problem was rutting in the outer wheel paths where rut depths ranged from 3/8" to 1/2".

Transverse cracking was also significant with crack widths up to 1/2". These cracks were spaced approximately between 30 and 100 feet apart throughout the project.

3.3 Environmental Conditions:

This region has low rainfall and extreme temperature differentials. The average rainfall is 10 inches, while the ambient air temperature can drop below 0 deg. F. in January and climb to 110 deg. in July. The terrain of this semi-arid rangeland is rolling hills covered with sage brush and rocks. The freeze thaw season runs from October through April.

4.0 CONSTRUCTION

All construction took place between April 19 and July 23 of 1988. Crack sealing occupied the first month and actual paving started on May 18.

4.1 Crack Sealing and Geotextile Placement:

In both test sections and in the early part of the project, cracks were sealed using liquid HFE-80 (SC) polymer modified emulsion (Elf Asphalt). In other parts of the project, other materials and techniques were tried. These materials and techniques are discussed in the Appendix as they do not pertain directly to geotextile performance.

Before crack sealing, the surface near the cracks was cleaned. Then a light primer was applied to promote adhesion of the geotextile. Placement of the geotextile in 24" wide strips was very labor intensive requiring abundant manpower to be efficient. The Contractor made it more efficient by constructing a dispenser to hold the roll of fabric. This allowed the material to be cut to length more easily.

4.2 Milling and Paving:

In May the outside lane of both the "control" and "test" sections were cold planned to a depth of 2 1/2". They were then inlaid with 2 1/2" of class "B" Polymer Modified AC Mix. In June the class "C" leveling course was laid where needed. This was followed by a 2 1/4" wearing surface of class "B" Polymer Modified AC Mix over the entire roadway. Definitions of these mix types can be found in appendix B.

During the paving operation only one problem was encountered that relates to geotextile use. The fabric strips would occasionally catch on the paver's ski. This would either roll the leading edge or pull up the entire strip. In general this was not a problem as the fabric adhered very well to the pavement.

4.3 Weather:

Temperatures during fabric laydown varied from 65 deg. F. in the mornings to 100 deg. F during the afternoons. There was no significant precipitation during construction.

4.4 Materials:

Geotextile fabrics from two different manufacturers were used in this project: Petrotac, and AMOCO CEF Style 4545. Only the AMOCO fabric was used in the test section. These materials are described in detail below.

PETROTAC is a combination of nonwoven polypropylene fabric precoated with rubberized asphalt protected by a release sheet to be removed at the time of installation. It serves as a waterproofing and stress relieving membrane. It is specially designed for placement over PCC joints and local areas of distressed bituminous pavement.

Manufacturer's Specifications for PETROTAC

Test Method	Manufacture Test Typical Value	Properties
ASTM D1777	75	Thickness, Mils
ASTM D1682	180	Grab Tensile, lbs
ASTM D1682	85	Elongation, %
ASTM D882	60	Strip Tensile, lbs/in
ASTM E154	200	Puncture resistance,lbs

AMOCO CEF 4545 is a polypropylene highly permeable nonwoven fabric. It is classified as a Soil Filtration Fabric but is the same fabric as AMOCO AmoPave 4599 minus the tack backing. The nonwoven fabrics help form a permanent, uniform moisture barrier.

Manufacturer's Specifications for AMOCO 4545

Test Method	Manufacture Test Typical Value	Properties
ASTM D4632	90	Grab Tensile, lbs
ASTM D4632	50	Grab Elongation, %
ASTM D3787	65	Puncture, lbs

5.0 COST

5.1 Geotextile:

The bid price for the geotextile material, including placement, was $2.00 per lineal foot. The total cost of geotextiles for the project was $25,935. This represents only approximately 3/4 of one percent of the overall construction cost for this $3.6 million project.

5.2 Crack Sealing:

The cost of crack sealing was initially estimated at $25,000 as allowed in the contract. A change order was necessary because the need for crack sealing was greater than anticipated. The total cost of crack sealing including temporary signing, equipment, materials and placement was $83,760. This is approximately 2.4 % of the total construction cost for this project.

6.0 EVALUATION

6.1 Field Survey:

A field inspection, of the two test sections, was made in June 1989 by ODOT Research personal. Detailed measurements were made of cracks observed at the monumented sites. Tables 1 and 2 compare the cracking prior to the overlay and the reflective cracking 1 year later. In the control section, 13 of the 23 cracks had reflected through. In the section where geotextile strips were placed, 18 of the 26 cracks had reflected through. In both sections most of the cracks extended across the road from shoulder to shoulder. No other type of distress was observed within these sections.

An analysis of this data indicates there is no difference in the performance between the two test sections. As the tables show, 66.7% linear feet of cracking reflected through in the control section. In the test section with geotextile strips, 66.6% linear feet of cracking reflected through.

