Treatments for Reduction of Reflective Cracking of Asphalt Overlays On Jointed-Concrete Pavements in Georgia

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For the past 6 years, the Georgia Department of Transportation has placed emphasis on the rehabilitation of the concrete pavement sections of the Interstate system. Many of these sections were resurfaced with asphaltic concrete. One of the problems that had to be addressed was that of reflective cracking of the joints into the overlay. A research project began in 1976, which consisted of placing 16 asphalt overlay test sections with various treatments on an existing jointed-concrete pavement on I-85 north of Atlanta. The treatments consisted of two nonwoven fabrics and sections with strips of a waterproofing membrane. The treatments were repeated for each of three overlay thicknesses. The philosophy behind the experiment was that no treatment would completely stop reflective cracking, but it would provide a waterproofing barrier to prevent surface water from entering the pavement system and thereby cause pumping of the concrete pavement. The waterproofing membrane was included in the experiment for this purpose and was placed in strips over the joints and cracks while the fabrics were placed full width. In 1979, additional test sections were placed on I-85 south of Atlanta to evaluate three types of waterproofing membranes and a nonwoven fabric. The fabric material was placed in strips rather than full width in this experiment. Overlay thicknesses of 2 and 4 in. were placed over the test sections. The performance to date indicates that the treatments reduced the rate of reflective cracking for the 4- and 6-in.-thick overlay sections. Some improvement was also obtained with the 2-in. overlay section, and the best performance was obtained with the waterproofing membrane.

The solution to the problem of the reflection of cracks from the existing pavement into an asphaltic-concrete overlay has eluded researchers for many years. Even today, with the existence of new techniques and products such as asphalt rubber and geotextiles, reflective cracking will occur at some time in the life of the overlay.

The mere presence of cracks is not necessarily a detriment to the performance of a pavement. Only when water and repeated applications of heavy loads are added do substantial problems occur. The entrance of water through cracks can lead to loss of subgrade strength under the existing pavement and pumping of base material through the cracks.

Additional problems occur when an asphaltic-concrete surface is placed over a jointed-concrete pavement. The expansion and contraction movement of the joints causes a crack to occur in the overlay. Jointed-concrete pavements also have vertical movements at the joints that are induced by heavy loads. The presence of water and an erodible base causes pumping and a loss of slab support. The eventual result will be faulted joints and slab breakage. These distresses are transferred into the asphaltic-concrete overlay, which behaves as a rigid rather than a flexible pavement.

Treatments of the existing concrete pavement, such as breakage of the slab into smaller pieces and the placement of aggregate layers, have been tried. Fabrics and waterproofing membranes have also been used. Past practice has been to place thick asphaltic-concrete overlays to delay the occurrence of reflective cracks. Many concrete pavements are structurally adequate and will not require thick overlays from that standpoint. It would be economically advantageous if the same effect as a thick overlay could be achieved with the use of a treatment and a thinner overlay to retard reflective cracking. Perhaps even more important than a reduction in reflection cracking for any treatment would be the prevention of surface water from entering reflective cracks into the base courses and subgrades of the existing pavement systems.

EXPERIMENTAL SECTIONS IN GEORGIA

The Georgia Department of Transportation (DOT) has emphasized the rehabilitation of plain jointed-concrete pavement on the Interstate system during the past 7 years. Many of these sections have been resurfaced with asphaltic concrete. One problem that had to be addressed before starting this resurfacing program was the occurrence of reflective cracking of the portland cement concrete (PCC) pavement joints. The deterioration of the PCC pavements in Georgia was mainly caused by the combination of heavy loads, the infiltration of surface water into the base and subgrade through joints and cracks, and erodible base materials.

A research project began in 1976, which consisted of placing 16 asphaltic-concrete test sections with various treatments over existing plain jointed-concrete pavements on I-85 north of Atlanta. These treatments consisted of placing two fabrics, strips of a waterproofing membrane, and a layer of a coarse stone before resurfacing.

