

EVALUATION OF GLASGRID BITUMINOUS PAVEMENT  
REINFORCEMENT MESH AND A BITUMINOUS SEPARATION  
COURSE WITH AND WITHOUT LATEX



MATERIALS and TECHNOLOGY  
DIVISION



MICHIGAN DEPARTMENT OF TRANSPORTATION  
M•DOT

EVALUATION OF GLASGRID BITUMINOUS PAVEMENT  
REINFORCEMENT MESH AND A BITUMINOUS SEPARATION  
COURSE WITH AND WITHOUT LATEX

V. T. Barnhart

An Experimental Project by the Michigan  
Department of Transportation in Cooperation  
With the U.S. Department of Transportation  
Federal Highway Administration

Research and Technology Section  
Materials and Technology Division  
Research Projects 88 NM-845 and 89 D-56  
Research Report No. R-1334

Michigan Transportation Commission  
Barton W. LaBelle, Chairman;  
Richard T. White, Vice-Chairman;  
Robert M. Andrews, Jack L. Gingrass  
John C. Kennedy, Irving J. Rubin  
Patrick M. Nowak, Director  
Lansing, October 1995

This report, authorized by the transportation director, has been prepared to provide technical information and guidance for personnel in the Michigan Department of Transportation, the FHWA, and other reciprocating agencies. The cost of publishing 60 copies of this report at \$1.29 per copy is \$77.28 and it is printed in accordance with Executive Directive 1991-6.

## **ACTION PLAN**

1. **Bituminous Advisory Committee**
  - A. **Review and consider recommendation on Bituminous Separation Course and advise the Materials and Technology Division relative to any committee action.**
  
2. **Engineering Operations Committee**
  - A. **No action necessary upon approval of this report.**
  
3. **New Materials Committee**
  - A. **The New Materials Committee should send a letter to the manufacturer and suppliers of this material, Glasgrid, stating that it will not be considered for further use by the Michigan Department of Transportation.**
  
4. **Materials and Technology Division**
  - A. **The Research and Technology Section will terminate these Research Projects 88 NM-845 and 89 D-56, with a memo to the project files after distributing this report to the New Materials Committee, Design Division, and the Districts.**

## INTRODUCTION

This project was initiated in 1988 to evaluate the use of "Glasgrid" as a high strength grid reinforcement mesh for bituminous overlays. In 1989 it was expanded to include an evaluation of the use of a Modified Bituminous Base Course (9A) as a separation course for reducing reflective cracking in a bituminous overlay of an existing pavement. The construction documentation for this project is contained in Research Report No. R-1305.

There have been several installations of high strength grid reinforcement mesh made in pavement rehabilitation projects with bituminous overlays since 1980. A laboratory study was completed in 1982 in Canada, which described the benefits of a high strength grid reinforcement mesh within a flexible pavement system. In 1990, a long term study by the department of a high-strength grid reinforcement mesh made by the Tensar Company was completed and the results of the evaluation were not favorable.

The concept of using a separation course for bituminous overlays of concrete pavements to reduce reflective cracking was evaluated about 1962 by the department by using several types of soil-aggregate cushions to act as separation courses, and the results of the evaluation were favorable. In recent years the department has used bituminous separation courses on several overlay projects, however, no investigative results are available.

## PROCEDURE

Test sections of Glasgrid Reinforcement Mesh and bituminous separation course with (BSCWL) and without latex (BSCWOL) were placed as part of a project (Control Section 73031, Job Number 26705A) that included concrete joint and concrete pavement repair with bituminous resurfacing on M-52 in Saginaw County. The BSCWL and BSCWOL was placed in October 1989, and the Glasgrid reinforcement mesh was placed in November 1989. A section of conventional bituminous resurfacing (Bituminous Mix No. 1100 T, 20AA; and 1100 L, 20AA) was placed as a comparison control section. Figure 1 shows the test section layout, including the control section. Cross-sectional drawings showing pavement design details are in Appendix A.

