

MLR 83 3

PERFORMANCE OF REINFORCEMENT FABRIC
USED
UNDER ASPHALTIC CONCRETE OVERLAYS

by
John Roland
Physical Tests Engineer

June 1983

Materials Laboratory
Iowa Department of Transportation

Floyd County FN-18-6(14)--21-34

Background

1. The contractor was Fred Carlson, Inc. of Decorah, Iowa.
2. The fabric area of the project is located on U.S. 18 approximately one mile east of Rudd, Iowa eastward to Station 300+00.
3. The fabric was placed in the month of June, 1979. The asphaltic concrete overlay was all two inches in thickness except for one 2500 foot section of three inch.
4. The fabrics used in the reinforcement areas were Petromat, a nonwoven polypropylene manufactured by Phillips Petroleum Company, and Bidim C-28, a nonwoven polyester manufactured by Monsanto Company. The Cerex (3.0 oz.) and Mirafi 140 as listed on the plans were not used. The Cerex fabric was not available, and the Mirafi 140 was not recommended for this application.
5. A total of 23,955 square yards of fabric reinforcement was placed.
6. The cost of the fabric was \$1.10 per square yard in place.
7. Four (4) 2500-foot sections of fabric reinforcement were placed full width of the pavement, separated by comparison control sections. In addition, a 2500-foot test section of 3" ACC was placed. The fabric was lapped one foot in the direction of traffic and one foot longitudinally between lanes of ACC paving.

Areas of Placement of Fabric Reinforcement,
Control Sections, and 3" ACC

<u>Station</u>	to	<u>Station</u>	<u>Type</u>
50+00		75+00	3" ACC
75+00		100+00	Petromat
100+00		125+00	Control
125+00		150+00	Bidim
150+00		175+00	Control

Areas of Placement of Fabric Reinforcement,
Control Sections, and 3" ACC

<u>Station</u>	to	<u>Station</u>	<u>Type</u>
225+00		248+00	Petromat
248+00		275+00	Control
275+00		300+00*	Bidim
300+00		325+00	Control

*Bidim was placed to Station 296+00 on right side of the pavement and to Station 300+00 on the left side.

8. A crack survey was made on the first 1000 feet of each section before the asphalt overlay was placed. Only the lineal footage of all cracks was recorded. A follow-up crack survey was made January 25, 1980, of the first 1000 feet of each section and another was made on November 5, 1980. These follow-up crack surveys show the development of cracks at an early age.
9. More extensive surface patching was done in the area of Station 50+00 to Station 110+00 than on the remainder of the sections.
10. The 1979 AADT was 3720 VPD with 19% trucks.
11. The test areas are over PCC pavement, which has been resurfaced with 3 to 6 inches of ACC and which is 22 feet in width.

On May 18, 1983, Robert Shelquist, Don Jordison and John Roland made a field examination of the test and control sections with the purpose of evaluating the performance of the fabrics as compared with each other and as compared with the control sections.

The evaluation determinations made are as follows:

1. The 3" ACC section (Sta. 50+00 - 75+00) has the least amount of reflection cracking of any of the sections. There were numerous transverse cracks but very little longitudinal or random cracking.
2. The section (Sta. 125+00 - 150+00) containing Bidim fabric reinforcement was in the worst condition in regard to the magnitude and severity of cracking. This section was judged to be worse than any other section including the control areas.
3. The Petromat section (Sta. 75+00 - 100+00) was judged to have slightly less cracking than the other areas including control sections.
4. The other fabric reinforced sections and control sections were rated the same in regard to the footage and severity of cracking.
5. It is not possible to identify the fabric treated areas from the control sections from visual observation while walking over the resurfacing on the project.
6. The fabrics do not decrease the longitudinal and diagonal cracking as was expected. Secondary transverse cracking was also evident in both the fabric reinforced and control sections.
7. It would be very difficult to justify the additional \$26,350 expended for the fabric reinforcement when comparing these sections with the control sections.
8. To quantify these visual observations, it is suggested that Operations Research conduct a follow-up crack survey on the first 1000 feet of each section as was done previously by the residency. This would involve 9 sections (9000 ft.) and would permit a calculation of the percentage of cracks reflected (after 4 years) of those present before the overlay was placed.

Crack Survey Before Overlaid

A crack survey was made in the first 1000 ft. of each section. Lineal footage of cracks are as follows:

Areas of Placement and Control Sections

<u>Station</u>	<u>to</u>	<u>Station</u>	<u>L.F. Crack</u>	<u>Type</u>
50+00		75+00	3796	3" A.C.C.
75+00		100+00	5328	Petromat
100+00		125+00	6331	Control
125+00		150+00	3951	Bidim
150+00		175+00	4581	Control
225+00		250+00	4954	Petromat
250+00		275+00	3930	Control
275+00		300+00	4243	Bidim
300+00		325+00	4000	Control

FABRIC REINFORCEMENT ON U.S. 18 EAST OF RUDD

A follow-up crack survey was made January 24, 1980, in the first 1000 feet of each section. Lineal footage of cracks are as follows:

Areas of Placement and Control Sections

<u>Station</u>	to	<u>Station</u>	<u>L.F. Crack</u>	<u>Type</u>
50+00		75+00	22	3" A.C.C.
75+00		100+00	22	Petromat
100+00		125+00	88	Control
125+00		150+00	198	Bidim
150+00		175+00	264	Control
225+00		250+00	55	Petromat
250+00		275+00	440	Control
275+00		300+00	0	Bidim
300+00		325+00	110	Control

FABRIC REINFORCEMENT ON U.S. 18 EAST OF RUDD

A crack survey was made November 5, 1980, in the first 1000 feet of each section. Lineal footage of cracks are as follows:

<u>Station</u>	to	<u>Station</u>	<u>Type</u>	<u>L.F. Crack</u>	<u>Change</u>
50+00		75+00	3" A.C.	84	+62
75+00		100+00	Petromat	93	+71
100+00		125+00	Control	155	+67
125+00		150+00	Bidim	423	+225
150+00		175+00	Control	480	+216
225+00		250+00	Petromat	201	+146
250+00		275+00	Control	525	+86
275+00		300+00	Bidim	135	+135
300+00		325+00	Control	165	+55

Dallas (Boone) Counties FN-89-1(4)--21-25

Dallas (Boone) Counties FN-89-1(4)--21-25

Background

1. The contractor was Iowa Road Builders
2. The fabric test area of the project is located on Iowa Highway 89 from south of Woodward, Iowa to the Boone County line (Station 1126+00 to Station 1202+48).
3. The fabric was placed in the fall of 1971. The asphaltic concrete overlay was 3 inches in thickness in all sections.
4. The fabrics used in the reinforcement areas were Petromat, a nonwoven polypropylene manufactured by Phillips Petroleum Company, Structofors, a polyester fiber mesh fabric manufactured in Holland and distributed by American ENKA Corporation of Enka, N.C., and Cerex a spunbonded nylon manufactured by Monsanto Chemical Company. Petromat is the only fabric of the three that is currently approved and used for asphaltic concrete reinforcement.
5. The total plan quantity of reinforcement fabric was 4241 square yards.
6. The fabric costs for this project were as follows:
 - a. Structofors -\$1.25 per square yard
 - b. Petromat - \$0.46 " " "
 - c. Cerex- \$0.479 " " "
7. Two sections of each fabric were placed full width of the pavement (one section of each in rural and urban areas). Each section with fabric was separated by a comparison control section of various lengths.

Areas of Placement of Fabric Reinforcement
and Control Sections

	<u>Station</u>	<u>to</u>	<u>Station</u>	<u>Type</u>	<u>Lineal Feet</u>
Rural	1126+00		1128+00	Control	200
"	1128+00		1130+00	Structofors	200
"	1130+00		1140+00	Control	1000
"	1140+00		1143+00	Petromat	300
"	1143+00		1153+59	Control	1059
Urban	1153+59		1155+75	Structofors	216
"	1155+75		1159+25	Control	350
"	1159+25		1162+50	Cerex	325
"	1162+50		1167+50	Control	500
"	1167+50		1170+75	Petromat	325
"	1170+75		1174+92	Control	417
"	1174+92		1186+50	Business Area (Not in Test)	
Rural	1186+50		1189+25	Cerex	275
"	1189+25		1202+00	Control	1275

Total in Project

Petromat	6+25	Stations
Cerex	6+00	"
Structofors	4+16	"
Control	<u>48+01</u>	"
Total	64+42	"

8. All cracks in the existing pavement were cleaned and filled with asphalt mix.
9. The Cerex was placed with a 3-inch lap, the Petromat with a 4-inch lap, and the Structofors with a 7-inch lap.
10. The original highway in the rural area was Portland Cement Concrete 20 feet wide. It was widened by adding two feet of asphaltic concrete, 10 inches deep, on each side prior to resurfacing.

Evaluation

1. To evaluate the effectiveness of fabrics for the prevention of reflection cracking, a crack survey was performed on the existing Portland Cement Concrete before the overlay was placed. Annual crack surveys of the asphaltic concrete overlay were conducted for five years.
2. The results of the reflection cracking that occurred during the first five years are shown in the HR-158 final report (May 1977). The percentages of reflected cracking are also shown on the following tabulation:

Rural Transverse Cracking
% Reflected

Time(Years)	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
12	90.0	65.0	93.0	74.0

Urban - Total Cracking
% Reflected

Time (Years)	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
12	89.0	78.0	83.0	79.0

3. In May 1983 (nearly 12 years after the resurfacing was placed) a follow-up crack survey was made. The percent of reflected cracks at this age is also shown on the tabulation.
4. Comparing the Petromat sections with the control sections (Petromat is the only one of the three fabrics currently approved and used), it is apparent that the fabric treated sections contain approximately the same percentages of reflected cracking as the non-fabric reinforced areas. The percentages for the other two fabrics are somewhat less.
5. The reflection cracking progressed at a much slower rate in the fabric areas during the first five years than in the control areas, but it caught up in the 5-12 year interval.
6. If the slower progression of reflected cracks in the fabric areas would result in sufficiently lower maintenance costs (during the first 12 years) to offset the costs of the fabrics, then their use is cost effective.
7. The value of the Petromat in the structure from this age on would appear to be negligible unless some cracks develop without breaking the fabric. Then a barrier to surface moisture intrusion into the subgrade is an added advantage of the fabric.

8. The progression of reflected cracks on the Floyd County project is much more rapid than on this project. This is at least partially due to the difference in the overlay thickness (2 inches against 3 inches).

Hamilton County DP-17-3(25)--36-40

Background

1. The contractor was Cessford Construction Company.
2. The fabric test area involved the entire length of the project which is located on Iowa Highway 17 from the west junction of US 20 to just north of the Wright County line.
3. The widening, fabric placement, and overlay were completed in July, 1981. The asphaltic concrete overlay was 1½ inches at the edges and 2 inches at the centerline of Type B binder course, and 1½ inches of Type B surface course.
4. The fabrics used in the reinforcement areas were Petromat manufactured by Phillips Petroleum Company, and Reepav 376 and 323 manufactured by Dupont Company.
5. The total plan quantity of reinforcement fabric was 52,500 lineal feet with a width of 3 feet.
6. The contract cost of the fabric in place was 50 cents per lineal foot.
7. The only use of fabric on the project was a three foot wide strip for reinforcement, placed over each widening joint from Station 7+69.5 (beginning of the project) to Station 271+50. From Station 271+50 to E.O.P., no fabric reinforcement was placed and this area is used as a comparison control section.
8. Petromat fabric was used exclusively on this project except that Dupont Reepav 376 (3.4 ounces) was used on the right side from Station 194+55 to 206+50, and Dupont Reepav 323 (4 ounces) was used on the right side from Station 206+50 to 218+50.

