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CRACK-REDUCTION, PAVEMENT-REINFORCEMENT, GLASGRID

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Prepared in cooperation with the
U.S. Department of Transportation
Federal Highway Administration

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16. Abstract

The main objective of this study was to evaluate the effectiveness of Glasgrid as a reflective crack reducing method. Two locations were selected for evaluation. The first location was on I-70, west of the Eisenhower Memorial Tunnel. At this location the section containing the Glasgrid was evaluated and compared to an equivalent section containing the material (Trevira Spunbond) and an untreated section. The second location was on U.S. 40, east of Hayden. On this project the Glasgrid was placed at two locations. At the first location the Glasgrid was placed over a railroad crossing which was no longer in use. The remainder of the Glasgrid was placed over the construction joint where the pavement was wider.

Following the four year evaluation the pavement in the Glasgrid section has a significant more amount of cracking in the wheel paths than the Trevira and untreated sections. Most of the longitudinal cracking in the wheel path has deteriorated into alligator cracking. Neither of the other two sections are showing any signs of this type of distress. Cracking in the Glasgrid section is appearing at a much faster rate than cracking in the Trevira and untreated sections.

As of the final evaluation the U.S. 40 east of Hayden location shows no evidence of reflective cracking at the construction joint. This includes both the untreated and treated areas. The Glasgrid over the railroad tracks did not prevent reflective cracking. The overlay and Glasgrid was removed and the railroad tracks were restored.

Based on findings from this study, it is not recommended to use Glasgrid as a crack-reduction treatment without further data supporting its effectiveness.

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I. INTRODUCTION

In Colorado, the use of an asphalt overlay as a method for restoring or rehabilitating an existing deteriorated pavement is frequently recommended.

One of the main problems with an asphalt overlay is reflective cracking from the underlying mat. In addition to increasing maintenance on the pavement, this cracking reduces the structural strength of the pavement and could eventually lead to the pavement's failure.

Colorado has used low modulus engineering fabrics to reduce reflective cracking in asphalt overlays for several years. Although the method by which fabrics improve pavement life is not fully understood, fabrics are thought to provide both waterproofing and reinforcement for the rehabilitated pavement. In most all cases, fabrics have shown to be effective in retarding longitudinal reflective cracking.

In 1988, Glasgrid, a new type of reflective cracking treatment was introduced in Colorado. Unlike other paving fabrics, Glasgrid is a fiber grid which does not provide any waterproofing. However, according to manufacturer, it has a higher tensile strength and modulus than most engineering fabrics which should provide better reinforcement for reducing reflective cracking in new overlays.

II. OBJECTIVE

The main objective of this study was to evaluate the effectiveness of Glasgrid as a reflective crack reducing method. To do this, two locations were selected for evaluation. The first location was located on I-70, west of the Eisenhower Memorial Tunnel. On this project, the section containing the Glasgrid was evaluated and compared to an equivalent section containing the material (Trevira Spunbond) that was initially selected by the contractor. Both the Glasgrid and Trevira Spunbond test sections were compared to an untreated section.

