New Mexico Study of Interlayers Used in Reflective Crack Control

VIRGINIA M. LORENZ

The application of an overlay restores the riding quality and skid properties and prolongs the service life of a roadway that has deteriorated. This type of rehabilitation may result in a new problem, reflective cracking, where subsurface cracks propagate into and through the protective overlay. By placing some form of interlayer between the old deteriorated pavement and the new overlay, reflective cracking may be reduced or even prevented. Thus, the useful life of the overlay is increased, resulting in a savings in maintenance costs. New Mexico established several experimental projects under Category 2 experimental projects under Category 2 experimental construction in which different forms of interlayers were used. A description is provided for seven types of interlayers incorporated into the reported four of the original six projects located throughout the state. For each project, the original pavement structure, the new overlay, and the type of interlayer is given. Also, inspections made at different intervals are summarized. Conclusions derived from the studied projects indicate that interlayers do retard the rate of reflective cracks, implying a savings in maintenance cost. Interlayers do not necessarily prevent crack reflection. Of all the types of interlayers used in the reported projects, one type of paving fabric (Mirafi 140) performed the best at reducing reflective cracks whereas the two types of rubberized asphalt membranes performed second and third best. On one project, it was revealed that two control sections performed just as well as the fabric and the two rubberized asphalt membranes. Out of the three projects with similar weather data, two projects had similar results, and the aforementioned fabric performed best.

The primary objective of any pavement design system is to provide a roadway that is not only safe and rides comfortably, but also extends these characteristics over a maximum useful life with a minimum amount of required maintenance. Because the pavement generally deteriorates in the forms of cracking, rutting, and other surface deformations, rehabilitation frequently involves applying a thin overlay over a properly prepared cracked pavement. This method of restoration may subsequently result in a new problem—that of reflective cracking patterns that migrate into and eventually through the overlay. Once the overlay is fractured, erosion can occur rapidly. the ride and safety performance of the roadway are eventually severely affected, resulting in further costly maintenance. Many highway agencies perceive that placing some form of interlayer between the old deteriorated pavement and the new overlay will prevent, or at least retard, reflective cracking, thereby increasing the life of the overlay and resulting in a savings in maintenance costs.

New Mexico Highway Department, P.O. Box 1149, Santa Fe, N. Mex. 87504–1149.

The objective of this study was to finalize the evaluation of several New Mexico experimental projects that were established under Category 2 experimental construction and to provide an overall evaluation of several interlayer systems that New Mexico has implemented for the purpose of retarding reflective cracking. Only the first four of the original six reported projects are discussed.

MECHANISMS OF REFLECTIVE CRACKING *(1, 2)*

Horizontal and vertical movements between the original pavement and the overlay are the basic mechanisms that result in the development of reflective cracking. Although several field observations and theoretical analysis of reflective cracking have been made, there have not been many controlled projects in which sufficient data were taken to accurately determine the cause or factors associated with this type of cracking. Most of the projects studied consisted of an asphalt overlay over a portland cement concrete pavement. Hence, a generally accepted well-developed description of the mechanisms and response variables is not available.

Reflective cracking is generally accepted to be partially due to horizontal movements resulting from the expansion and contraction of the existing pavement as a result of temperature and moisture changes. Tensile stresses produced from movements at the joints or cracks become critical because of the bond between the overlay and the existing pavement. The amount and rate of temperature change, slab length, gauge length across the joint or crack, and properties of the overlay materials are all contributing factors to the development of reflective cracking.

Repeated traffic loadings produce differential vertical movements at joints and cracks that result in shear stress concentrations at the joints and cracks in the overlay. The magnitude of load, the amount of load transfer across the joint or crack, and the differential subgrade support under the existing pavement are important factors involved in differential deflections.

INTERLAYER SYSTEMS

Several projects have been undertaken in New Mexico in which interlayers were used in the hopes of reflective crack retardation. The types of interlayers incorporated into the four experimental project locations are as follows:

The Arizona rubberized asphalt membrane is produced by the Arizona Refining Co., Phoenix, Arizona. An 85-100 pen asphalt was combined with 20 percent reclaimed replasticized rubber and 2 percent extender oil and then heated to 410°F. A

120-150 pen asphalt was used in lieu of the 85-100 pen asphalt on one of the projects. As the material was uniformly applied at an average rate of 0.63 gal/yd^2 across the roadway, the small cracks were filled. Chips were then spread across the membrane at an average rate of 38 lb/yd^2.

Arkansas mix consists of an open-graded bituminous pavement with a coarse gradation with aggregate less than 2 in. in size and 3 percent AC-20 grade asphalt. The material is placed in one 3½-in. lift and then rolled by a 5-ton roller.

Heater-scarification is carried out by two units used to preheat the pavement. One unit scarifies the existing mat to a depth of ¾ in. The rejuvenating agent Reclamite is then applied to the scarified surface by a distributor at a rate of 0.08 gal/yd^2. A steel roller follows the distributor to compact the material.

Mirafi 140, manufactured by Celanese Fibers Marketing Co., is a nonwoven fabric uniquely constructed from two types of continuous filament fibers. One type of fiber consists of a polypropylene homofilament, and the other is a heterofilament composed of a polypropylene core covered with a nylon sheath. During the webmaking process, the heterofilaments are heat bonded or fused together where they intersect. During this process, the homofilament polypropylene, which is unaffected by the heat, becomes mechanically interlocked with the other fibers, thereby giving the fabric its high tear strength and elongation capability.

Petromat, a nonwoven fabric, is manufactured by Philips Fibers Corp. A needlepunching process uses polypropylene filameters to form the fabric.