9. The original highway was Portland Cement Concrete, 20 feet wide, and which had been previously resurfaced with a.c.c. It was widened as a part of this project by adding two feet of asphaltic concrete, 8 inches deep on each side, prior to resurfacing.
10. The 1980 AADT was 1060 V.P.D. with 20 percent trucks.

Evaluation

1. On May 18, 1983, Robert Shelquist, Don Jordison and John Roland made a field examination of the test and control sections with the purpose of evaluating the performance of the fabrics as compared with each other and as compared with the control section.
2. Since the asphaltic concrete was reinforced with fabric only over the widening joint, this area was closely examined for reflected cracking. In the fabric reinforced area, not a single foot of reflected crack was detected over the widening joint.
3. The control section at the north end of the project is approximately a mile long and it too had no reflection cracking over the widening joint. In this section, a few cracks (6 to 8 inches in length) were observed radiating from transverse cracks over the widening joint. This cracking (which amounted to less than a total of 10 feet) was judged to be insignificant in comparing the fabric treated area with the control section.
4. The twelve stations each of Dupont Reepav 376 and 323 also exhibited no reflection cracking over the widening joint.
5. It is apparent that two years is not sufficient time for an evaluation of the fabric performance on this project.
6. It is interesting to note that the transverse cracks continued uninterrupted through the three feet of fabric on each side. The thermal stresses, causing

perhaps most of the transverse reflected cracking, are tremendous in magnitude and cannot reasonably be expected to be contained by the use of fabric. The use of steel mesh reinforcement in asphaltic concrete, when used by the Iowa Highway Commission over two decades ago, failed to prevent the thermal stresses from causing reflected cracking.

7. A continuing evaluation of this project should prove to be both interesting and informative. If fabric reinforcement is to be practical and/or cost effective, then it must perform on a project such as this one where longitudinal reflection cracking is measured, rather than the thermal induced transverse cracking.

Clark County I-IR-35-2(157)33--14-20

Background

1. The contractor was Des Moines Asphalt and Paving Company.
2. The fabric reinforced area is on I-35 under the U.S. Highway 34 overpass from Station 8+75 on the southbound lanes and Station 9+07 on the northbound lanes, north to Station 17+25.
3. The fabric and overlay in this area were placed in the month of June, 1979. The asphaltic concrete overlay is 4 inches of Type B binder and 1-1/2 inches of Type A surface.
4. The fabric used in the reinforced area was Petromat manufactured by Phillips Petroleum Company.
5. The total plan quantity of reinforcement fabric was 3939 square yards, which was not adequate for the intended use. A total of 8248 square yards was actually used.
6. The contract cost of the fabric in-place was \$2.00 per square yard.
7. The existing pavement was removed from shoulder to shoulder (outside edges) to a depth of 6 inches from Station 8+00 to Station 17+00; with transition areas at both ends. The fabric was placed full width (40-42 feet plus tapers at the ramps) between the two-inch layers of the Type B binder course. The fabric was used in the entire area that had 6-inch pavement removal, so there were no control areas for comparison purposes on this project.
8. The existing highway structure consisted of 4 inches of granular subbase, 14 inches of rolled stone base, original 4-1/2 inches of Type A, previously added 4 inches of Type A leveling, and it was previously resurfaced with a 3-inch Type A surface and binder course.
9. The 1979 AADT was 6990 VPD with 20% trucks.

Evaluation

1. On May 27, 1983, Robert Shelquist and John Roland made a field examination of the fabric reinforced area of this project with the purpose of evaluating the performance of the fabric in reducing reflection cracking.
2. A fabric project such as this one is of limited value for evaluating fabric performance since there is no control section. No comparisons could be made between fabrics (only Petromat was used) and between fabric treated and untreated sections (no control areas).
3. Also, it is not possible to determine if the fabric reduced or delayed reflection cracking. It definitely did not prevent reflection cracking.
4. Compared to the roadway immediately north of the fabric area, which had been cold milled and recycled at the same time (1979) as the fabric was placed, the fabric reinforced area appears to have less rutting and cracking. However, reasons other than the use of fabric undoubtedly contributed to this better surface condition.
5. Numerous transverse cracks and some rutting were observed in the southbound lanes and shoulders but little random or longitudinal cracking was evident. The magnitude and severity of the cracking and rutting in the northbound lanes was very much greater.
6. Two probable causes for the considerably more distressed conditions in the northbound lanes are:
 - a. A natural waterway parallel to the north bridge comes from the east and discharges along the shoulder of the roadway. This area is very wet with cattails growing in the waterway and along the east side of the northbound lanes. This undoubtedly weakened the subbase and rolled stone base more in the northbound lanes causing the greater distress. No fabric can be expected to compensate for this condition.