In 1979 additional test sections were placed on I-85 south of Atlanta to evaluate three types of waterproofing membranes and a nonwoven fabric. The fabric material was placed in strips rather than full width. Short asphalt pavement test sections that used fabrics and asphalt-rubber membranes were placed in 1976, but the emphasis in this paper is on the experimental sections placed over the PCC pavements.

DESCRIPTION OF TEST SECTIONS

I-85, Gwinnett County

The test section in Gwinnett County is located approximately 30 miles north of Atlanta on I-85. It carries 23,000 vehicles/day, with 31 percent heavy trucks. The original pavement is a 9-in.-thick plain jointed-concrete pavement that has 30-ft joint spacing and no load-transfer devices in the joint.

The existing pavement was faulted, where 29 percent of the joints had a difference in slab elevation at the joint of 0.25 in. or more and approximately 8 percent of the slabs were cracked. Before placing the asphaltic-concrete overlay, all slabs were test rolled for excessive movement; they were subsequently stabilized with a cement-lime-fly ash mix where needed. The major variables in the test section were three overlay thicknesses of 2, 4, and 6 in. and various treatments before placing the overlay. These treatments consisted of two nonwoven engineering fabrics, the placement of edge drains, and strips of a waterproofing membrane over all joints and cracks. The fabrics used were Petromat, which is a polypropylene material, and Mirafi 140, which consists of a combination of polypropylene fibers and a polypropylene fiber covered with nylon. The waterproofing membrane was heavy-duty Bituthene, which consisted of a self-adhesive rubberized asphalt with woven fabric reinforcement.

All test sections were repeated for each overlay thickness along with a control section. In addition, a special test section was placed that contained a 3.5-in.-thick Arkansas-type base layer, which was used with a 3.5-in.-thick asphaltic-concrete overlay. The length of the test sections was 1,320 ft for the control, edge drain, Arkansas base, and 4-oz Petromat sections, whereas the Mirafi 140 and waterproofing membrane sections were 660 ft long. The total project was 3.5 miles long, with short transition sections placed where a change in overlay thickness occurred.

I-85, Troup County

Additional test sections were placed in Troup County in 1979, primarily for the evaluation of additional waterproofing membrane materials. A heavier Petromat (8 oz) was also included in the experiment. The control section was Polyguard with 14 percent rubber content, which was used on the construction project as the standard treatment. Placement was also made of Polyguard with 9 percent rubber content, Bituthene, and Protecto-Wrap. All materials, including the Petromat, were placed in 12-in.-wide strips over joints and cracks for a distance of 600 ft/test section. The test sections were repeated for a 2-in.-thick asphaltic-concrete overlay and a 4-in.-thick overlay. The original pavement was a 9-in. undoweled plain jointed-concrete pavement that had 30-ft joint spacing. The construction project represented the first use of Polyguard for this application in Georgia and was selected by the contractor after it was determined that the product met Georgia DOT specifications.

CONSTRUCTION OF TEST SECTIONS: GWINNETT COUNTY

Fabrics

A leveling course of 70 lb/yd² of asphaltic concrete was placed over the entire test area before placement of the fabrics. A tack coat rate of 0.25 gal/yd² of AC-10 was used with the 4-oz Petromat and 0.18 gal/yd² of AC-10 was used with Mirafi 140.

Fabrics were placed by hand on this particular project. Special emphasis was placed on obtaining a wrinkle-free installation to prevent cracks in the overlay caused by wrinkles in the fabric. When wrinkles did occur, they were cut and the ends tacked down. The standard width of the Mirafi 140 was 14 ft 9 in., which allowed for a 2-ft lap onto the shoulder and a 9-in. lap at the centerline of the 12-ft-wide lanes. The Petromat was 13.5-ft wide, which allowed a 1-ft lap onto the shoulder and a 6-in. lap at the center of the roadway. The initial 2-in.-thick lift of the overlay was constructed immediately after the fabric had been placed. Traffic was maintained at all times in the adjacent lane while the material was being placed. No severe problems were encountered with the placement of the fabrics, with the exception of obtaining the required tack rate at all times.