The Sahuaro rubberized asphalt membrane is produced by the Sahuaro Petroleum and Asphalt Co., Phoenix, Arizona. The rubberized asphalt, which is blended at 350°F, consists of 25 percent vulcanized granulated rubber and 120-150 pen asphalt. The mixture is diluted to between 5.5 and 7.5 percent by volume with kerosene. The mixture is applied at 325°F on the roadway at an average rate of 0.6 gal/yd^2. Chips are then spread across the membrane at an average rate of 38 lb/yd^2.

The standard base course, which is placed directly on top of the existing mat, consists of a finer gradation with aggregate ¾ in. in size and smaller. The moisture content is maintained at 5 percent; a vibratory roller is used for compacting the 4-in. layer.

EXPERIMENTAL PROJECTS

The four experimental projects in which these interlayers were used, located as shown in Figure 1, were the following:

1. I-25, 7.0 mi south of Raton, in north Colfax County;
2. I-40, 4.5 mi east of Clines Corners, in east Torrance County;
3. I-25, 8.2 mi north of Truth or Consequences and North and Mitchel Point Interchanges, in north Sierra County; and
4. I-40 west of Grants, mileposts 70.15 to 79.0, Bluewater Interchange to Milan Interchange, in Cibola County.

Environmental conditions that affect the pavement structure were collected for a 3-year period (1980–1982) at national weather stations located in close proximity to each project site. Provided by the National Climatic Data Center in Asheville, North Carolina, the data were compared and found to be similar for the following projects: I-25 at Raton, I-40 at Corners, and I-40 at Grants.

Project on I-25, South of Raton

Discussion of Project

The original roadway was completed in 1968 with thicknesses and types of layers as follows: ⅝-in. plant mix seal coat, 4½-in. plant mix bituminous pavement, 6-in. untreated base, 6-in. cement-treated base course, and 4-in. untreated subbase. The project was designed using the *R*-value, traffic index, and gravel equivalent design concept rather than the AASHTO Interim Design Guide procedures for pavement design.

The experimental project consisted of overlaying the existing roadway and using two types of crack relief systems. Prior to construction, several pavement distresses were observed. Some rutting had occurred in the wheelpaths of the driving lanes. Extensive longitudinal and transverse cracking could be seen as well as some localized alligator-type cracking. There was no indication that the pavement failed structurally, requiring the removal and replacement of the underlying structure. Six 600-ft monitor sections were demarcated so that each of the types of crack relief systems was represented in the construction of two sections, whereas the remaining four sections were constructed as control sections with different thicknesses of plant mix bituminous pavement (PMBP) layers and without the use of an interlayer. All cracks in each monitor section were photographed and logged in a field book for future reference. The overlay thicknesses consisted of 2½ and 4 in. for the no-interlayer sections and 2 in. for the Mirafi 140 and Petromat sections. A ⅝-in. plant mix seal coat was constructed on the entire project.

This experimental project was completed in November 1978 at an initial cost of $72,212/lane-mi. All cracks in the existing pavement had been blown clean and filled with 120-150 pen asphalt. An 85-100 pen asphalt was spread as a tack coat before the Mirafi 140 fabric was placed at a rate of 0.15 to 0.20 gal/yd^2 and at an approximate temperature of 375°F. Before the Petromat fabric was placed, the 85-100 pen asphalt was applied as a tack coat at a rate of 0.25 gal/yd^2 and at an approximate temperature of 325°F. No specific problems were reported during construction.

This project has since been inspected several different times with the last inspection occurring on October 18, 1983. Only the monitor sections were inspected and all cracks were noted in the log book. The primary distresses that occurred in one or all of the monitor sections were rutting, raveling, and fatigue cracking. Table 1 summarizes the number of cracks observed before the overlay construction and during each inspection after the construction, and the percent of the reflective cracks of the original cracks for each monitor section.