- b. The northbound lanes go up an incline in this area, whereas the southbound lanes go down. The stresses from the added acceleration may have also contributed to the more severe deterioration of the northbound lanes.
7. An area perhaps 50 feet long under each overpass is in relatively good condition and the reasons for this cannot be explained.
 8. The removal of 6 inches of original surface and the replacement of it with ACC should have resulted in a better four-year service record (with or without fabric) if the underlying components of the structure functioned properly. The use of fabrics under asphalt overlays to compensate for the structural inadequacy is not practical.
 9. The fabric section has been tested with the Road Rater for several years and these tests will verify that the structural rating is lower on the northbound lanes.
 10. The use of fabric as a "cure all" for all types of overlay cracking, or assigning a structural equivalency (in terms of ACC thickness) to fabric in all applications is not realistic.
 11. The northbound lanes would probably be in the same condition today with or without fabric. Its value in the southbound lanes is questionable.
 12. The fabric had little chance of beneficial effect on this project.

Polk County I-IR-35-4(37)88--14-77

Background

1. The contractor was Iowa Road Builders.
2. The fabric reinforced area is on the mainline of I-80 at the north interchange of I-35, I-235, and I-80. The stationing on the eastbound lanes is from 1057+50 to 1130+62 and on the westbound lanes from 1060+00 to 1106+00.
3. The fabric and overlay in this area were placed in September and October, 1979. The asphalt concrete overlay is 1-1/2 inches of Type A binder course and 1-1/2 inches of Type A surface course on the mainline and ramps. The shoulders were built up with an extra inch of Type A binder in addition to the 3 inches used on the mainline.
4. The fabric used in the reinforced areas was Petromat, manufactured by Phillips Petroleum Company.
5. The total plan quantity of reinforcement fabric was 1989 square yards, and the total used was 2241 square yards.
6. The contract cost of the fabric in-place was \$3.62 per square yard.
7. The only use of fabric on the project was in 5-foot wide strips placed over longitudinal cracks at 22 locations on the eastbound lanes and at 10 locations on the westbound lanes. The cracks varied in length from 12 to 600 feet.
8. The existing highway structure consisted of portland cement concrete under the traffic lanes, and 7 inches of rolled stone with one inch of asphalt concrete surface on the shoulders.
9. The 1979 AADT was 25,900 VPD with 20% trucks.

Evaluation

1. On May 27, 1983, Robert Shelquist and John Roland made a field examination of the fabric reinforced areas of this project with the purpose of evaluating the percentage of longitudinal reflective cracking that has occurred in the past four years in the reinforced areas.
2. Since it was not possible to locate the fabric reinforced areas without accurate stationing, the construction residency measured and painted the stations on the shoulder.
3. The locations of the longitudinal cracks covered with fabric were by stationing only. They were not tied in with the centerline or the edges of the pavement. We had hoped that the longitudinal cracking would be so insignificant that an evaluation could still be made, or if a longitudinal crack occurred in this area defined by the stationing, that it could be identified as a fabric treated area.
4. A walk-over examination of the project showed that we could not identify the fabric reinforced cracks. Generally two or three longitudinal cracks were found in the area of the reinforced crack as defined by the stationing. It was not possible to choose which of the longitudinal cracks was a reflection of the reinforced one.
5. Since guessing at which crack to measure would be meaningless and erroneous, no percentage of reflected cracks could be made.
6. An evaluation of fabrics used in this manner requires that the areas of the reinforcement be defined in the transverse as well as the longitudinal directions.
7. The traffic conditions make this location a poor choice for an investigational project. Even if the areas had been properly defined, traffic control would have been necessary to make the required evaluation.

FABRIC REINFORCEMENT

Station to	Station	Lane	Width	Lin. Ft.
1057+50	1058+50	EBL	5'	100'
1058+75	1059+75	"	5'	100'
1071+50	1072+15	"	5'	65'
1074+00	1074+75	"	5'	75'
1075+75	1077+25	"	5'	50'
1077+42	1077+61	"	5'	19.0'
1079+11	1079+35	"	5'	24.0'
1081+38	1081+77	"	5	39.0'
1081+75	1082+50	"	10	75'
1082+46	1082+58	"	5	12.0'
1085+20	1087+00	"	5	180'
1093+85	1096+00	"	5	225'
1096+16	1096+46	"	5	30.0
1097+00	1098+00	"	5	100
1101+50	1102+00	"	5'	50
1103+20	1103+70	"	5'	50
1106+75	1107+80	"	5	105
1108+00	1108+70	"	5	70
1113+75	1113+25	"	5'	50
1129+35	1129+55	"	5	20.0
1129+86	1130+05	"	5	19.0
1130+43	1130+62	"	5	19.0

FABRIC REINFORCEMENT

Station to Station	Lane	Width	Lin. Ft.
1060+00 1060+25	WBL	5	25
1061+00 1062+50	"	5	150
1070+50 1071+00	"	5	50
1071+75 1074+50	"	5	275
1079+00 1080+00	"	5	100
1087+00 1093+00	"	5	600
1093+20 1096+00	"	5	280
1098+00 1101+00	"	5	300
1103+00 1105+50	"	5	250
1105+50 1106+00	"	5	50

Summary and Conclusions

Summary

Floyd County FN-18-6(14)--21-34

Four years after the fabric and overlays were placed a field evaluation was made to determine the performance of the fabric reinforced sections in reducing or delaying reflection cracking. From visual observations, it was judged that the fabric treated sections have as much reflection cracking as the control sections. The fabrics did not decrease the longitudinal, diagonal or random cracking as compared with the non-fabric areas. Any delay in the appearance of reflection cracking, as shown in the crack surveys made at 7 and 17 months after placement, was very temporary. The 2500-foot section of three-inch overlay without fabric was judged to be considerably better than any of the other two-inch overlays (with or without fabric).