The test section for the Glasgrid Reinforcement Mesh was further subdivided into two sections, each containing a different type of Glasgrid Material (Glasgrid 8501 Complete Road System and Glasgrid 8502 Detail Repair System [Figure 2]). The Glasgrid Reinforcement Mesh was placed on a bituminous leveling course full width, covering both 12-ft lanes of the roadway (Figures 4 and 5) by means of a tractor modified for the placement of the material (Figure 3). The special provision for the Glasgrid Reinforcement Mesh test sections was in the project proposal and is in Appendix B.

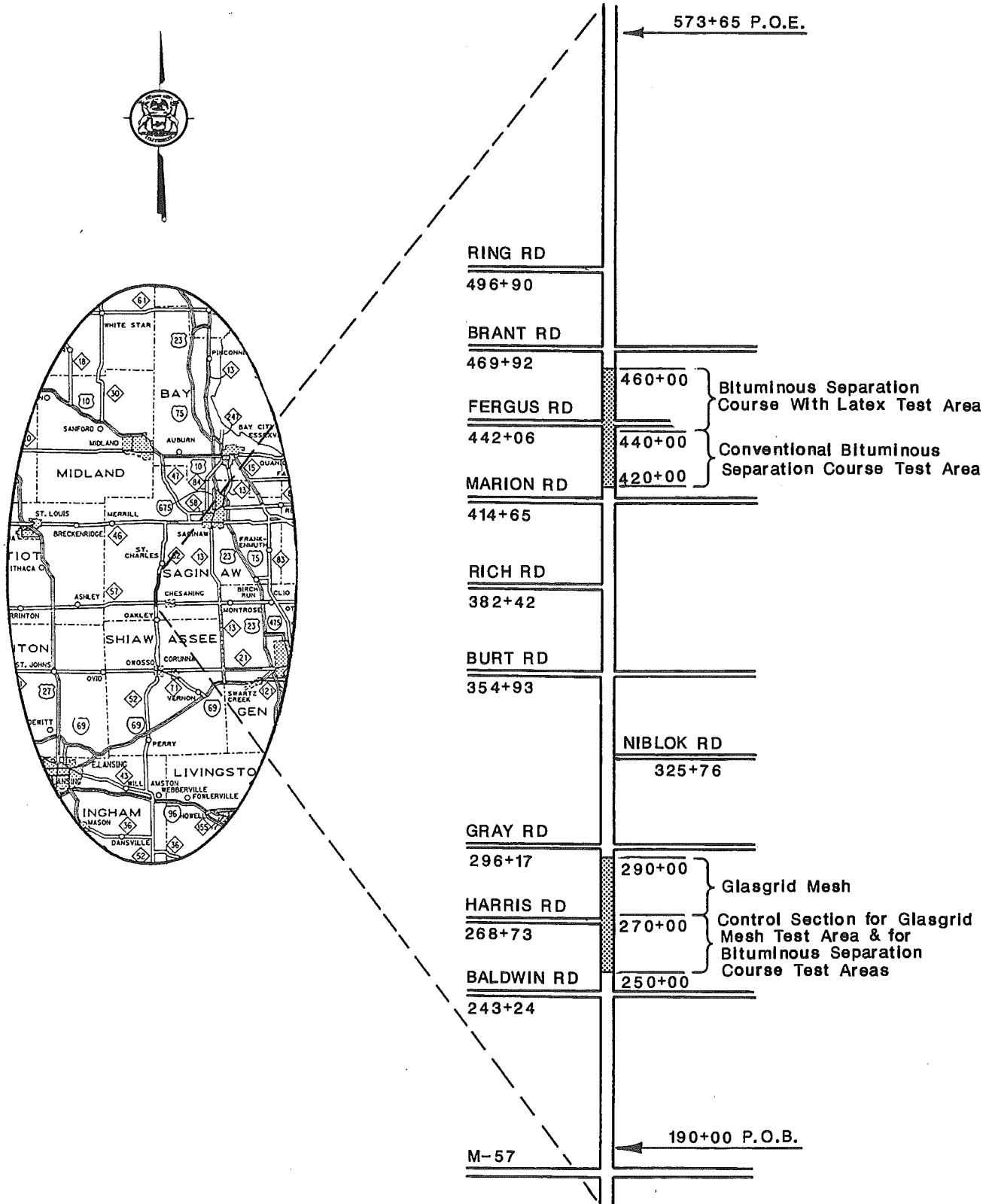


Figure 1. Glasgrid and bituminous separation course test areas, and control section locations.

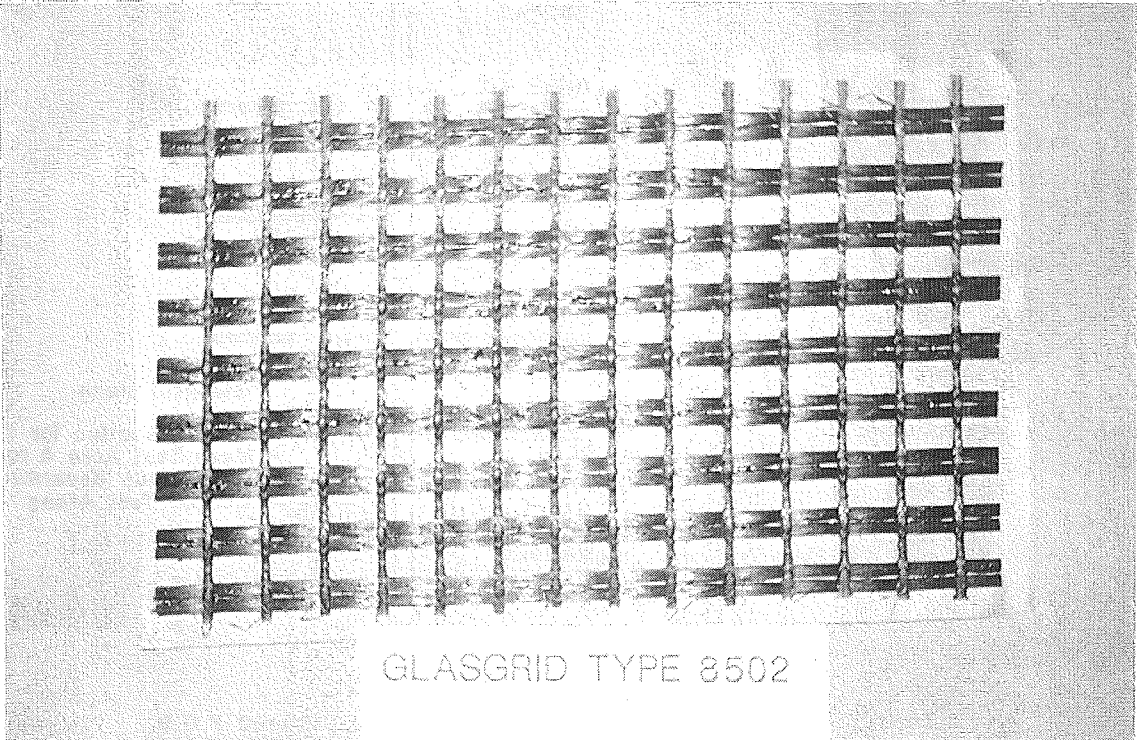
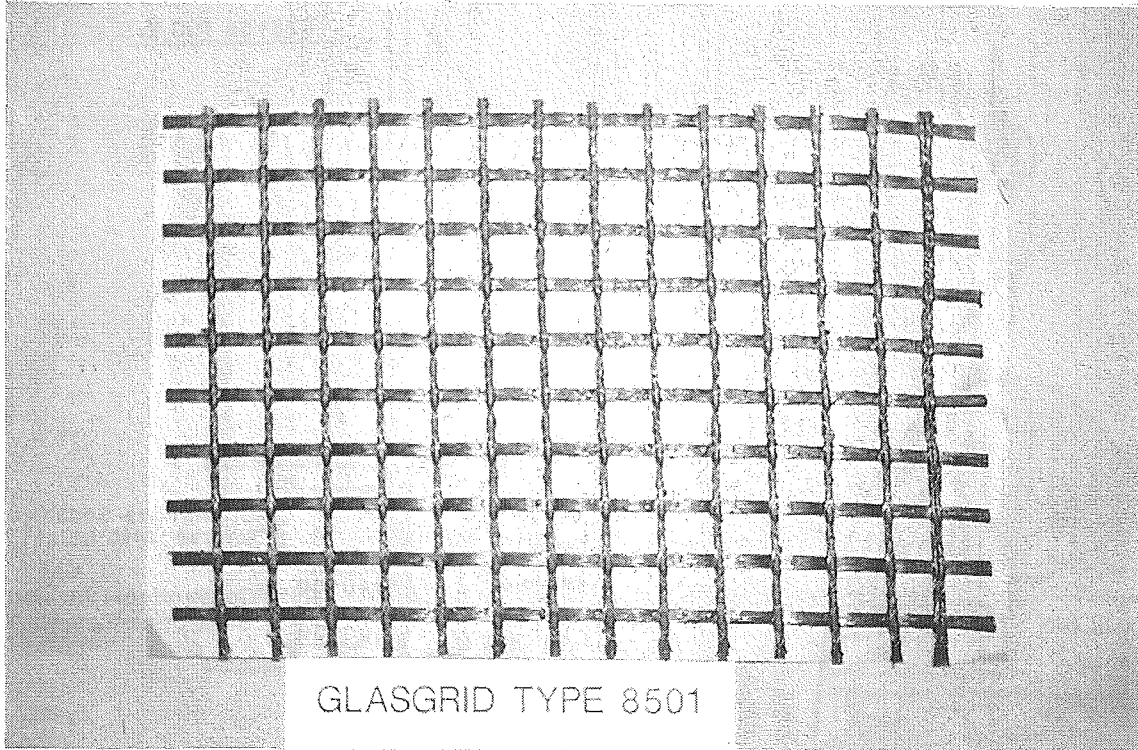