Summary and Conclusions

Cracks were first observed during the final inspection, which

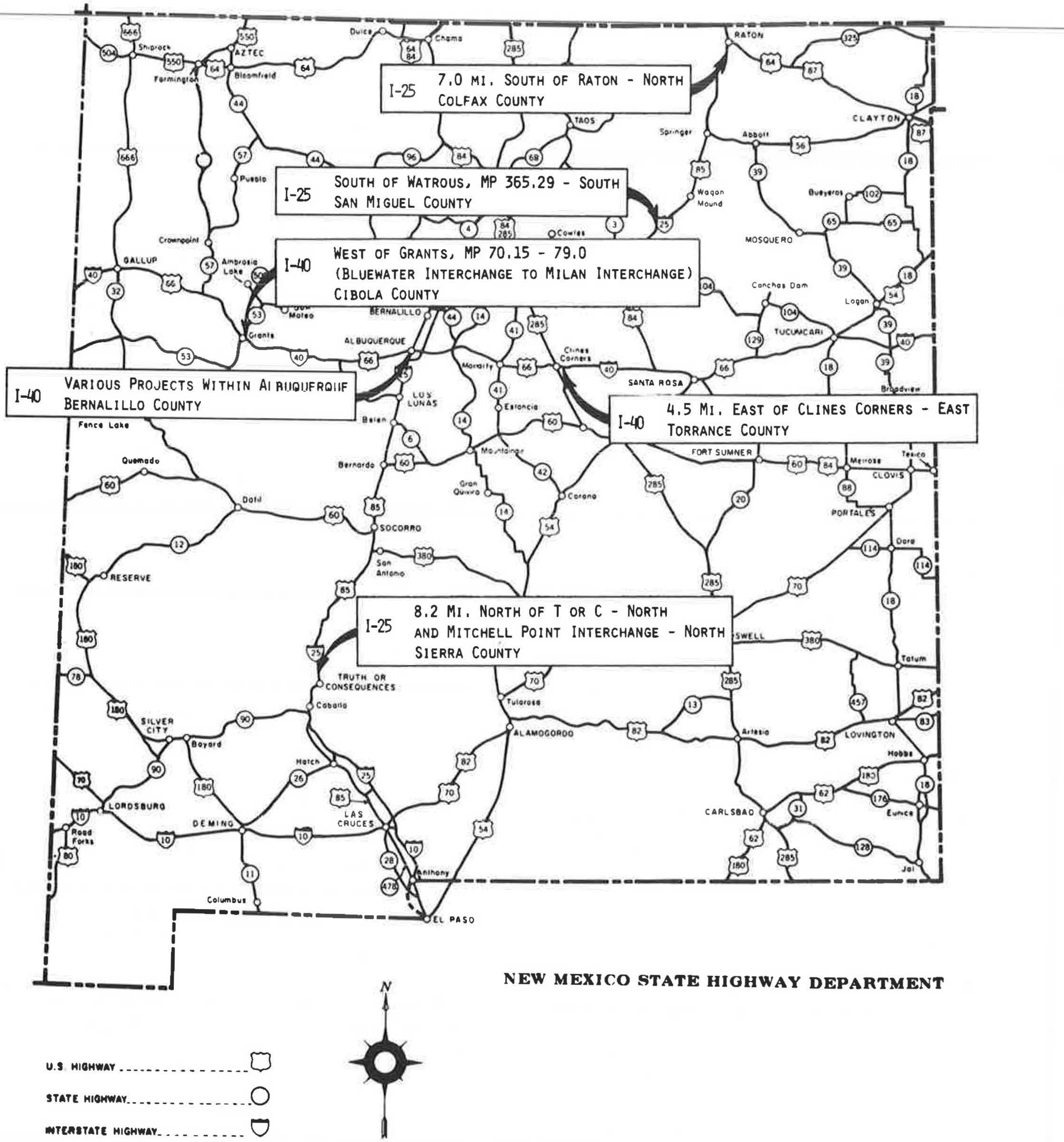

FIGURE 1 New Mexico experimental project locations.

TABLE 1 REFLECTIVE CRACKS, I-25 SOUTH OF RATON

TEST SECTION NUMBER Type of Interlayer	Total No. of Original Cracks	Number of Cracks Observed Percent of Total Number of Original Cracks Date of Inspection (Age of Overlay in Years) 4/26/79 (0.4)	1/22/80 (1.2)	10/15/81 (2.9)	10/18/83 (4.9)
SECTION I Control Section No Interlayer	23	0 0%	0 0%	0 0%	9 39%
SECTION II Mirafi 140 Fabric	32	0 0%	0 0%	0 0%	9 28%
SECTION III Petromat Fabric	37	0 0%	0 0%	0 0%	10 27%
SECTION IV Control Section No Interlayer	46	0 0%	0 0%	0 0%	9 20%
SECTION V Control Section No Interlayer	35	0 0%	0 0%	0 0%	8 23%
SECTION VI Control Section No Interlayer	32	0 0%	0 0%	0 0%	9 28%

took place almost 5 years after the overlay construction. The two monitor sections with 4 in. of PMBP and no interlayer have both the greatest percentage (39 percent) and the smallest percentage (20 percent) of reflective cracks. The section using Mirafi 140 fabric had 28 percent of the cracks return. The section constructed with Petromat fabric had 27 percent of the original cracks return. Where a 2½-in. layer of PMBP was built without an interlayer, 23 percent of the original cracks reflected through in one section and 28 percent occurred in the other section. Figure 2 is a graph of the percent of cracks returned versus the number of years since the overlay was constructed. As shown, after almost 5 years of service, fewer than 30 percent of the cracks reflected through the overlay in five out of the six sections. The pavement distresses that developed indicate that the reflective cracks could be caused by repeated traffic loads. The Petromat section and two control sections had the best performance of all the experimental sections in reducing reflective cracking.