Dallas (Boone) Counties FN-89-1(4)--21-25

The use of fabrics on this project for the reduction or delay in reflection cracking was incorporated in a highway research project (HR-158). Better control was exercised on this project than perhaps any of the others. A complete crack survey was made before the fabric and overlay were placed and annually thereafter for the first five years and then again at 12 years (May 1983). The percentage of reflection cracking could thus be obtained and tabulated to check on its progression. Three fabrics were evaluated but only one is currently approved and used on highway projects in Iowa. All three fabrics showed a decrease in the percentage of reflected cracking for the first five years on both the rural and urban sections. The 12-year crack survey shows, however, that as much reflection cracking has now occurred on the Petromat section as on the control sections. When, in the time interval

of 5 to 12 years, this equalization took place was not determined. It is questionable whether the delay in reflection cracking at the earlier ages would make the use of the fabric cost effective.

Hamilton County DP-17-3(25)--36-40

This project utilized 10 miles of Petromat fabric, with a width of 3 feet, placed over only the widening joint. The project was completed only two years ago, which is not sufficient time to evaluate the effectiveness of the fabric in preventing reflection cracking over the widening joint. This is evident inasmuch as no widening cracks have reflected to the surface in either the control or fabric treated locations. Two of our currently approved fabric brands were used on this project. It will be interesting in the years ahead to watch the progression of reflection cracking over the fabric reinforced longitudinal widening joints as compared to the mile long control section on this project.

Clarke County I-IR-35-2(157)33--14-20

Very little information on the performance of the fabric in reducing or delaying reflection cracking could be obtained on this project since no control section was provided for comparison. However, it does not appear as though much benefit was obtained from use of the fabric, for reflection cracking still abounds especially in the northbound lanes. Pavement removal to a 6-inch depth and replacement with ACC and fabric did not solve the basic problem in this test area.

The longitudinal cracks (32) that were reinforced using fabric under the overlay were well defined as to starting and ending stationing, but they were not located transversely on the pavement. Longitudinal cracking is so prevalent that it is not possible to determine which is the one that had the fabric over it. No evaluation of the fabric performance could be made on this project.

Conclusions

The 1982 cost of a two-inch asphaltic concrete overlay, with fabric, was an average of 85% of the cost of a three-inch overlay (see attached calculations). A structural number can be assigned to the extra inch of overlay, whereas it is doubtful that any number can be assigned to the fabric.

The observations made on the projects in this report leave little reason to be optimistic on the use of fabrics under asphalt overlays. This is especially true of the Floyd, Dallas and Clarke county projects. A great amount of fabric is being used nationwide for this purpose, probably more from sales promotion than from actual documented performance. Full scale field testing is continuing each time a project is let utilizing fabric reinforcement under asphaltic concrete overlays. It has already become apparent that the use of fabrics in AC overlays is not always cost effective.

Cost of 2" w/Fabric VS 3" AC

From summary of contract prices - 1982 Book

Asphalt Cement - \$170 ton @ 120# per ton = \$10.20

Type B - \$13.68 ton

Fabric Rein. - 0.72 sq. yd.

1 " A.C. = 108 #

A. 2" Type B, A, C with fabric = \$3.30 sq. yd.

Type B = \$13.68

A.C. = 10.20

\$23.88 ton = .01194¢ per lb. x 216 # for 2" = \$2.58 A.C.
+ .72 Fabric

B. 3" Type B = \$3.87 sq. yd.

Type B = \$13.68

A.C. = 10.20

\$23.88 = .01194¢ per lb. x 324# for 3" = \$3.87

ADDENDUM

Pottawattamie County I-IR-29-4(19)59--14-78

Background

1. The contractor was Cessford Construction Company.
2. The fabric reinforced area is on I-29 from Council Bluffs northerly to Missouri Valley (Harrison County). Only Division 2 (Station 102+86 to Station 912+32) of this project was evaluated.
3. The fabric in this area was placed in the summer of 1977. The asphaltic concrete overlay is a 2 inch average thickness Type "A" asphaltic concrete binder course and a 1½ inch Type "A" asphaltic concrete surface course.
4. The fabric used in the reinforced area was Petromat manufactured by Phillips Petroleum Company. However, a small amount of Bidim fabric was placed for producer's information and at no cost to the D.O.T. (The Bidim fabric is no longer available).
5. The total plan quantity of reinforcement fabric for Division 2 was 4,150 lineal feet. A total of 5,443 lineal feet of fabric was actually placed in Division 2.
6. The contract cost of the fabric in-place was \$1.10 per lineal foot.
7. The only use of fabric in Divison 2 of the project was in 4-foot wide strips placed over longitudinal cracks and over the joint between the mainline edge and ramp taper. The longitudinal cracks varied in length from 13 feet to several hundred lineal feet.
8. The existing highway was P.C.C. in the traffic lanes.
9. The 1977 AADT was 9,960 V.P.D. with 20 percent trucks.

Evaluation

1. On June 7-9, 1983, Richard Smith made a field examination of the fabric reinforced areas of this project with the purpose of determining the lineal footage of reflection cracking that had occurred in the six years since the fabric was placed.
2. The stationing of the fabric reinforced longitudinal cracks was provided by the Council Bluffs Construction Residency. The transverse positioning of the cracks on the roadway was also furnished by the residency. No fabric was used to cover the center-line joint.
3. The lengths of the reflected cracks matching the fabric reinforced ones were measured.
4. Some of the reinforced cracks could not be positively identified so they were omitted from the evaluation. A total of 4,079 lineal feet of fabric reinforced cracks was evaluated or 75 percent of the total fabric footage in Division 2.
5. A total of 946 lineal feet of reflection cracks was measured or 25.5 percent of the 3,708 lineal feet of reinforced cracks evaluated. In addition, 371 lineal feet of fabric were used to cover the joint between the mainline edge and the ramp on a ramp modification at station 578+84 to 582+53. The reflected cracks in this area was 333 lineal feet.
6. The performance of the fabric on this project in holding reflection cracking to 25.5 percent over a six year period seems very promising. An average overlay thickness of 3½ inches of Type "A" asphaltic concrete may be a factor in this performance. There is no way to determine what the percentage of reflective cracking would have been if no fabric had been used.