Special attention needs to be given to the operation of the dump trucks; they should not be allowed to make sudden stops or starts or sharp turning movements on the fabrics. An additional caution had to be taken with the Mirafi 140 because the asphalt concrete (AC) tack on the truck tires tended to pick up the top fibers of this fabric. This problem was overcome by not allowing the trucks to park on the fabric before dumping into the asphalt spreader. One major construction drawback in placing the fabrics was the time and personnel required to place the material. This problem can easily be rectified through the use of placement equipment for the fabrics.

Only minor problems were encountered with the placement of the asphaltic-concrete overlay on the fabrics. Some slippage during rolling was observed where excessive tack coat was placed.

Waterproofing Membrane

The primary application for the waterproofing membrane is as a waterproofing barrier for bridge decks underneath an asphalt overlay. The use of this material on the roadway, therefore, was primarily intended to waterproof the joints and cracks in the concrete pavement. The membrane was placed in 18-in. strips over all transverse and longitudinal, centerline, and shoulder joints. The strips were placed directly on the concrete pavement after the application of a special primer provided by the manufacturer. Initial placement was extremely tedious because the material was 36 in. wide and had to be cut on the roadway and then placed by hand. In addition, the placement of the material for this application was new to the contractor, the state personnel, as well as the manufacturer, and problems in placement and proper use of manpower had to be worked out.

The membrane is self-adhesive, and once placed can only be removed with great difficulty. Traffic was allowed for 1 day on the test sections with the waterproofing membrane before placement of any overlay. The action of the traffic actually improved the installation by securely adhering the material to the pavement and molding it to the faulted joint contours. The leveling course was placed over the strips of membrane followed by the required overlay thickness. Some problems were encountered with shoving of the mix over the membrane in some places, especially when the roller stopped or started on the strips.

Arkansas Base Test Section

A special test section was constructed with an Arkansas base interlayer to prevent reflection cracking. The stone was mixed with 2 percent asphalt at a temperature of 200° to 225°F. Drainage of liquid asphalt from the mix was not a problem at this temperature.

No problems were encountered with placement of the material on the roadway leveling course that had been placed previously. Edge drains had also been installed previously in this test section. The material was placed with two asphalt spreaders working simultaneously in the travel lane and outside shoulder, because the Arkansas base layer extended over both shoulders as well as the roadway.

The Arkansas base course was compacted with only one pass of a 5-ton steel roller to set the stone. Rolling was done immediately behind the spreaders, and there was no excessive shoving in most cases. When shoving did occur, the mix was allowed to cool slightly before rolling. The basic function of the rolling operation was to key-in the stone, not to achieve any kind of compaction. After placement of the base course, 2.5 in. of asphaltic-concrete binder was placed with no apparent problems, although some minor pickup of stone by the asphalt trucks was noted. One possible construction drawback to using the Arkansas-type interlayer was the need for two asphalt plants because the material had to be covered with an asphalt mix before traffic could use the roadway.

In addition to the 2.5-in.-thick binder, a 1-in. surface course was also placed for a total overlay thickness of 3.5 in. Cores obtained after placement of the overlay indicated that the binder penetrated the Arkansas base up to a depth of 1 in., thereby effectively keying-in the Arkansas base layer and providing stability.

Control Sections

The control sections were similar to the test sections for each overlay thickness, but without the fabrics and waterproofing membrane. Two control sections were placed with each overlay thickness. The difference between control sections was the placement of a 3-in. corrugated plastic drain along the pavement edge in the outside shoulder of one of the control sections. The drain rapidly removed any infiltrated surface water from under the slab that may have entered through any reflection cracks over joints in the old pavement.