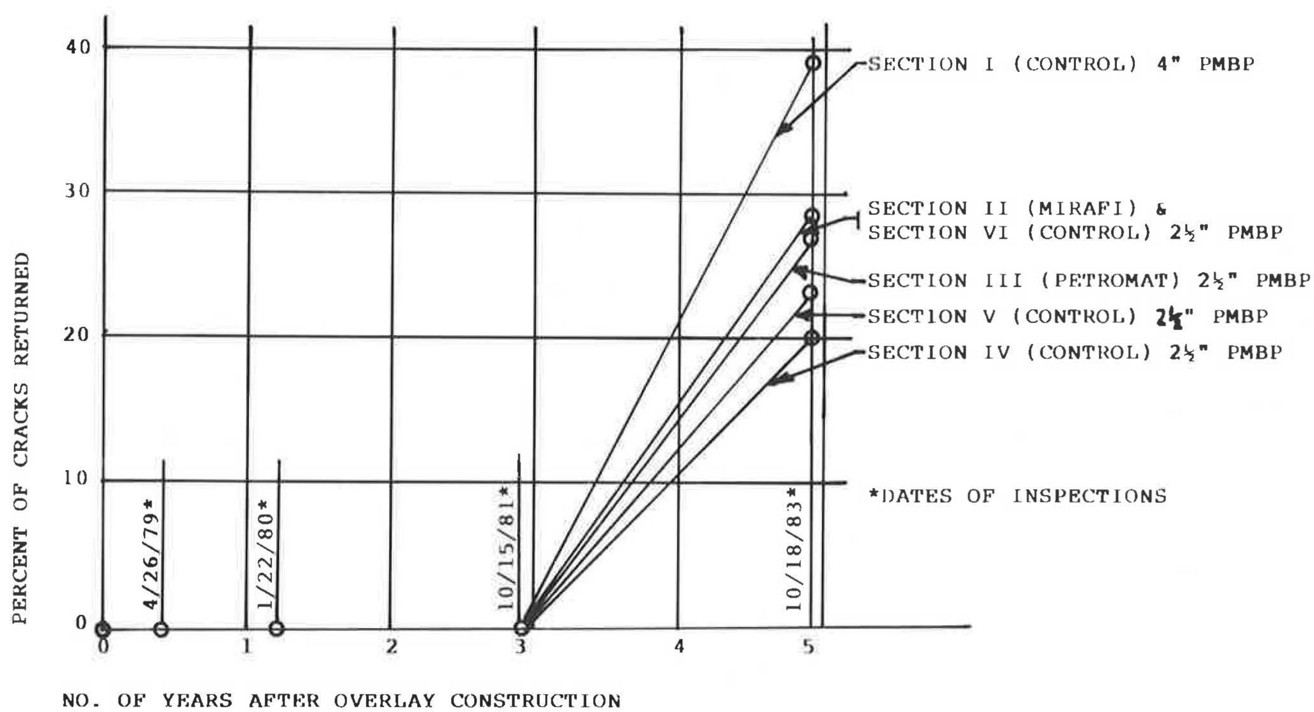

FIGURE 2 Reflective cracks versus overlay life, I-27, 7.0 mi south of Raton.

Project on I-40, East of Clines Corners

Discussion of Project

Completed under three contracts, the original roadway was built in 1956–1958 with layer thicknesses and types of materials used in the construction as follows: 5/8-in. plant mix seal coat, 3-in. PMBP, 4-in. base course, and 4-in. subbase. Stage construction surfacing was designed using an R-value, traffic index, and gravel equivalent. Records indicated that a 2-in. overlay was anticipated to be structurally sufficient to complete the stage construction for the anticipated life expectancy.

The entire experimental project, which was completed at a cost of $102,297/lane-mi, consisted of overlaying the existing roadway with 5 1/2 in. of PMBP and implementing four different types of crack relief systems: Sahuaro rubberized asphalt, Arizona rubberized asphalt, Mirafi 140, and Petromat. Extensive transverse, longitudinal, and alligator cracks observed before construction were photographed and logged in a field book for future reference. Some pavement areas were removed and replaced because they were so badly deteriorated.

Six 600-ft sections completed by July 1978 were selected to be monitored. Sections I–V were constructed with one type of crack relief system and one of these sections was built without an interlayer.

Several problems arose during construction of the overlay project. An investigation attributed the raveling of the rubberized asphalt mixture to incorrect mixing times. An incomplete reaction between the rubber and the asphalt resulted in the stripping of the rubberized material. Section VI was added to the project when these problems occurred during the construction of the section with Sahuaro rubberized asphalt. Section VI was constructed with the same interlayer but with only a 4-in. PMBP layer. The tack coat for the fabrics was 120-150 pen asphalt. For Mirafi 140, the application rate varied from 0.15 to 0.20 gal/yd^2.

Problems occurred in other sections. When the chips that were spread over the rubberized asphalt were too fine, a poor bond to the next layer resulted. The problem disappeared after the chips were rescreened.

Other problems experienced were related to fabric blowing and parachuting because it was not adhering to the tack coat. Additional labor was used to straighten, cut, and replace the fabric. Because the spray bar on the distributor was not long enough to apply the full width required for the Mirafi 140 fabric, a second pass was made that resulted in an excess of asphalt where the two passes overlapped. In addition, the tack coat was not spread uniformly. The laydown machine had a tendency to pull on the fabric, thereby wrinkling it or pulling it apart at the joints. Because shoving of the PMBP occurred in some areas, those sections were removed and replaced. Throughout the entire project, the contractor made an attempt to fill the existing cracks with 120-150 pen asphalt, but it was estimated that only half the cracks were partially filled and the other half were left unfilled.

Flushing occurring in the initial lifts on top of one fabric was attributed to the segregation of the aggregate that occurred during several handling operations. The percentages of asphalt and fines were both increased in an attempt to reduce segregation, but the voids in the mix were reduced thus producing a dense mix. Segregation became a cumulative situation because of improper storage of the aggregate, and improper loading, unloading, and placing of the PMBP. The flushing was eventually eliminated by reducing the percent of asphalt, and the percent of fines was reduced to provide voids in the mix.

Since construction was completed, this project has been inspected several times with the most recent inspection occurring on September 8, 1983. All new cracks were logged in the book for only the monitor sections. Pavement distresses observed in one or more sections included severe bleeding, rutting, and transverse and longitudinal cracking.

Core samples taken in each monitor section in this project and analyzed to verify the causes of the observed pavement distresses indicated the following:

1. Bleeding occurring in the pavement surface resulted from too high an asphalt content in the plant mix seal coat or PMBP, or the asphalt stripped from the aggregate.
2. The original cracks had not been properly cleaned and sealed.
3. Stripping of the asphalt from the aggregate caused portions of the cores to disintegrate.
4. In most cases, the interlayer remained intact, even though the original crack propagated through the pavement layers to the top.