Table 1

Field Evaluation
of
Pavement / With
Geotextile Strips (AMOCO CEF Style 4545)

Station WB	Linear Ft. Trans. Cracking Prior to Construction April 88	Linear Ft. Trans. Cracking After Construction June 89
817+47	29.3'	29.0'
817+61	16.2'	0.0'
818+21	27.5'	12.0'
818+38	16.6'	29.0'
818+54	16.2'	12.0'
818+84	15.8'	8.0'
819+11	16.2'	16.0'
819+47	16.0'	8.0'
819+58	16.0'	0.0'
819+84	16.2'	24.0'
820+44	27.6'	29.0'
821+00	12.6'	0.0'
821+13	13.0'	6.0'
821+28	28.7'	0.0'
821+38	16.2'	5.0'
821+50	16.0'	29.0'
821+70	16.4'	0.0'
822+00	17.0'	0.0'
822+34	28.4'	29.0'
822+80	25.6'	29.0'
822+95	17.0'	6.0'
823+19	29.5'	29.0'
823+38	18.0'	0.0'
823+99	29.2'	29.0'
825+12	27.0'	0.0'
826+14	29.2'	29.0'
Total	537.4 lin. ft.	358.0 lin. ft.

$$\frac{358.0 \text{ lin. ft.}}{537.4 \text{ lin. ft.}} = 66.6\ \%\ \text{of lin. feet came through}$$

$$\frac{18 \text{ cracks resurfaced}}{26 \text{ orig. cracks}} = 69\ \%\ \text{of the cracks came through}$$

Table 2

Field Evaluation
of
Pavement - With no Geotextile

Station WB	Linear Ft. Trans. Cracking Prior to Construction April 88	Linear Ft. Trans. Cracking After Construction June 89
806+73	26.6'	29.0'
807+75	16.0'	21.0'
808+45	27.0'	0.0'
808+98	27.6'	26.0'
809+74	16.0'	12.0'
810+06	29.0'	29.0'
810+36	26.4'	29.0'
810+69	27.0'	29.0'
811+05	16.0'	0.0'
811+27	17.0'	0.0'
811+60	16.0'	0.0'
812+03	28.4'	29.0'
813+02	27.5'	29.0'
813+64	16.0'	24.0'
814+10	16.0'	0.0'
814+50	16.0'	0.0'
814+61	27.7'	29.0'
814+95	28.4'	24.0'
815+21	27.8'	0.0'
816+22	27.8'	29.0'
816+60	16.0'	0.0'
816+98	16.0'	0.0'
817+12	16.0'	0.0'
Total	508.2 lin. ft.	339.0 lin. ft

$$\frac{339.0 \text{ lin. ft.}}{508.2 \text{ lin. ft.}} = 66.7\ \% \text{ lin. feet came through}$$

$$\frac{10 \text{ crack resurfaced}}{23 \text{ orig. cracks}} = 56\ \% \text{ of the cracks came through}$$

7.0 OTHER GEOTEXTILE STUDIES

In general geotextiles have not been found effective when placed directly over transverse cracks. The following studies are examples of this finding.

7.1 Oregon Studies:

An experimental feature study in Oregon [1] found that geotextiles did not, by themselves, retard reflective cracking when placed directly over expansion joints on PCC pavement. This study evaluated a project constructed in 1975 located on a four lane section of Interstate-5. Here, three materials intended to retard reflective cracking were evaluated. The materials were: Petromat, by Phillips Petroleum Company; Fabric I-1980, by Burlington Glass Fabrics Company; and Typar Style 3401, by DuPont Company. These were placed at various levels in the pavement structure and using different combinations of fabrics and bond breakers (see figure 3).