CONSTRUCTION OF TEST SECTIONS: TROUP COUNTY

Waterproofing Membranes

The waterproofing membranes were placed in 12-in.-wide strips over all joints and cracks by using the primer recommended by each manufacturer. No problems were encountered with the placement of Bituthene, Polyguard, or Protecto-Wrap. All sections were left open to traffic with no apparent detrimental effects.

Severe problems were encountered with the Protecto-Wrap strips during the paving operation. The tack used during the paving operation was AC-20 placed at a rate of approximately 0.05 gal/yd^2 at 375°F. The construction sequence was such that trucks delivering the mix to the spreader had to back up over the test material, including the Protecto-Wrap. The tack on the truck tires pulled the Protecto-Wrap loose from the concrete in some instances and also caused the material to separate at the fabric interlayer. This problem was especially noted in the 2-in. AC overlay section. It was requested that the trucks not back up over the material; however, the construction sequence and the turnaround locations for the trucks made this impractical.

One possible reason for the problem occurring in the 2-in. AC section, but not to a large extent in the 4-in. AC section, was that the paving operation started in the 4-in. AC test area that was adjacent to the 2-in. AC test area. The distributor would apply the tack to both the 4- and 2-in.-thick AC test sections at one pass; therefore, the tack was still fairly warm and fluid when the 4-in. AC section was being paved, but was cool and sticky as the trucks were continually backing up over the 2-in. AC test area.

The major problem observed on the damaged joints was the delamination of the material at the fabric layer, which was approximately halfway in the material. Another problem that may have affected performance was the poor adhesion of Protecto-Wrap to the asphalt on the shoulder, generally along the entire length of the test section. Apparently the primer was not compatible with the asphalt. The Protecto-Wrap on some joints was damaged to the extent that the material had to be replaced with Polyguard.

Fabric

The fabric used in this test section was 8-oz Petromat placed in 12-in.-wide strips over both the transverse and longitudinal joints. The desired tack coat was to be 0.40 gal/yd^2, but the liquid AC had to be sprayed by hand, and it was difficult to estimate the actual application rate.

The placement of the Petromat strips took less time than that required for placement of the other material because there was no paper or plastic film to peel and no cleanup of discarded boxes.

It was initially thought by Georgia DOT personnel that the material would not withstand traffic and, therefore, the plans called for the material to be placed on the same day that the section was to be paved. Ten joints in the 4-in. AC section outside lane were placed 2 days before paving to determine if traffic would damage the strips. These strips held up excellently during 2 days of traffic with no apparent damage. The experience on this project indicated that it would be desirable to have the Petromat strips under traffic for several days.

Some problems were encountered during the paving of the Petromat sections. These problems were related to the fact that some of the material was placed just ahead of the paver, which did not allow time for the AC tack to cure out and be pressed into the fabric. Some of the strips were pulled up slightly as the asphalt trucks backed over them. The application of the tack coat over the material eased the problem somewhat. The strips were paved over within 15 min after they were placed in the inside lane of the 4-in. AC section. No such problems were encountered on the outside lane, where the material had been in place for 2 days or in the 2-in. overlay section where the AC tack had time to cure out for about 2.5 hr before paving. Also, on the 2-in. overlay section, tack was applied to the entire roadway before any of the asphalt trucks backed up over the strips.

METHOD OF EVALUATION

The performance of the test sections is being evaluated through visual observations, mapping of cracks, rutting measurements, and deflection measurements.

Rutting measurements are more an indicator of the stability of the asphalt mix than of the performance of the fabric or waterproofing membrane, and therefore are not discussed in this paper. Deflection measurements also do not necessarily indicate fabric performance, except that excessive deflections at joints may accelerate the reflection cracking. The magnitude of the deflections measured at joints are highly sensitive to the time of year and the time of day that the measurements are made. The main criteria for evaluating the effectiveness of the treatments at this time are the occurrence of reflective cracking and the rate at which this cracking is increasing. Tests to determine waterproofing ability of the materials have not been performed; however, they will be performed before preparation of the final report on the project.