Figure 2 Glasgrid reinforcement mesh type 8501 complete road system and mesh type 8502 detail repair system.



Figure 3. Modified tractor for installing the Glasgrid.

The Glasgrid reinforcement mesh was placed on a bituminous leveling course (Bituminous Mix No. 1100L, 20AA) by means of a tractor modified for the placement of the Glasgrid material (Fig. 2). The Glasgrid was placed on one lane at a time and then covered with a bituminous wearing course (Bituminous Mix No. 1100T, 20AA) at 170 lb/sq yd (1-1/2 in. thick) prior to the Glasgrid being placed on the other lane. The 5-ft wide Glasgrid strips were placed on the northbound lane first, starting at the centerline of the road and working outward toward the outside of the 3-ft shoulder ribbon (Figs. 3 and 4). It was then placed on the southbound lane starting with the overlapping of the material placed on the first pass of the northbound lane and again working outward toward the outside of the 3-ft shoulder ribbon, thus covering almost the entire paved portion of the roadway.

The bituminous separation courses, with and without latex, were both placed in a single 4-in. layer across the roadway, then covered with a bituminous leveling course (Bituminous Mix No. 1100L, 20AA) within 48

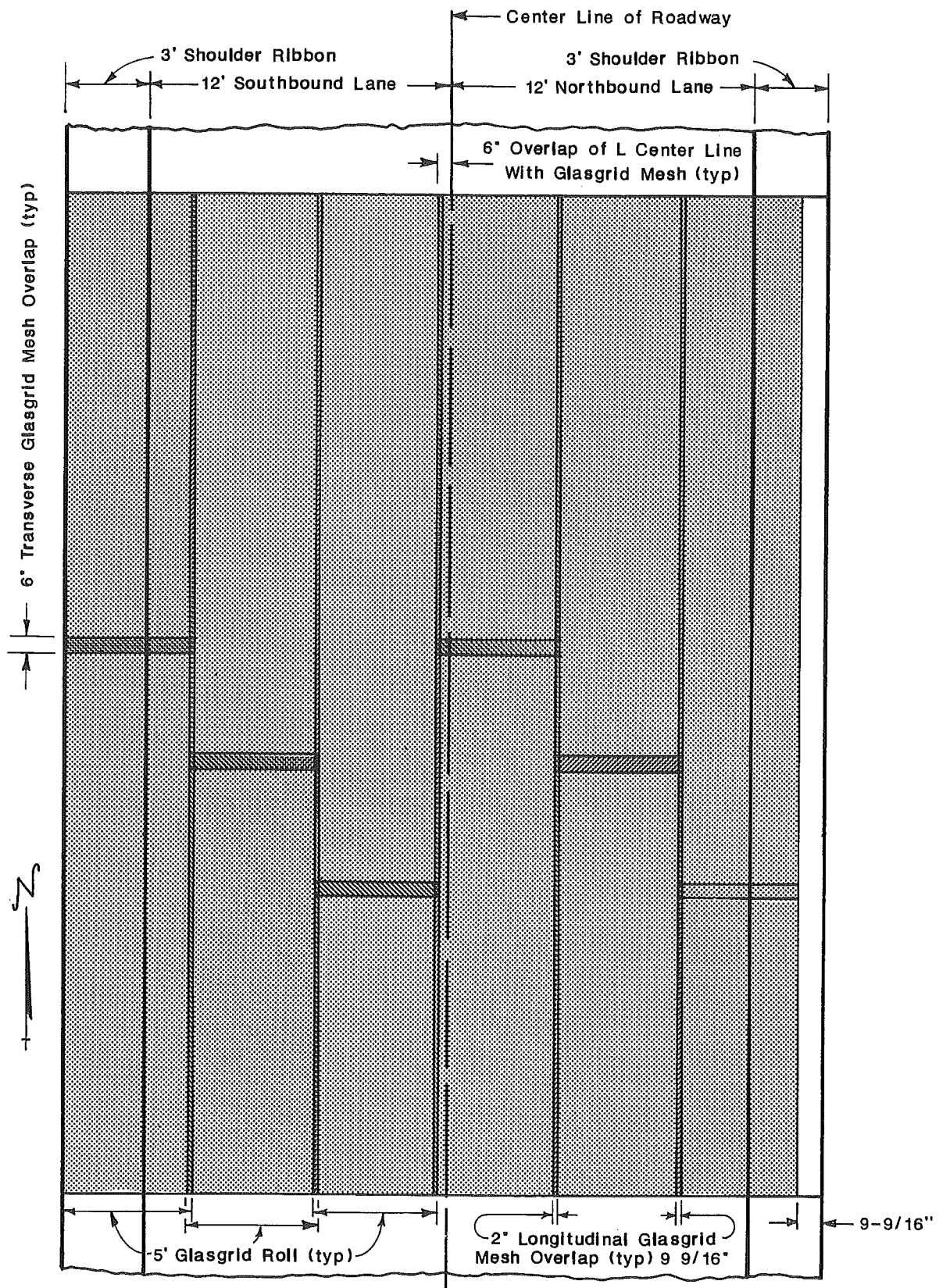


Figure 4. Typical Glasgrid coverage (M 52, Sta. 250+00 to Sta. 290+00).