7. Most primary projects that require fabric reinforcement have been made as a 3 to 4 foot wide strip placed over longitudinal joints or cracks. This would appear to be the most effective use of fabrics. However, when no control sections are provided for comparison purposes, it is difficult to evaluate just what the fabric has accomplished. Application of the fabric over the widening joints seems to be the most effective means of evaluating the performance of the fabric in reducing or delaying reflection cracking. Then with one or more control sections provided (for comparison purposes) within the fabric treated areas, an accurate evaluation can be made. This should include a percentage of reflection crack footage that has occurred, at a given age, when compared to the no-fabric areas.

8. The use of fabrics full width under asphalt overlays would rarely, if ever, be cost effective. Fabrics will not prevent, reduce, or delay cracking induced by thermal strains. The use of fabrics to bridge distressed areas is very questionable. To reduce or delay reflection cracking over longitudinal cracks or widening joints would seem at this time to be the best bet for effective fabric use.

Division 2

102+86.10 to 912+31.96

<u>Northbound</u>	<u>L.F.</u>
107+40 to 107+71	31.5
111+25 to 111+94	90.5
112+15 to 112+40	24.5
124+76 to 125+45	64.0
132+43 to 133+24	73.0
177.05 to 177+50	65.3
180+15 to 180+70	71.5
180+90 to 181+35	45.9
204+10 to 204+27	26.9
204+70 to 205+10	56.0
210+75 to 211+25	136.4
214+20 to 217+00	67.3
220+53 to 221+20	78.4
223+95 to 224+70	51.5
229+25 to 229+80	57.5
228+75 to 229+00	29.0
230+45 to 230+77	33.7
231+57 to 232+32	81.0
236+20 to 237+69	145.0
244+54 to 245+28	73.0
246+05 to 246+57	53.7
249+12 to 249+70	59.0
250+35 to 252+00	161.7
320+95 to 321+65	71.5
385+06 to 385+46	40.5
412+40 to 413+06	70.5

Division 2

102+86.10 to 912+31.96

<u>Northbound</u>	<u>L.F.</u>
107+40 to 107+71	31.5
111+25 to 111+94	90.5
112+15 to 112+40	24.5
124+76 to 125+45	64.0
132+43 to 133+24	73.0
177.05 to 177+50	65.3
180+15 to 180+70	71.5
180+90 to 181+35	45.9
204+10 to 204+27	26.9
204+70 to 205+10	56.0
210+75 to 211+25	136.4
214+20 to 217+00	67.3
220+53 to 221+20	78.4
223+95 to 224+70	51.5
229+25 to 229+80	57.5
228+75 to 229+00	29.0
230+45 to 230+77	33.7
231+57 to 232+32	81.0
236+20 to 237+69	145.0
244+54 to 245+28	73.0
246+05 to 246+57	53.7
249+12 to 249+70	59.0
250+35 to 252+00	161.7
320+95 to 321+65	71.5
385+06 to 385+46	40.5
412+40 to 413+06	70.5

Division 2 Continued

<u>Northbound</u>	<u>L.F.</u>
448+75 to 449+75	51.0
452+38 to 453+08	70.0
456+40 to 456+91	52.5
493+00 to 494+50	155.0
498+60 to 498+75	15.5
499+40 to 500+12	73.0
504+25 to 505+49	124.0
519+55 to 520+05	53.5
520+10 to 520+50	41.0
520+90 to 521+54	66.0
557+42 to 558+15	74.5
570+98 to 571+55	57.0
582+53 to 583+41	88.0
591+40 to 591+62	22.5
597+25 to 597+65	40.0
600+14 to 600+42	28.0
603+30 to 604+30	100.0
664+20 to 664+70	59.0
689+25 to 689+72	46.5

<u>Southbound</u>	<u>L.F.</u>
102+86 to 107+94	512.0
102+86 to 107+94	512.0
105+30 to 105+52	22.0
105+90 to 106+38	46.5
111+01 to 111+42	35.0
122+40 to 122+80	28.0
222+40 to 223+25	57.5
231+70 to 323+25	55.0
234+62 to 234+75	13.0
234+75 to 235+10	35.5
250+55 to 251+05	50.5
328+64	12
340+56 to 341+10	54.0
351+10 to 351+37	28.0
351+97 to 352+60	64.0
357+12	76.0
357+18 to 357+86	68.0
376+18 to 376+70	52.0
377+35 to 377+87	52.0
378+48 to 379+00	50.0
578+84 to 582+53	371.0
593+97 to 594+12	15.0
594+21 to 594+82	60.0
820+62 to 821+35	68.0
832+95 to 834+40	46.5
883+28 to 883+58	34.0

FABRIC REINFORCEMENT
1983 WORK

COUNTY	PROJECT NO.	LOCATION	QUANTITY	UNIT PRICE SQ. YD.	TOTAL COST	REMARKS
Lee	F-61-1(18)	U.S. 61 in Fort Madison	6,075	\$2.00	\$12,150.00	3' wide over longitudinal widening joint
Muscatine	FR-61-4(35)	U.S. 61	7,400	\$1.00	\$ 7,400.00	3' wide over longitudinal joints
Polk	FR-5-5(17)	Army Post Road in Des Moines	2,145	\$1.80	\$3,861.00	Strip fabric 3' wide
Polk	FN-65-4(40)	On U.S. 69 in Des Moines	2,222	\$1.80	\$ 3,999.60	Strip fabric 6' wide
Pott.	IR-80-1(138)5	At various locations on I-80 in Council Bluffs from Madison Ave. to I-680 Interchange	1,689	\$3.00	\$ 5,067.00	4' wide over longitudinal joints