Table 2 indicates the number of cracks observed before the overlay construction and during each inspection.

Summary and Conclusions

Cracks began appearing as early as 19 months after the overlay construction in the Arizona rubberized asphalt section. After 2 years, cracks were observed in the first Sahuaro rubberized asphalt section. Cracks appeared in the control section and the second Sahuaro rubberized asphalt section after almost 2 1/2 years. After more than 5 years, cracks were observed in all sections. The greatest percentage (51 percent) of reflective cracks that were observed during the final inspection occurred in the control section where no interlayer was used. The smallest percentage (22 percent) of cracks that returned was observed in the Petromat section. The percent of cracks in the remaining sections ranged from 25 to 44 percent. Figure 3 is a graph of the percent of cracks returned versus the number of years since the overlay was constructed for each monitor section. After more than 5 years of service, less than 30 percent of the cracks returned in three out of the six sections. The pavement distresses observed indicated that repeated traffic loads and temperature and moisture changes possibly aided in the development of the reflective cracking. The Petromat, Sahuaro, and Arizona sections performed the best in reducing the number of reflective cracks.

Project on I-25, North of Truth or Consequences

Discussion of Project

The original roadway was built in July 1966 with the configuration of materials and layer thicknesses as follows: 1 1/2-in.

TABLE 2 REFLECTIVE CRACKS, I-40 EAST OF CLINES CORNERS

TEST SECTION NUMBER Type of Interlayer	Total No. of Original Cracks	Number of Cracks Observed Percent of Total Number of Original Cracks Date of Inspection (Age of Overlay in Years) 1/15/80 (1.4)	7/31/80 (2)	2/19/81 (2.4)	10/6/81 (3.2)	9/8/83 (5.1)
SECTION I Sahuaro Rubberized Asphalt	25	0 0%	1 4%	2 8%	3 12%	11 44%
SECTION II Arizona Ref. Co. Rubberized Asphalt	28	1 4%	0 0%	1 4%	1 4%	7 25%
SECTION III Mirafi 140 Fabric	40	0 0%	0 0%	0 0%	0 0%	12 30%
SECTION IV Petromat Fabric	37	0 0%	0 0%	0 0%	0 0%	8 22%
SECTION V Control Section No Interlayer	41	0 0%	0 0%	5 18%	6 15%	21 51%
SECTION VI Sahuaro Rubberized Asphalt	53	0 0%	0 0%	3 6%	3 6%	15 28%

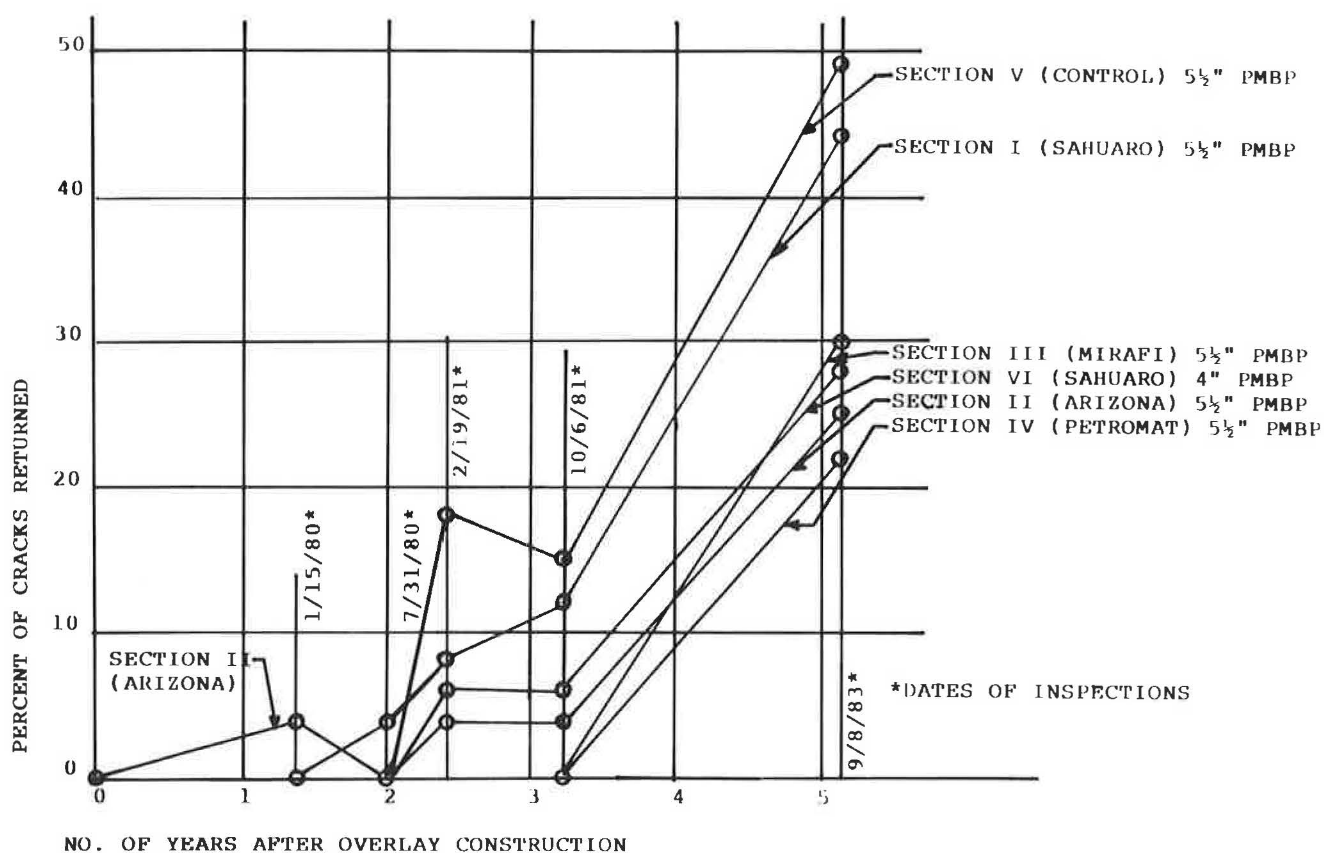

FIGURE 3 Reflective cracks versus overlay life, I-40, 4.5 mi east of Clines Corners.

surface course, 2-in. binder course, 4-in. asphalt-treated base, and 4-in. subbase. Design data were not available in the project files.