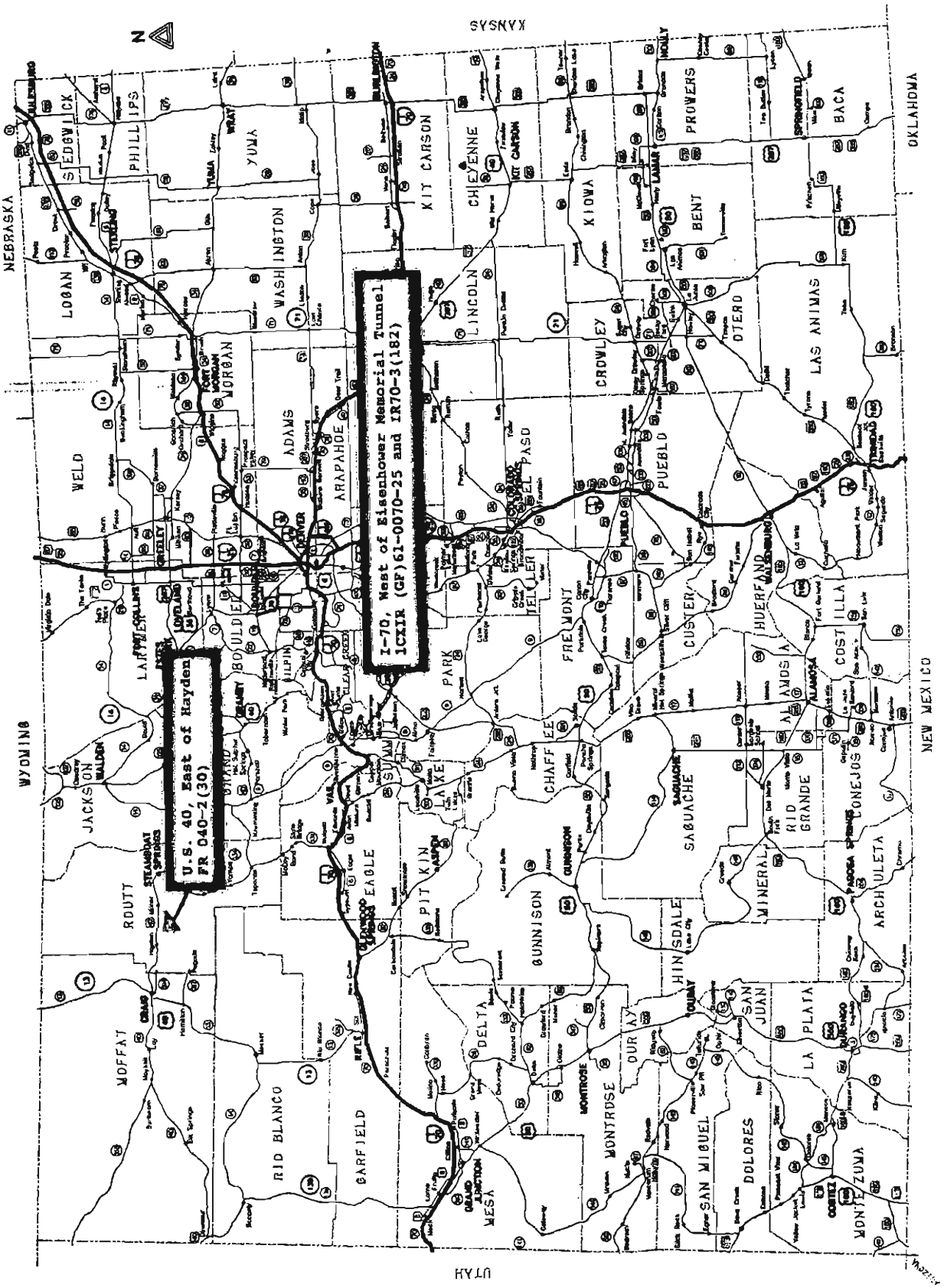
The second location was on U.S 40, east of Hayden. On this project the Glasgrid was placed at two locations. At the first location the Glasgrid was placed over a railroad crossing which was no longer in use. The remainder of the Glasgrid was placed over the construction joint where the pavement was widened.
The location of the projects are shown in Figure 1.

III. CONSTRUCTION, I-70, WEST OF THE EISENHOWER MEMORIAL TUNNEL

The location selected for the evaluation was in an overlay project located on I-70, west of the Eisenhower Memorial Tunnel between the west portal of the Eisenhower Tunnel and the Silverthorne exit. The limits of the combined project Nos. CXIR (GF) 61-0070-25 and IR 70-3(182) were M.P. 212.87 and M.P. 205.53.

The evaluation sections were established in the westbound lanes. The Glasgrid starts at M.P 207 and extends west for approximately 971 feet. The Glasgrid starts at the outside edge of the pavement and extends 22 feet toward the center. In this test section, Trevira Spunbond was placed in the remaining 16 foot of the roadway which covers the passing lane and inside shoulder. At the west end of the Glasgrid test section a 516 foot control section without fabric (untreated) was established. At the end of

FIGURE 1 SITE LOCATION MAP



the control section a 500 foot Trevira Spunbond test section was established (full width). Only the outside 22 feet of these sections were evaluated.

The project consisted of 3/4" (average) leveling course GR EX (GR EX is a 1/2" dense graded mix). The fabric was placed on the top of the leveling course. Two inches of HBP GR C (rubberized) was place on top of the fabric to complete the overlay (GR C is a 3/4" dense graded mix). Both mixes contained AC-10.

On September 23, 1988, the section of Glasgrid was placed. The Glasgrid was placed in the westbound direction in the outside shoulder and driving lane.

Glasgrid comes in five feet wide rolls, 330 feet long. On this section five widths of Glasgrid were placed covering the ten foot outside shoulder and 12 foot driving lane (Appendix A, Photograph 1). The width of the longitudinal overlap was approximately six inches. The specifications for Glasgrid requires a minimum of two inches longitudinal overlap.

Glasgrid is a fiber grid with an adhesive backing which eliminates the need for a tack coat during placement (Appendix A, Photograph 2). A specially adapted tractor was used to place the material (Appendix A, Photograph 3). Once the material was placed on the pavement a rubber tire roller was used to insure a good bond between the Glasgrid and pavement. Since other fabrics require a tack coat, a rubber tire roller is not required with other paving fabrics (Appendix A, Photographs 4 and 5).

A manufacturer's representative was present during the placement to instruct the contractor's personnel in proper installation of the Glasgrid material. He was available to correct problems that arose during the placement. During the placement of the Glasgrid some minor buckling of the

material occurred in one area of the test section due to a slight curvature in the roadway alignment. Overall the placement went quite smoothly considering the contractor had no prior experience in placing Glasgrid.