PERFORMANCE

I-85, Gwinnett County

The latest cracking survey of the test sections was made in February 1982. The results of this survey are expressed as a percentage of the joints that have reflected into the overlay (Table 1) and as a percentage of the available joint length that has reflected (Table 2). The data in Table 2 are considered to be a more valid indicator, because the data in Table 1 do not distinguish between a 6-in.-long crack and, for example, an 18-ft-long crack, but merely indicate the number of joints that indicate reflective cracking.

Little difference is noted between the sections in the number of joints that have reflected after 5 years for the 2- and 4-in.-thick overlay. There is a significant difference in the 6-in.-thick overlay section for the heavy-duty Bituthene when compared with the control section or with the other treatments.

The data in Table 2 are more indicative of actual performance, and these reveal a reduction in the amount of reflective cracking for the fabric and waterproofing treatments compared with the control sections for the 4-in. overlay and for the waterproofing treatment for the 6-in. overlay section. Of interest is the unsatisfactory performance of the edge drain section with the 6-in. overlay.

The progression of the accumulative length of cracking on the test sections is shown in Figures 1-3. These figures give a better indication of the effect of the treatments on the occurrence of the reflective cracking. An increase in cracking is always observed after the winter months; a section may show small increases for several winters, and then cracking may begin to increase at a rapid rate.

The amount of cracking for the 2-in. overlay is currently about the same for all treatments. It can be seen from Figure 1 that the fabrics delayed the rapid increase in reflective cracking for about 1 year. The waterproofing membrane showed virtually no reflective cracking for the first 2 years and no significant increases until after the first 4 years.

The performance of the treatments with a 4-in. overlay showed only slight differences between the fabrics and the waterproofing membrane. The control sections showed large increases in cracking lengths

Table 1. Percentage of joints reflected into overlay after 6 years: I-85, Gwinnett County.

Treatment	Joints Reflected (%) by Overlay Thickness 2 in.	4 in.	6 in.
Heavy-duty Bituthene	96	82	17
Mirafi 140 fabric	100	95	50
4-oz Petromat fabric	98	86	66
Edge drains	100	100	93
Control	100	100	73

Note: Arkansas base = 70 percent.

Table 2. Percentage of joint length reflected into overlay after 6 years: I-85, Gwinnett County.

Treatment	Joint Length Reflected (%) by Overlay Thickness 2 in.	4 in.	6 in.
Heavy-duty Bituthene	83	55	6
Mirafi 140 fabric	97	70	24
4-oz Petromat fabric	91	54	27
Edge drains	98	92	73
Control	100	89	29

Note: Arkansas base = 34 percent.

Figure 1. Crack reflection: 2-in. AC overlay, I-85, Gwinnett County.