FABRIC REINFORCEMENT
1982 WORK

COUNTY	PROJECT NO.	LOCATION	QUANTITY	UNIT PRICE SQ. YD.	TOTAL COST	REMARKS
Benton	SN-4825(3)	On Secondary Road E-44 from Ia. 21 east 5 miles	69,372	\$.47	\$32,604.84	Full width
Benton	SN-4742(1)	On Secondary Road V-42 from Keystone north approx. 9.3 miles to Sec. Rd. E-22	135,031	\$.47	\$63,464.57	Full width
Mills	FM65(3)	On Secondary Road L-55 from the Pott. Co. Line south approx. .3 mile to just north of Silver City	5,630	\$ 1.50	\$ 8,445.00	
Tama	SN-4706(4)	On Secondary Road V-18 from U.S. 30 near the S $\frac{1}{4}$ Cor. Sec. 29-83-13 north 1.7 miles into Vining	24,899	\$.98	\$24,400.04	Full width
Tama	SN-4873(3)	On Secondary Road E-49 from near the S $\frac{1}{4}$ Cor. SW $\frac{1}{4}$ Sec. 25-83-16 Westerly approx. 0.5 mile	533	\$ 1.38	\$ 735.54	
Tama	FM-86(4)	On Secondary Road E-27 in the City of Garwin over Deer Creek	800	\$ 1.20	\$ 960.00	
Story	SN-4749(1)	On Secondary Road E-18 from W.C.L. of McCallsburg east approx. 3.6 miles to near Jct. U.S. 65	approx.	\$ 1.75 installed		Strip application over joints - EWO Roadglas \$1.10 Material provided by County

FABRIC REINFORCEMENT
1982 WORK

COUNTY	PROJECT NO.	LOCATION	QUANTITY	UNIT PRICE SQ. YD.	TOTAL COST	REMARKS
Linn	I-380-6(149)281	On I-380 approx. 1 mile west of Center Point between East Blue Creek and West Blue Creek	1274 sq.yds.	\$ 1.80	\$2,293.20	Widening units
Linn	I-F-380-6(130)267	In City of Hiawatha on I-380 from just north of Emmons St. northwesterly to relocated Carpenter Rd.	484 sq.yds.	\$ 7.90	\$3,823.60	Widening units 700 In.ft. 1' wide Roadglas 700 In.ft. 2' wide Roadglas 751 In.ft. 3' wide Petromat
Lee	FN-61-1(38)	In City of Keokuk on U.S. 61 from Des Moines River bridge northerly to jct. U.S. 218	1117 sq.yds.	\$ 1.50	\$1,675.50	Widening Units 3' width
Polk	FN-5-5(6)	On Ia. 5 from west jct. Ia.28 west approx. 0.6 mile	1760 sq.yds.	\$ 1.80	\$3,168.00	Placed between strengthening course & binder course - full width
Scott	FFD-61-5(50)	In City of Davenport on U.S. 61, southbound, from 35th St. northerly to the I-80 interchange	3300 sq.yds.	\$10.25	\$33,825.00	3' Petromat 3' Reepay T-323 3' Trevira S 1120 2' Roadglas

FABRIC REINFORCEMENT
1981 WORK

COUNTY	PROJECT NO.	LOCATION	QUANTITY	PRICE	TOTAL COST	REMARKS
Hamilton	DP-F-17-3 (25)	On Iowa 17 from U.S. 20 North 6 miles	52,500 Lin.Ft.	.50/Ft. 3 Ft. wide	\$26,250	Placed in 3' wide strip over widening unit crack control section without fabric north 1 mile; A.C. widening and 3" over
Polk	FN-65-4 (20)	S.E. 14th St. near New Virg.	1,477 sq.yd.	2.25/ sq.yd.	\$ 3,323	Placed 6' wide fabric over longitudinal widening unit joint (P.C.) 3" overlay.
Polk	FN-5-5 (13)	S.W. 9th and Army Post Road Inters.	2,448 sq.yd.	2.25/ sq.yd.	\$ 5,508	Placed 6' wide fabric over longitudinal widening unit joint (P.C.) 3" overlay.
Henry	F-34-9 (36)	U.S. 34 and U.S. 218 intersection in Mt. Pleasant	7,567 sq.yd.	1.80/ sq.yd.	\$13,621	Placed 4' wide fabric over existing P.C. pavement widening joint prior to placing 2" overlay.
Cass	FR-71-3 (26)	U.S. 71 Atlantic to Montgomery Co. Line	3,467 sq.yd.	1.425/ sq.yd.	\$ 4,940	Placed 6' wide strips over distressed areas in asphalt paving. Increased quantity by 1000 sq.yds. Followed with thin lift and 2" overlay.
Montgomery	FR-71-2 (17)	Co. Line to U.S. 34	107 sq.yd.	1.425/ sq.yd.	\$ 152	Placed 6' wide strips over distressed areas in asphalt paving. Followed with thin lift and 2" overlay.
Jones	F-64-1 (13)	Wyoming to Monmouth	6,233 sq.yd.	1.75/ sq.yd.	\$10,908	Research Project added by EMO. Included 4 - 500' test sections placed full width of base. Two sections placed on subgrade, & 2 sections between first & second lifts ATB.
		Tack	1,100 gals.	0.96/ gal.	\$ 1,056	