The experimental project consisted of incorporating four crack relief systems (Sahuaro rubberized asphalt, Arizona rubberized asphalt, Petromat, and Mirafi 140) and the heater-scarification process with a 2-in. PMBP overlay.

Prior to construction, numerous transverse cracks were observed with widths ranging from 1/4 to 1 in. and with depths of approximately 8 in. No alligator cracking was apparent. One 500-ft monitor section was laid out in each experimental test section and one in the control section. All cracks in each monitor section were photographed and logged in a field book for future reference.

This experimental project was completed in July 1979 at an initial cost of $112,434/lane-mi. The contractor attempted to fill all cracks in the existing pavement with 120-150 pen asphalt; however, because of the depth and width of each crack, not all cracks were filled. Other problems occurred during construction. In the heater-scarification section, while the second heater unit was scarifying the old pavement, the asphalt in the previously filled cracks began to bleed through the scarified material. Excessive asphalt from crack sealing also caused a problem in the Sahuaro section. Bleeding occurred through the chips when the hot rubberized asphalt blend was applied to the area where cracks had been filled. Minor wrinkles that occurred in both fabric sections did not present any problems.

Since the date when construction was completed, several inspections have taken place. During an interim inspection, several cores were sampled. An analysis resulted in the following comments:

1. The rubberized asphalt membranes and the fabrics appeared to be intact.
2. Small cracks remained filled with crack sealant while large cracks had voids as deep as 2 in. between the interlayer and PMBP. Where no crack sealant was used, the cores fell apart into pieces.
3. Old cracks in the control section reflected through the new surfacing.
4. There was no evidence of reflective cracking in the heater-scarification section.

The final inspection was performed on September 27, 1983, when the monitor sections were observed in detail and all new cracks were noted in the log book. The pavement distresses observed in one or more sections were raveling, rutting, and transverse and longitudinal cracks.

The data in Table 3 show the number of cracks and the percent of original cracks observed during all reported inspections. Figure 4 shows the increase of percent of cracks returned versus the age of the overlay construction.

Summary and Conclusions

Cracks began to appear within the first year after the overlay construction in four of the six monitor sections. Cracks appeared in the remaining two sections within the next 6 months following that first year. The pavement distresses indicate that both vertical and horizontal movements possibly contributed to the development of reflective cracking. The heater-scarification section and the Mirafi 140 section had the best performances for reducing reflective cracking after 4 years with cracks returning at 77 and 80 percent, respectively.

TABLE 3 REFLECTIVE CRACKS, I-25 NORTH OF TRUTH OR CONSEQUENCES

TEST SECTION NUMBER Type of Interlayer	Total No. of Original Cracks	Number of Cracks Observed / Percent of Total Number of Original Cracks / Date of Inspection (Age of Overlay in Years) 9/12/79 (0.1)	1/7/80 (0.4)	12/11/80 (1.4)	10/13/81 (2.2)	10/12/83 (4.2)
SECTION I Heater-Scarify & Rejuvenate	30	0 0%	0 0%	3 10%	6 20%	23 77%
SECTION II Sahuaro Rubberized Asphalt	22	0 0%	0 0%	7 32%	9 41%	23 100%
SECTION III Arizona Ref. Co. Rubberized Asphalt	25	0 0%	5 20%	14 56%	15 60%	28 100%
SECTION IV Petromat Fabric	19	0 0%	1 5%	9 47%	11 58%	20 100%
SECTION V Mirafi 140 Fabric	25	0 0%	3 12%	8 32%	9 36%	20 80%
SECTION VI Control Section No Interlay	31	0 0%	13 42%	19 61%	19 61%	31 100%