The remainder of the Glasgrid section which included the passing lane and inside shoulder was covered with Trevira Spunbond. The next 500 feet adjacent to this section on the west side was left untreated. No fabric was placed in this section. From this point to the end of the project Trevira was placed. In each one of these sections a evaluation section was laid out and evaluated for three years. Figure 2 shows the location of the evaluation sections.

Upon completion of the project the pavement was restriped creating three lanes. The Glasgrid now extends from the outside shoulder to within two feet of the stripe between the middle and inside lane which is approximately 22 feet from the outside pavement edge.

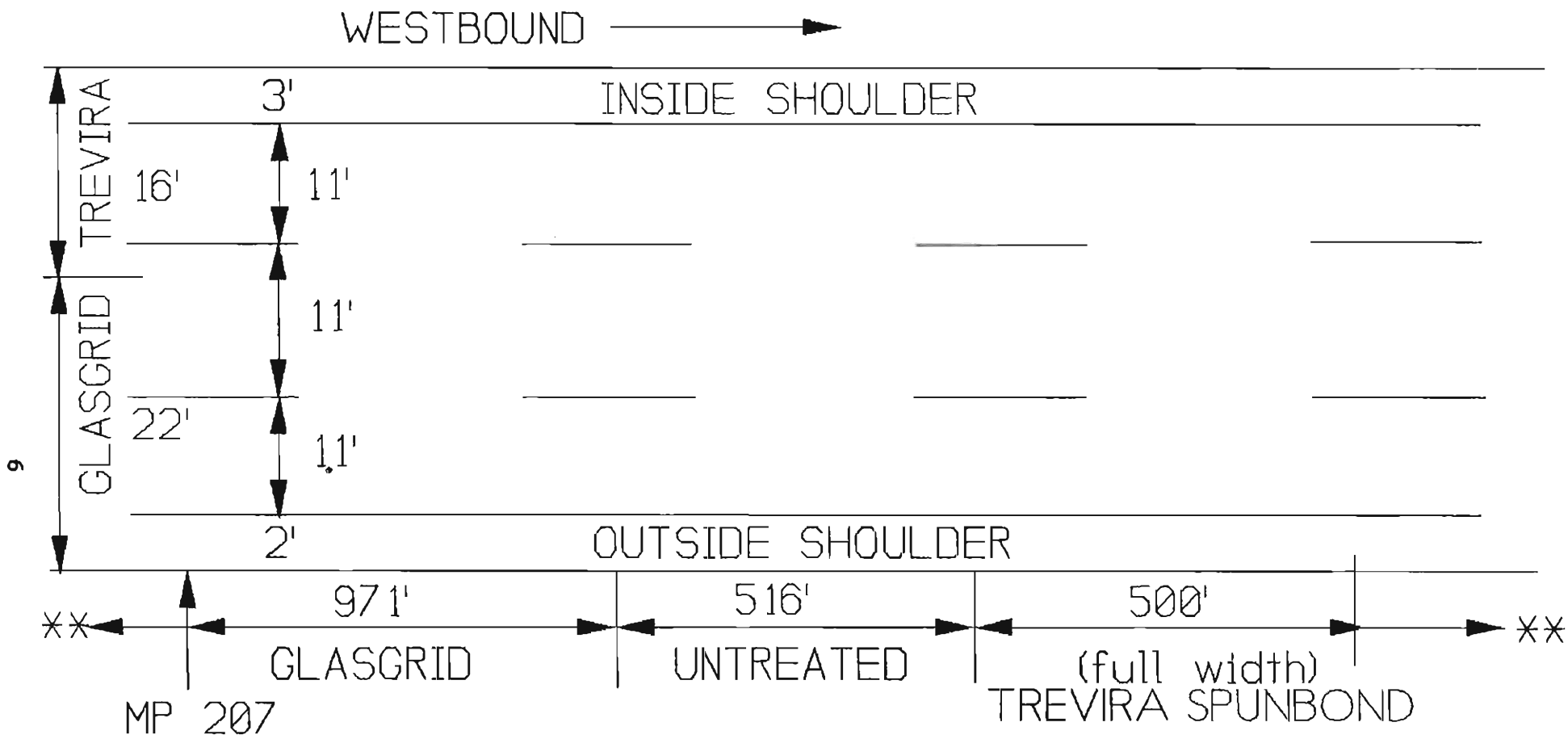
IV. PRE-CONSTRUCTION AND POST-CONSTRUCTION EVALUATIONS I-70, WEST OF EISENHOWER MEMORIAL TUNNEL

Prior to construction, crack maps were drawn of the evaluation section. It was concluded that the three evaluation sections were similar in surface distress (Appendix A, Photograph 6). These crack maps were used to determine if cracking appearing during the evaluation period was reflective.

After construction, evaluations were performed each year. These evaluations included crack mapping and photos. The evaluation made in the Spring of 1992 also included cores and Falling Weight Deflectometer (FWD) measurements. The final evaluation which included only a visual inspection of the pavement surface was made on March 17, 1993.