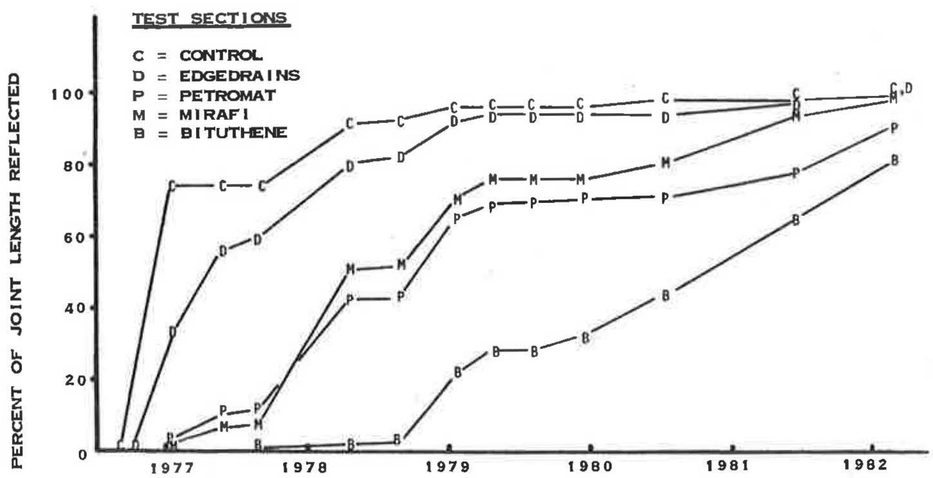

Figure 2. Crack reflection: 4-in AC overlay, I-85, Gwinnett County.

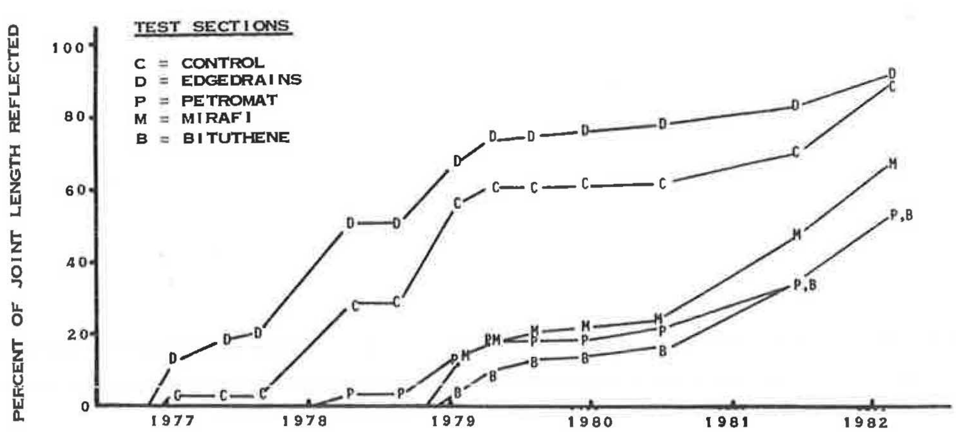

Figure 3. Crack reflection: 6-in. AC overlay, I-85, Gwinnett County.

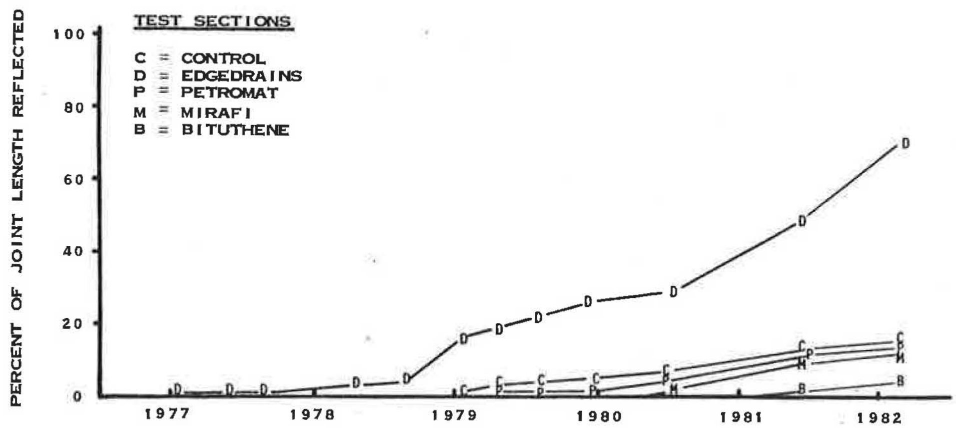

Table 3. Joint reflection into asphalt overlay: I-85, Troup County (March 1982).