FABRIC REINFORCEMENT
1982 WORK

<u>COUNTY</u>	<u>PROJECT NO.</u>	<u>LOCATION</u>	<u>QUANTITY</u>	<u>UNIT PRICE SQ. YD.</u>	<u>TOTAL COST</u>	<u>REMARKS</u>
Benton	SN-4825(3)	On Secondary Road E-44 from Ia. 21 east 5 miles	69,372	\$.47	\$32,604.84	Full width
Benton	SN-4742(1)	On Secondary Road V-42 from Keystone north approx. 9.3 miles to Sec. Rd. E-22	135,031	\$.47	\$63,464.57	Full width
Mills	FM65(3)	On Secondary Road L-55 from the Pott. Co. Line south approx. .3 mile to just north of Silver City	5,630	\$ 1.50	\$ 8,445.00	
Tama	SN-4706(4)	On Secondary Road V-18 from U.S. 30 near the S $\frac{1}{4}$ Cor. Sec. 29-83-13 north 1.7 miles into Vining	24,899	\$.98	\$24,400.04	Full width
Tama	SN-4873(3)	On Secondary Road E-49 from near the S $\frac{1}{4}$ Cor. SW $\frac{1}{4}$ Sec. 25-83-16 Westerly approx. 0.5 mile	533	\$ 1.38	\$ 735.54	
Tama	FM-86(4)	On Secondary Road E-27 in the City of Garwin over Deer Creek	800	\$ 1.20	\$ 960.00	
Story	SN-4749(1)	On Secondary Road E-18 from W.C.L. of McCallsburg east approx. 3.6 miles to near Jct. U.S. 65	approx.	\$ 1.75 installed		Strip application over joints - EWO Roadglas \$1.10 Material provided by County

FABRIC REINFORCEMENT
1982 WORK

<u>COUNTY</u>	<u>PROJECT NO.</u>	<u>LOCATION</u>	<u>QUANTITY</u>	<u>UNIT PRICE</u> <u>SQ. YD.</u>	<u>TOTAL COST</u>	<u>REMARKS</u>
Linn	I-380-6(149)281	On I-380 approx. 1 mile west of Center Point between East Blue Creek and West Blue Creek	1274 sq.yds.	\$ 1.80	\$2,293.20	Widening units
Linn	I-F-380-6(130)267	In City of Hiawatha on I-380 from just north of Emmons St. northwesterly to relocated Carpenter Rd.	484 sq.yds.	\$ 7.90	\$3,823.60	Widening units 700 ln.ft. 1' wide Roadglas 700 ln.ft. 2' wide Roadglas 751 ln.ft. 3' wide Petromat
Lee	FN-61-1(38)	In City of Keokuk on U.S. 61 from Des Moines River bridge northerly to jct. U.S. 218	1117 sq.yds.	\$ 1.50	\$1,675.50	Widening Units 3' width
Polk	FN-5-5(6)	On Ia. 5 from west jct. Ia.28 west approx. 0.6 mile	1760 sq.yds.	\$ 1.80	\$3,168.00	Placed between strengthening course & binder course - full width
Scott	FFD-61-5(50)	In City of Davenport on U.S. 61, southbound, from 35th St. northerly to the I-80 interchange	3300 sq.yds.	\$10.25	\$33,825.00	3' Petromat 3' Reepay T-323 3' Trevira S 1120 2' Roadglas

FABRIC REINFORCEMENT
1981 WORK

COUNTY	PROJECT NO.	LOCATION	QUANTITY	PRICE	TOTAL COST	REMARKS
Hamilton	DP-F-17-3 (25)	On Iowa 17 from U.S. 20 North 6 miles	52,500 Lin. Ft.	.50/Ft. 3 Ft. wide	\$26,250	Placed in 3' wide strip over widening unit crack Control section without fabric north 1 mile; A.C. widening and 3" over
Polk	FN-65-4 (20)	S.E. 14th St. near New Virg.	1,477 sq. yd.	2.25/ sq. yd.	\$ 3,323	Placed 6' wide fabric over longitudinal widening unit joint (P.C.) 3" overlay.
Polk	FN-5-5 (13)	S.W. 9th and Army Post Road Inters.	2,448 sq. yd.	2.25/ sq. yd.	\$ 5,508	Placed 6' wide fabric over longitudinal widening unit joint (P.C.) 3" overlay.
Henry	F-34-9 (36)	U.S. 34 and U.S. 218 intersection in Mt. Pleasant	7,567 sq. yd.	1.80/ sq. yd.	\$13,621	Placed 4' wide fabric over existing P.C. pavement widening joint prior to placing 2" overlay.
Cass	FR-71-3 (26)	U.S. 71 Atlantic to Montgomery Co. Line	3,467 sq. yd.	1.425/ sq. yd.	\$ 4,940	Placed 6' wide strips over distressed areas in asphalt paving. Increased quantity by 1000 sq. yds. Followed with thin lift and 2" overlay.
Montgomery	FR-71-2 (17)	Co. Line to U.S. 34	107 sq. yd.	1.425/ sq. yd.	\$ 152	Placed 6' wide strips over distressed areas in asphalt paving.
Jones	F-64-1 (13)	Wyoming to Monmouth	6,233 sq. yd.	1.75/ sq. yd.	\$10,908	Followed with thin lift and 2" overlay.
		Tack	1,100 gals.	0.96/ gal.	\$ 1,056	Research Project added by EWO. Included 4 - 500' test sections placed full width of base. Two sections placed on subgrade, & 2 sections between first & second lifts ATB.