FIGURE 2. WEST OF EISENHOWER MEMORIAL TUNNEL

(SITE MAP)



** THE REMAINDER OF THE WESTBOUND LANES CONTAIN TREVIRA SPUNBOND

The first evaluation following construction was made June 6, 1989. Reflective transverse and longitudinal cracking had appeared in all three evaluation sections. Typically paving fabrics have not shown to be effective in reducing transverse thermal cracking so the appearance of transverse cracking was expected (Appendix A, Photograph 7). The longitudinal cracking appears to be the result of the longitudinal construction joint and not contributed to the paving fabric (Appendix A, Photograph 8). Cracking at this point of the evaluation was considered minimal.

The next evaluation at this location was made on April 20, 1990. There had been considerable precipitation during the days prior to this visit. On the day of the evaluation the surface of the pavement was dry but the cracks still contained some moisture. The presence of moisture facilitated the identification of even the smallest of cracks. It was noted during this evaluation that longitudinal cracking in the Glasgrid section was appearing at a much faster rate than the Trevira and untreated section.

The next evaluation was made on May 20, 1991. During this review there appeared to be a significant difference in the cracking patterns between the Glasgrid test section as compared to the Trevira Spunbond test section and the control section.

The Trevira and control sections appeared to demonstrate typical reflective transverse and longitudinal cracking. However, the cracking in the Glasgrid section had increased dramatically since the previous April 1990 evaluation. In addition to what appeared to be typical reflective transverse and longitudinal cracking patterns, short longitudinal and transverse cracks were beginning to appear in the wheel paths of the Glasgrid section (Appendix A, Photograph 9).

Further evaluation was needed to determine the cause of this unusual cracking pattern. It was decided that the next evaluation would include FWD measurements for the purpose of evaluating and comparing the roadway strengths of the Glasgrid, Trevira and untreated evaluation sections. In addition, cores would be taken through cracked and uncracked areas in the Glasgrid section to help determine if debonding was occurring in the layers separated by the Glasgrid. Cores would also be taken in the Trevira and untreated sections to evaluate if the cracks were reflective.

On May 14, 1992 the evaluation included core samples and FWD measurements. In the Glasgrid section cores were taken from areas not exhibiting cracking in addition to cores taken over longitudinal cracks and transverse cracks. The cores taken from the areas which were not cracked on the surface did not show any signs of cracking in the lower lifts either. The cores taken over the longitudinal cracks showed no cracks in the lower lifts; the crack only appeared in the overlay and was cracked down to the Glasgrid interlayer (Appendix A, Photograph 10). The core taken over the transverse crack was cracked the entire depth of the pavement (Appendix A, Photograph 11).

All the cores taken in the Glasgrid section separated easily at the Glasgrid. Even the cores taken over the uncracked areas tended to separate easily at the Glasgrid interface (Appendix A, Photograph 12).

The only longitudinal cracks in the untreated and Trevira evaluation sections were located very close to the skip stripe which would have made it very difficult to drill without creating a safety problem. Therefore, cores over longitudinal cracks in the untreated and Trevira evaluation section were not taken. The cores taken over transverse cracks in these sections showed the transverse cracks through the entire depth of the pavement.

The final evaluation was made on March 17, 1993. This evaluation consisted only of a visual observation of the surface. The pavement in the Glasgrid section has a significant larger amount of cracking in the wheel paths than the Trevira and untreated sections (Appendix A, Photograph 13). Most of the longitudinal cracking in the wheel path has deteriorated into alligator cracking. Neither of the other two sections are showing any signs of this type of distress (Appendix A, Photograph 14). Cracking in the Glasgrid section has appeared at a much faster rate than cracking in the Trevira and untreated sections.