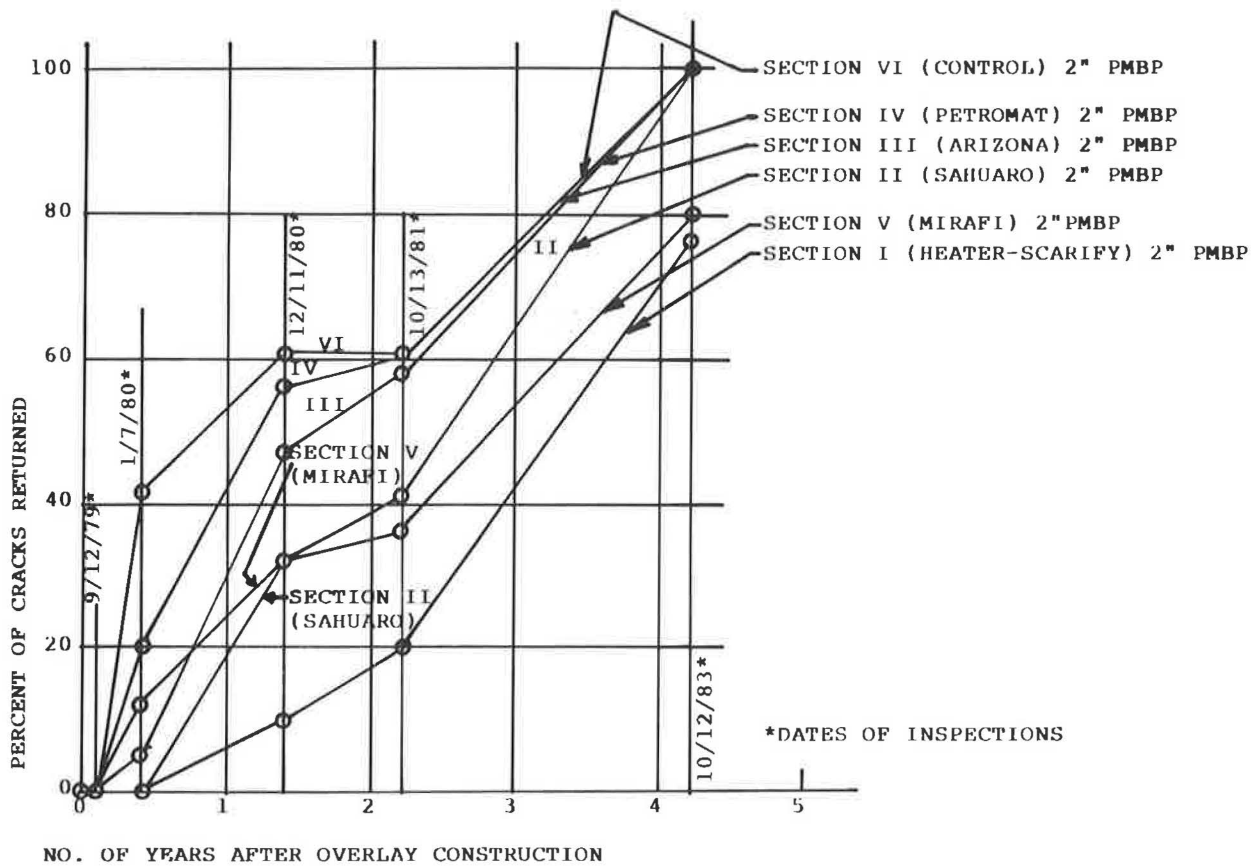

FIGURE 4 Reflective cracks versus overlay life, I-25, 8.2 mi north of Truth or Consequences.

Project on I-40 West of Grants

Discussion of Project

The project for constructing the original pavement was completed in 1970 with the following configuration of the thicknesses and materials: 3 in of asphalt concrete, 6 in. of cement-treated base, and 4 in. of subbase. Design data were not available for this project.

Two types of systems were incorporated as stress-relieving interlayers in this experimental project. The Arkansas mix was overlaid with 2½ in. of PMBP and the standard base course was overlaid with 3½ in of PMBP. A 500-ft monitor section was laid out in each experimental test section for which all major cracks were photographed and logged in a field book.

This project was completed in November 1979 at a cost of $76,044/lane-mi. No major problems developed during the construction of the standard base course or the Arkansas mix. Only construction traffic was allowed on these sections prior to placement of the hot mix; all traffic was discouraged on the Arkansas mix until it had completely cooled.

Since project completion, three inspections have been documented. The last inspection occurred on October 5, 1983, in which the monitor sections only were observed in detail. New cracks that appeared since the overlay construction were logged in the field book. The primary pavement distress that occurred in each section was rutting with an average depth of 3/8 in.

Some flushing or bleeding also occurred in both sections of the driving lane. In addition, transverse and longitudinal cracks were observed.

Table 4 presents the number of cracks returned for each inspection and the percent of the original cracks. Figure 5 is a graph showing the percent of reflective cracks versus the time in years after the overlay construction.

Summary and Conclusions

Cracks first began appearing in each section after slightly less than 4 years. Pavement distresses indicate that the reflective cracks were possibly developed by repeated traffic loads. A total of 37 percent of the cracks had returned in the Arkansas mix section. The standard base course performed better with only 5 percent reflective cracks.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions were derived from this study.

1. Interlayers do retard the rate of reflective cracks, and can therefore produce a savings in maintenance costs.

TABLE 4 REFLECTIVE CRACKS, I-40 WEST OF GRANTS

TEST SECTION NUMBER Type of Interlayer	Total No. of Original Cracks	Number of Cracks Observed / Percent of Total Number of Original Cracks / Date of Inspection (Age of Overlay in Years) 2/6/80 (0.3)	4/80 (0.4)	10/8/81 (1.9)	10/5/83 (3.9)
SECTION I Arkansas Mix	24	0 0%	0 0%	0 0%	9 37%
SECTION II Standard Base Course	41	0 0%	0 0%	0 0%	2 5%