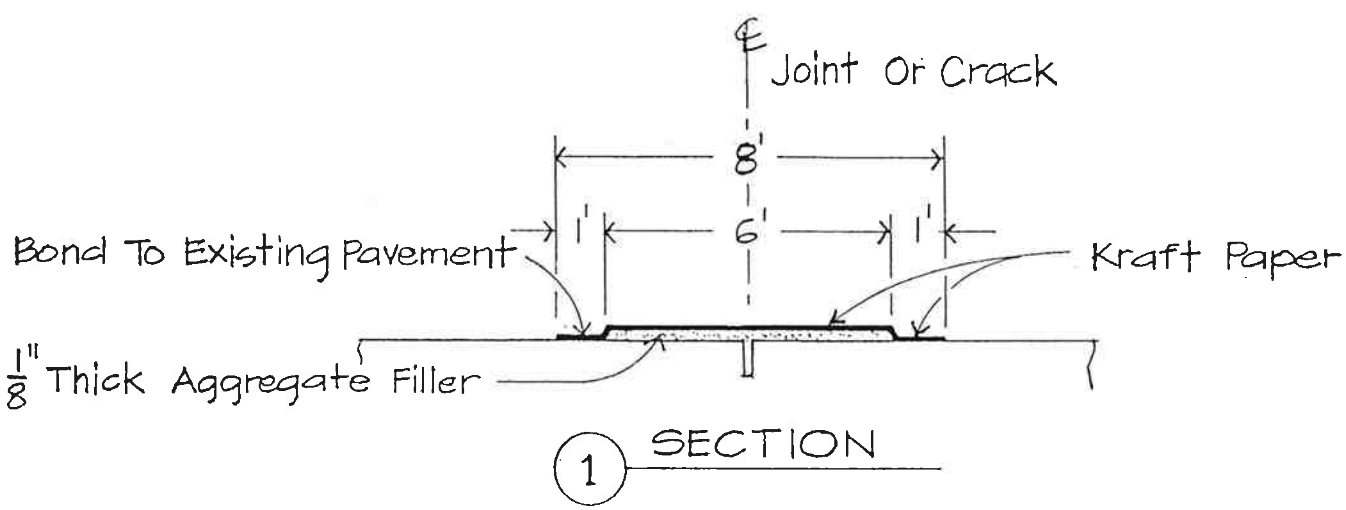


FIGURE 3: BOND BREAKER DETAILS

This project was constructed in three lifts of AC 3", 2", and 1" in thickness in order of placement. It was found that, where the fabrics were placed over a bond breaker, reflective cracking was delayed for at least six years. The fabrics that were placed directly over the PCC pavement without bond breakers did not appear to perform better than the control sections without fabrics. There appeared to be some benefit from fabrics alone when placed between the first and second lifts.

7.2 Arizona Study:

The state of Arizona reported in a recent "Research Note" that a test section constructed in August of 1988 with paving fabrics had started to show reflective cracking in December of 1988.[3] Three paving fabrics products were placed in strips over transverse cracks after milling out 2 inches of AC. These fabrics are: Paveprep, Glassgrid, and Tapecoat. A field evaluation, conducted in April of 1989, indicated that most of the cracks have reflected through.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations apply only to the conditions present in this test. The ability of paving fabrics to resist fatigue related cracking is not addressed.

Conclusion:

Light-weight non-woven geotextiles placed directly over cracks are not effective in retarding thermally caused reflective cracks. Although this study evaluated fabric strips, it is believed that neither continuous laydown nor wider strips would provide additional benefits.

Recommendation:

Paving geotextiles should not be used by themselves directly over severe transverse cracks when attempting to retard or prevent reflective cracking. Fabrics placed by themselves between lifts of AC may still be effective in some applications, as another study [1] has suggested this.

Conclusion:

Lightweight geotextiles by themselves cannot resist the force or stress concentration found in AC placed over thermal cracks.

Recommendation:

Future efforts to retard thermal reflective cracks should include a controlled experiment using "bond breakers" in combination with fabrics. Bond breakers are needed to reduce the concentration of thermal stresses. Various "bond breaker" designs should be tried in a severe environment.

REFERENCES

1. Douglas W. Bish and Keith Martin "Use Of Fabrics For Reflective Crack Control In Asphalt Concrete Overlays Aver PCC Jointed Pavements"

2. State Of Arizona report, AZ-198801 "Paving Fabrics for Reducing Reflective Cracking"

3. Research Note - Arizona Transportation Research Center, Fall 1989

APPENDIX A

CRACK SEALING

Crack sealing is somewhat incidental to the problem of geotextile fabrics. It is discussed here because crack sealers may have a bearing on the tendency for cracks to reflect through.

Various materials for sealing cracks were tried. Each material had its own particular problem. In both test sections and throughout the early part of the project, cracks were sealed using liquid HFE-80 (SC) polymer modified emulsion (Elf Asphalt). Later an attempt was made to fill the upper portion of large cracks with 1/4" -0 asphalt mix. The 1/4" -0 mix did not work well as it "bridged" the crack with this lift instead of penetrating the desired 2 inches. To avoid this problem a #10-0 sand/asphalt mix was then used to fill the large cracks. Filling the cracks with the HFE-80 (SC) proved undesirable. This material stayed liquid and would track badly by motorists. When the pavement was hot, the cracks would close up pushing the liquid to the surface. It was found that the high float emulsions and rubberized, Craftco-type sealers act much the same way. The material will expand from retained heat and cause a bump in the pavement.

APPENDIX B

Definitions of AC Mix Types

Asphalt Content and Proportion of Material for Hot Mixes

PERCENTAGES OF AGGREGATE BY WEIGHT
DENSE GRADED

SIEVE SIZE	"B"	"C"
1"	100	-
3/4"	95-100	100
1/2"	81-93	95-100
1/4"	52-72	52-80
No.10	21-41	21-46
No.40	8-24	8-25
No.200	2-7	3-8
Asphalt	4-8	4-8