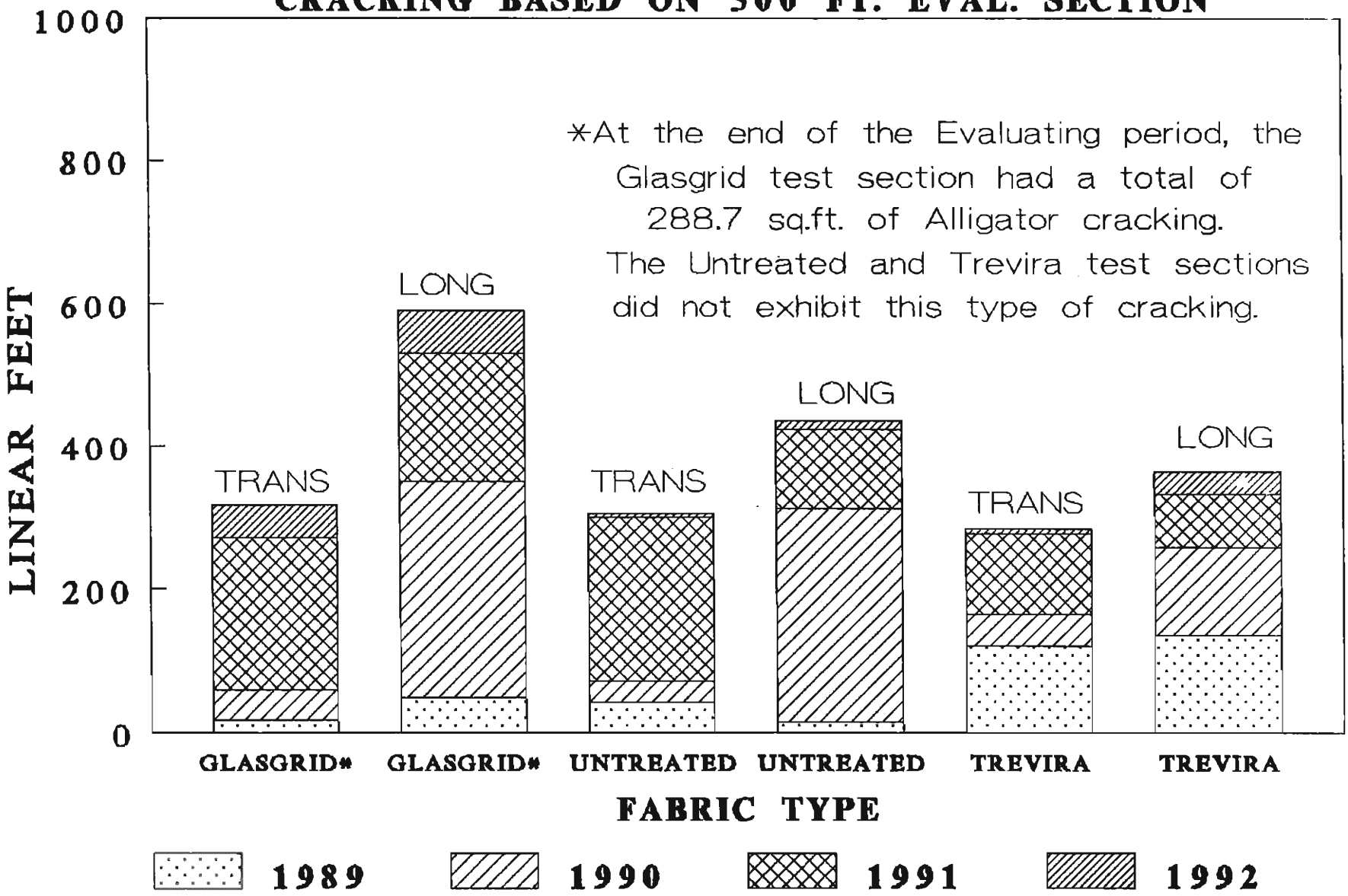
Table 1 shows the comparison of the amount of cracking in the Glasgrid, untreated and Trevira evaluation sections over the evaluation period.

V. CONSTRUCTION, U.S. 40, EAST OF HAYDEN

The remainder of the Glasgrid material which was not used on the I-70 project was placed on project No. FR 040-2(30) east of Hayden on July 7, 1989. The original roadway consisted of two 10 foot driving lanes with one foot shoulders. During construction the driving lanes were widened to 12 feet and two 6 foot shoulders were added (Appendix A, Photograph 15). The Glasgrid was placed in two locations on this project. One location was over a railroad crossing which was no longer in use. A leveling course was first placed on the roadway surface including the abandoned tracks. At the railroad track location the Glasgrid was placed one width wide perpendicular to the roadway and covered with 1-3/4" HBP.

The remainder of the Glasgrid material was placed over the existing pavement and adjacent widened portion of the roadway prior to the overlay. This technique was used to determine if the Glasgrid could retard or prevent the