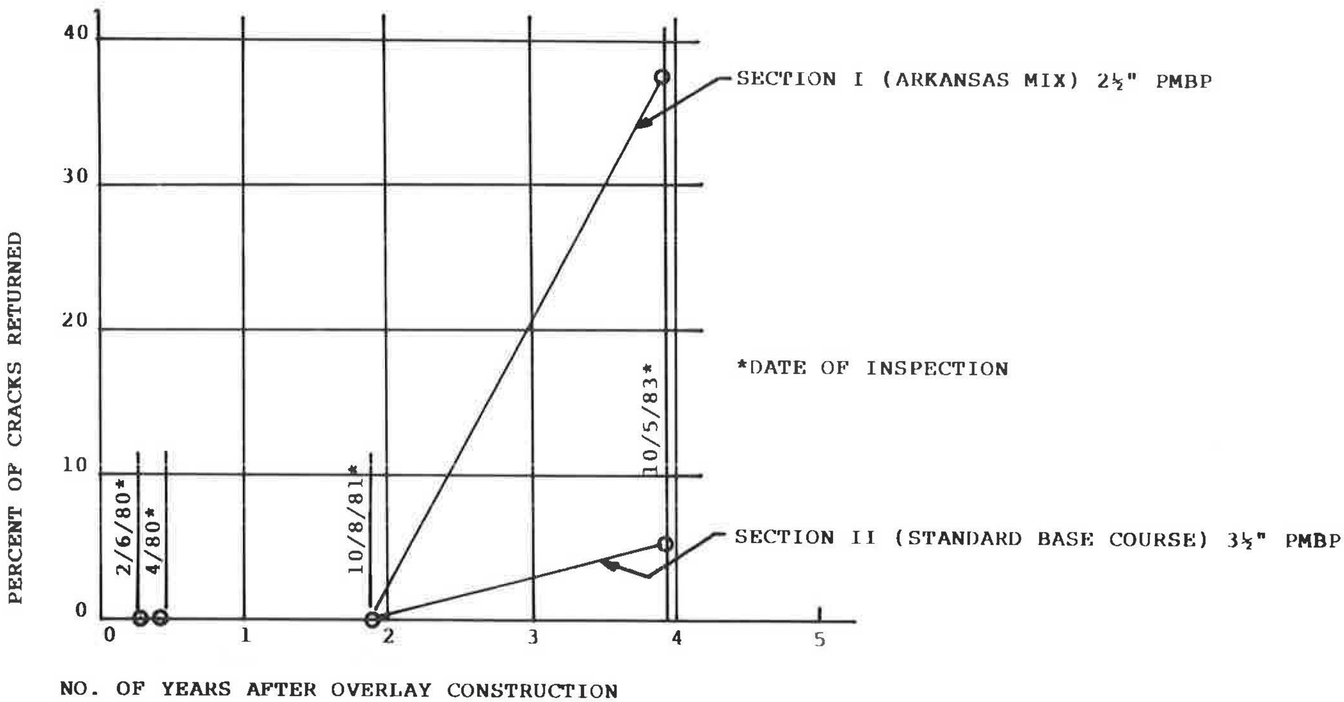

FIGURE 5 Reflective cracks versus overlay life, I-40, Mileposts 70.15 to 79.00, west of Grants.

2. Interlayers do not necessarily prevent crack reflection.
3. Petromat fabric performed the best when all of the New Mexico experimental projects were compared.
4. Arizona and Sahuaro rubberized asphalt membranes were close competitors to Petromat in reducing reflective cracking.
5. Two control sections on I-25 at Raton performed just as well as the Petromat fabric and the Arizona and Sahuaro rubberized asphalt membranes on the project on I-40 at Clines Corners. One section had a 4-in. overlay and the other section had only a 2½-in. overlay. A thicker overlay appears to reduce crack propagation, but it would not be as cost-effective as the fabric or rubberized asphalt membrane.
6. Two of the three projects with similar weather data had similar results. The results from both the I-40 project at Clines Corners and the I-25 project at Raton indicated that Petromat fabric performed the best with 30 percent or less reflective cracks.

The following are recommendations for future experimental research and routine construction projects:

1. Tighter control is needed in construction of projects. Numerous problems occurred during construction of these projects that probably affected the actual performance of the interlayers. To achieve the expected results of a reduction of reflective cracks, the interlayers must be constructed according to specifications.
2. Interlayers consisting of a paving fabric or a rubberized asphalt membrane are highly recommended for reducing reflective cracks in an overlay construction project. For the interlayer to be successful, the existing surface needs to be patched, cleaned, free of irregularities, and dry. All cracks wider than ½ in. are to be cleaned and sealed. In the case of fabrics, the tack coat application rate should consist of a total of the asphalt retention required by the fabric as tested, and an amount of

asphalt needed to satisfy the surface hunger of the existing pavement.

3. Heater-scarification is a plausible alternative if cracking in the existing pavement is excessive. The initial cost of this process could be less than cleaning and sealing the cracks followed by the placement of an interlayer.

ACKNOWLEDGMENT

The author expresses appreciation to Douglas I. Hanson, Robert D. Williams, and Robert G. Ringer for their critical reviews and suggestions; to H. Gerald Boxberger, Robert D. Williams, Robert L. Wheeler, Lloyd Buchwald, L. Linson, Dan Sowle, John Gonzales, Ruben C. Garcia, and Thomas J. Koglin for their assistance in the collection and documentation of field information; to Arthur Palmer for his assistance in the collection of historical data; to William Gonzales for his graphical work; and to Ray Pavlovich, Orlando P. Garcia, Susan Q. Gallaher, and Connie Maestas for their assistance in assembling and editing the printed portion of the paper.

REFERENCES

1. G. Sherman. *NCHRP Synthesis of Highway Practice 92:Minimizing Reflection Cracking of Pavement Overlays.* TRB, National Research Council, Washington, D.C., Sept. 1982.
2. H. J. Treybig, B. F. McCullough, P. Smith, and H. Von Quintus. *Overlay Design and Reflection Cracking Analysis for Rigid Pavements.* FHWA-RD-77-66. FHWA, U.S. Department of Transportation, Aug. 1977.

Publication of this paper sponsored by Committee on Pavement Rehabilitation.