	Joints Reflected (%) by Overlay Thickness		Joint Length Reflected (%) by Overlay Thickness	
Treatment	2 in.	4 in.	2 in.	4 in.
Polyguard	100	70	38	28
Polyguard with 9 percent rubber	95	35	48	8
Heavy-duty Bituthene	95	55	33	18
8-oz Petromat strips	89	75	53	30

during the second and third winters after placement, whereas the treated sections began to show increases after the fifth and sixth winter. The Bituthene and Petromat sections are still significantly lower in reflective cracking than the control sections.

No definite trends can be seen as yet in the 6-in. overlay area because the sections with fabric and the control section are performing equally well. The Bituthene section has the best performance--a lower crack reflection percentage than the other sections. Of interest is the unsatisfactory performance of the area with edge drains.

The section with the Arkansas base as a crack-relief treatment is showing significant reflection cracking. In comparison to the 4-in.-thick overlay section, it is performing well; however, when compared with the 6-in.-thick overlay section, it is not performing as satisfactorily as the other treatments. The Arkansas treatment has a 3.5-in. overlay, but the total thickness of the treatment plus overlay is 7 in., and the performance has generally been gauged against the 6-in.-thick sections in Georgia.

I-85, Troup County

The results of the latest available crack survey are given in Table 3. The data represent the amount of reflective cracking after three winters. Generally the waterproofing membranes have less length of the joints reflected through them for both the 2- and the 4-in. AC overlays. Any differences between the membranes are not clear-cut at this time. The Polyguard, which has a lower rubber content, has the least length of reflective cracking with the 4-in. overlay but has the greatest amount of cracking of the membranes with the 2-in. overlay.

The heavy-duty Bituthene is considered the control section on this project because of its past history on the original research sections on I-85 in Gwinnett County. The reflective cracking that has occurred is concentrated on the outside lane, with less cracking occurring on the passing lane. This phenomenon could be attributed to the concentration of heavy trucks on the outside lane and to larger vertical movement of the joints. The slabs were test rolled, and slabs that had excessive corner movements were stabilized through pressure grouting.

For comparison purposes, the amount of reflective cracking on the Gwinnett County project was 29 percent on the 2-in. overlay and 10 percent on the 4-in. overlay for the Bituthene sections after three winters. The amount of reflective cracking on the Troup County project is somewhat higher for the same time period. Additional time will be needed to determine if this trend will continue.

IMPLEMENTATION

Georgia's program for rehabilitation of the Interstate system dictated an early decision on the type of joint treatment under asphaltic-concrete overlays. The waterproofing membrane was chosen based on the excellent results that were obtained in the early phases of the project. The use of strips of waterproofing membrane became a standard construction item for treatment of PCC pavement joints before placing an asphalt overlay. Both construction and material specifications were developed by Georgia DOT. The width of the strips used on the experimental sections was 18 in., but this was reduced to 12 in. for all contract projects. The material should only be placed over joints with stable slabs so as to minimize vertical movement. The membrane should also have firm support over the joint, and all joints should be filled flush with the pavement surface.

Traffic is allowed to travel over the waterproofing strips for up to 7 days. It is preferred that traffic travels over the strip at least overnight to tightly bond the material to the concrete. Some problems can be encountered with the strips during the paving operation. Some shoving over the strips has been noticed at times, especially when the roller stops or starts on a strip of waterproofing membrane or during extremely hot weather. Bulging of the asphalt mix over the strips can also occur during placement of the first lift.

The use of fabrics has been limited to the experimental sections. A limited application of heavy fabric strips has recently been made over longitudinal and transverse cracks in asphalt pavement on the Interstate system before placing an asphalt overlay.

CONCLUSIONS

1. The fabrics and waterproofing membranes have

reduced the rate of reflective cracking in both the 2- and 4-in.-thick asphaltic-concrete overlay sections. No conclusions can be drawn at this time with respect to the 6-in.-thick overlay section.