TABLE 1. CRACKING ON WESTBOUND I-70 WEST OF THE EISENHOWER MEMORIAL TUNNEL



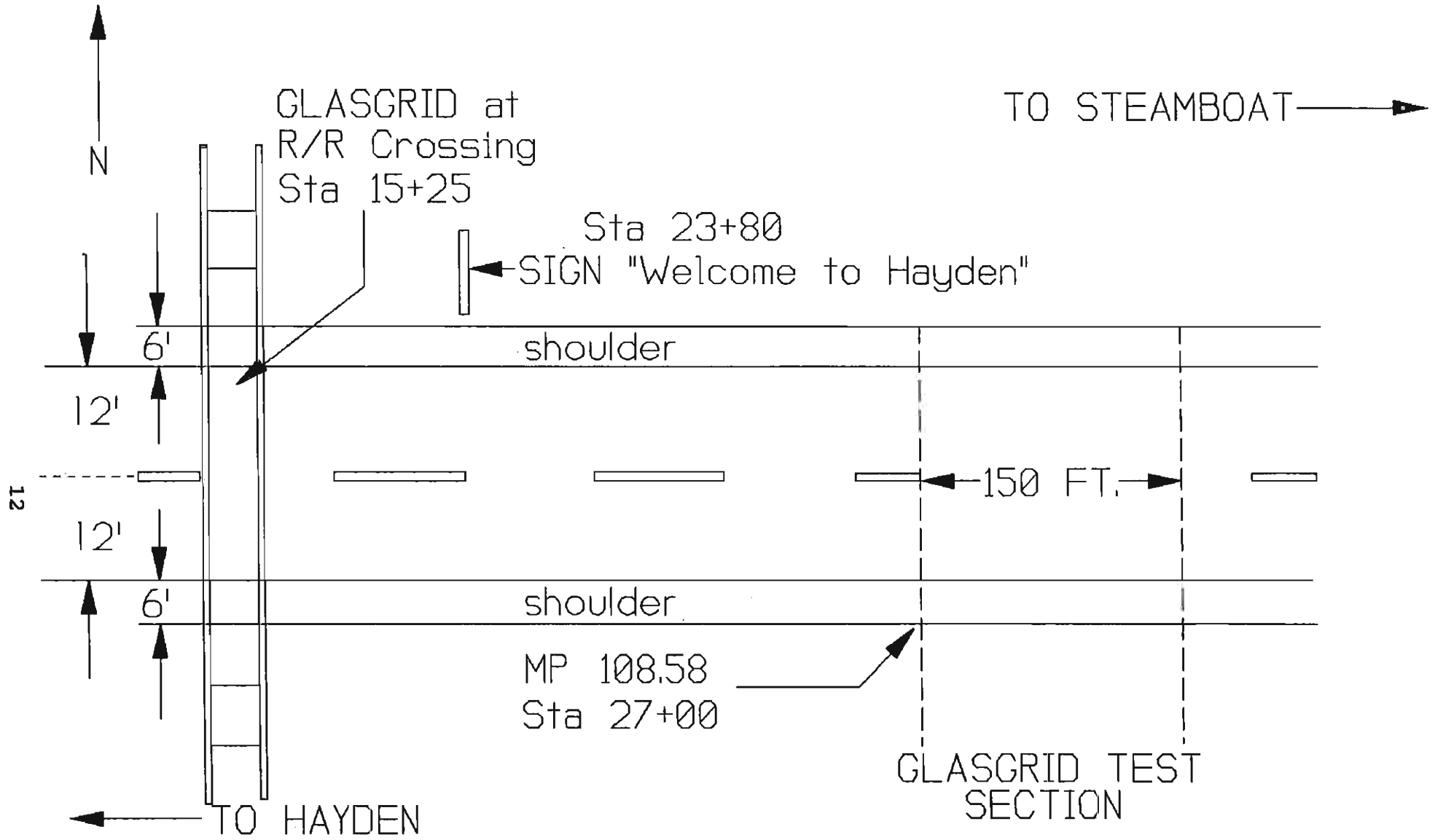
reflective cracking that typically occurs at the a longitudinal construction joint between the existing roadway and the widened section. The material was placed 4 feet in from the shoulder edge, two widths wide for approximately 150 feet (Appendix A, Photograph 16). This covered two feet of the new shoulder, construction joint, and 6 feet of the driving lane. This section was located approximately 2770 feet from the beginning of the west end of the project in the eastbound direction. Figure 3 shows the location of the evaluation sections on this project. This section contained a leveling course, the Glasgrid and a 1" GR E HBP mat (GR E is a 3/4" dense graded mix). This section was covered with a 3/4" PMSC Type B on July 19, 1989.

Both Glasgrid areas were inadvertently tacked. The Glasgrid was not rolled with a rubber tire roller before being paved at either location. During paving there were no obvious problems with the Glasgrid placed over the railroad tracks; however, the material that was placed on the roadway developed folds and considerable slipping occurred when the paver crossed it. It is felt that the tack coat contributed to this problem. This was not a problem during construction on I-70 as all the placement procedures were followed. Although the material at this location was not placed in accordance with manufacturer's recommendations, the test sections were still evaluated.

VI. PRE-CONSTRUCTION AND POST CONSTRUCTION, U.S. 40, EAST OF HAYDEN

Material available from the I-70 project was incorporated on U.S 40 at two locations. The first location was installed over the abandoned railroad tracks. Although the Glasgrid is not marketed for this particular application the project personnel asked to use the Glasgrid to determine its effectiveness in retarding cracking over

FIGURE 3. U.S. 40, EAST OF HAYDEN
(SITE MAP)



the tracks. The second location was placed over the construction joint in the widened section.

Since the main purpose of the evaluation on this project was to determine the effectiveness of the Glasgrid to retard reflective cracking at the construction joint, a pre-construction pavement distress survey was not performed.

Following construction, evaluations were performed each year. These evaluations consisted of visual observations.

Evaluation at Railroad Crossing

During the Spring 1990 evaluation, one year after construction, the evaluation section over the abandoned railroad tracks was showing signs of reflective cracking (Appendix A, Photograph 17).

Prior to the March 17, 1993 final evaluation the overlay and Glasgrid material had been removed and the railroad tracks restored.

Evaluation at Construction Joint

At the final evaluation, March 17, 1993, there is no evidence of reflective cracking at the construction joint. This includes both the untreated and treated areas.

VII. CONCLUSIONS

Based on the amount and severity of distress at the I-70 location, the Trevira and untreated sections performed better than the Glasgrid section. The FWD data taken in 1992 did not provide conclusive evidence for this difference. However, the cores collected during the 1992 evaluation indicate the Glasgrid placed without a tack coat acted as a bond breaker and prevented the overlay from

bonding to the existing pavement. This may have caused the overlay to slip under traffic, resulting in loss of effective structural strength which led to alligator cracking in the wheel paths of the Glasgrid section.

Typically a heavy tack coat is used in conjunction with the placement of a paving fabric; however Glasgrid has an adhesive on the back which eliminates the need for a tack coat. It appears that the adhesive with out tack coat did not provide sufficient bonding for the overlay. The steep grade above the evaluation section and the trucks which are forced to brake because of this grade, may have contributed to the accelerated cracking in the Glasgrid section. Even though the Glasgrid material was installed in strict compliance with the manufacturer's recommendation, the material did not perform at this site as anticipated.

At the U.S. 40 location, there is no apparent difference in performance in the sections with or without the Glasgrid. Neither the treated or untreated sections are showing signs of distress. It is felt that the four years that the Glasgrid has been in place is not long enough to determine the full effectiveness of the Glasgrid's ability to retard the reflective cracking from the construction joint.

The evaluation section, at this site, will continue to be monitored on an informal basis and any notable changes will be reported.

VIII. IMPLEMENTATION AND RECOMMENDATIONS

The findings from this study indicated, Glasgrid did not perform as intended at the I-70 location.

Since the installation of the Glasgrid in Colorado, the manufacturer has changed the adhesive on the back to improve the bond between the grid and the pavement. These changes to

the Glasgrid product should address the possible failure mechanism that occurred at the I-70 location. However, further evaluation on an experimental basis is required before a determination of effectiveness and implementation recommendations can be made.

In addition, since the results of this study indicated that the I-70 failure could have resulted due to a bond failure between lifts. It is recommended that a tack coat be considered in future Glasgrid applications and special care be taken to prevent slipping and folds of the material when the paver crosses it.

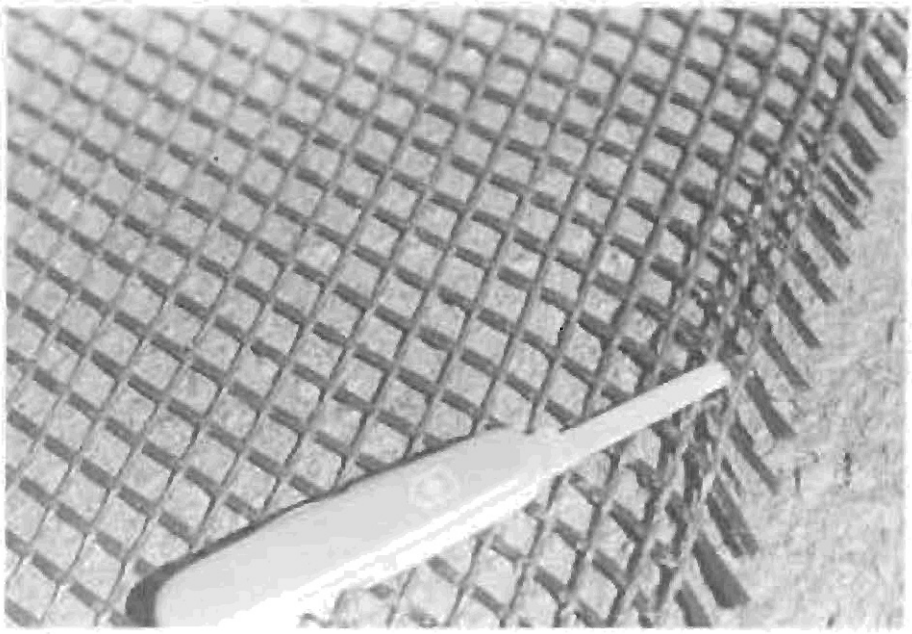
Further evaluations should focus on transverse cracking reduction and also include maintenance applications.

APPENDIX A

Photographs

Photograph 1

The Glasgrid was placed in five widths covering the outside shoulder and driving lane.



Photograph 2

Glasgrid has an adhesive backing which eliminates the tack coat. A rubber tire roller is used to reinforce the bond between the Glasgrid and the pavement surface.

Photograph 3

Specially adapted tractor used to place Glasgrid

Photograph 4

A tack coat was placed prior to laying the Trevira Spunbond.

Photograph 5

The asphalt paving material is placed directly on top of the paving fabrics.