2. The best performance to date has been obtained with the waterproofing membranes.

3. Even when reflective cracking appears over joints with membrane treatment, the cracks appear to stay tighter than cracks over joints without membrane treatment.

4. Proper preparation of the existing concrete pavement and stabilization of slabs with large corner movements must be done in order to obtain maximum benefit from the joint treatment.

5. A minimum of 4-in.-thick asphaltic-concrete overlay should be used on jointed-concrete pavement, and the membrane treatment should be used to control the rate of reflective cracking.

6. The use of waterproofing membranes over concrete pavement joints before placing an asphalt overlay has been adopted as a standard practice in Georgia.

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The contents of this paper reflect our views, and we are responsible for the facts and accuracy of the data presented. The contents do not necessarily reflect the official views or policies of FHWA or Georgia DOT.

Trade and manufacturers' names appear in this paper only because they are considered essential to the object of the document and do not constitute endorsement of a product by FHWA or Georgia DOT.

This paper does not constitute a standard, specification, or regulation.

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Laboratory Testing of Fabric Interlayers for Asphalt Concrete Paving: Interim Report

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Because of the proliferation of paving products being presented as reflection crack retarders, the need developed for laboratory tests that can be used as a screening device to avoid the extensive costs and delays associated with full-scale field tests of all of these products. This need resulted in an FHWA-financed research project to generate laboratory tests for estimating the effect of various fabric interlayers on asphalt concrete (AC) overlay properties such as (a) water permeability, (b) susceptibility to flexural fatigue reflection cracking, (c) susceptibility to vertical shear fatigue reflection cracking, and (d) susceptibility to horizontal shear failure (slipping). Testing was also done to characterize popular fabrics in terms of physical and mechanical properties such as tensile strength, elongation, modulus, weight, thickness, and heat resistance. Possible correlations between these fabric properties and the above four overlay properties were investigated. In addition, methods for estimating the optimum asphalt tack-coat application rate for fabrics were developed. These research efforts have led to a more educated and selective use of fabrics in AC paving.

Laboratory test methods can be used to predict the relative in-service performance of fabric interlayers in asphalt concrete (AC) pavement overlays as well as the amount of asphalt tack coat to be used with each fabric type. To better understand the need and use of these test methods, the following items are described in this paper:

1. Basic causes of AC overlay cracking,
2. Popular theories of fabric interlayer effectiveness in reducing overlay cracking,
3. Earlier research efforts to predict interlayer effectiveness by using laboratory tests,
4. Measurement of physical and mechanical properties of 12 commercially produced fabrics,
5. Laboratory testing of AC specimens to investigate the effectiveness of fabric interlayers in thwarting the common causes of overlay reflection cracking, and
6. Attempted correlations between the physical and mechanical properties of the fabrics and their performance in the above tests.

BACKGROUND INFORMATION

The reflection of cracks from old distressed pavement through relatively new AC overlays significantly decreases the service life of these overlays. Numerous fabric materials--primarily polyesters and polypropylenes, as well as rubber-asphalt combinations--are being proposed as interlayers to retard this reflection cracking, but no laboratory procedures have been developed to evaluate the validity of these claims. Simple laboratory tests are therefore needed for the

1. Analysis of the mechanisms by which reflection cracking occurs,
2. Estimation of the benefits of using various interlayers,
3. Definition of which interlayer properties correlate to crack retardation, and
4. Avoidance of the extensive costs and delays that are associated with full-scale field testing of inappropriate materials.

Reflection cracking is the propagation of cracks from an existing surfacing of portland cement concrete (PCC) or AC through the resurfacing layer. This problem is serious. Many different remedies have been tried (with varying degrees of success) to eliminate or deter such cracking.

Reflection cracking develops from movement of the pavement under the overlay (Figure 1). It can be caused by several mechanisms, such as

1. Differential vertical movement at a crack or slab joint in the old pavement, which induces a vertical shear stress in the overlay;
2. Horizontal movement associated with tempera-