Photograph 6

Typical cracking pattern before overlay

Photograph 7

Typically paving fabrics have not been effective in controlling transverse thermal cracking.

Photograph 8

Majority of the longitudinal cracking in the evaluation sections were determined to be the result of the construction joint.

Photograph 9

May 20, 1991
Cracking in
Glasgrid test
section.

Photograph 10

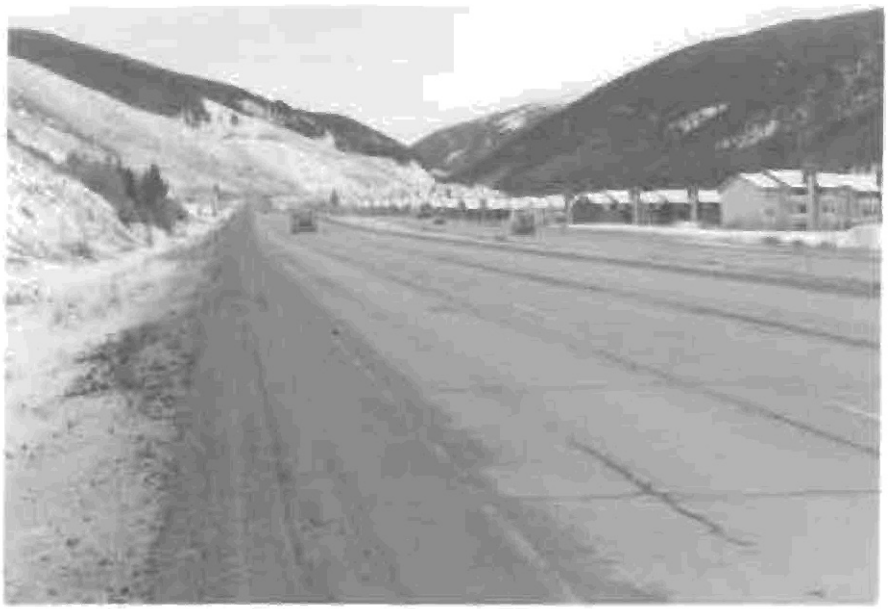
Some of the
longitudinal
cracks only
appeared in the
top mat in the
Glasgrid section.

Photograph 11

The transverse crack in all the evaluation sections went through the entire depth of the pavement. The pavement surface is at the bottom of the photograph.

Photograph 12

The Glasgrid cores broke at the interface between the Glasgrid and the new pavement.



Photograph 13

March 17, 1993
Looking east into Glasgrid evaluation section. This section had more cracking in the wheel paths than the other two evaluation sections.

Photograph 14

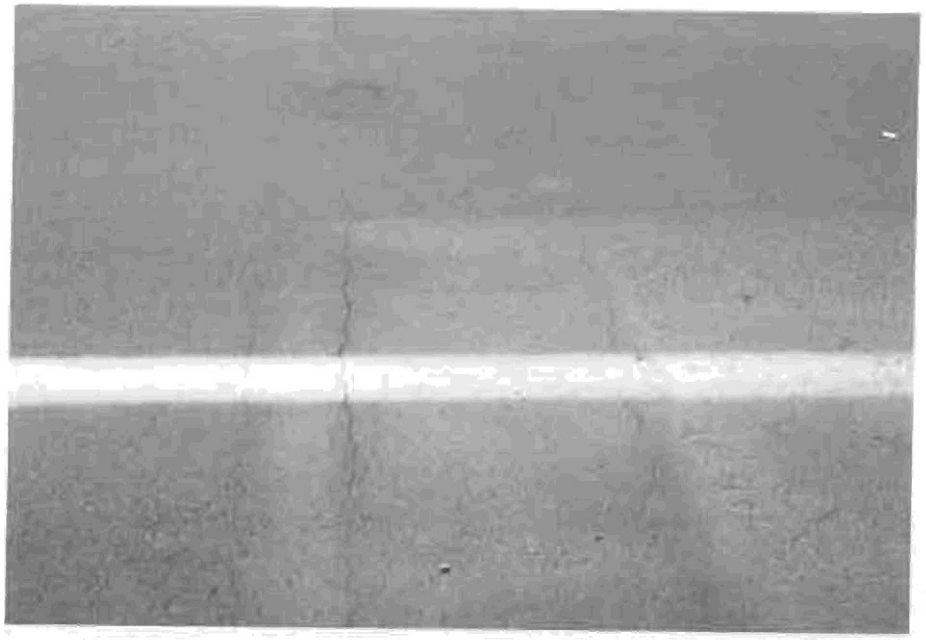
March 17, 1993
Looking west into untreated evaluation section. The cracking in the wheel path is quite different than in Photograph 13.

Photograph 15

During construction the 11 foot driving lanes were widen to 12 feet and a 6 foot shoulder was added in each direction.

Photograph 16

Glasgrid was placed on the construction joint in the widen section.



Photograph 17

The pavement over the railroad tracks began to crack within one year after construction.