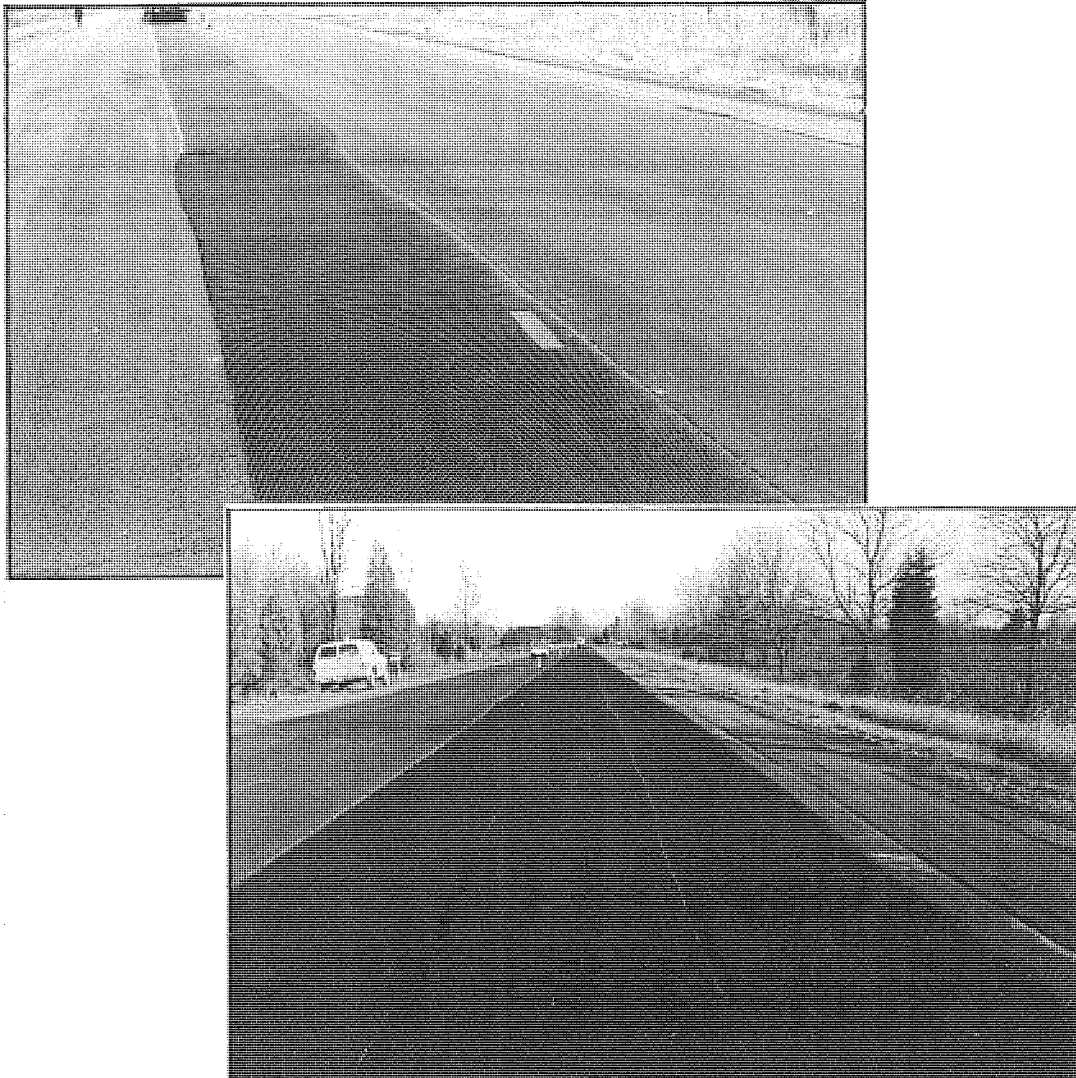


Figure 5. Glasgrid placement.

hours of placement of the separation course. Later, a bituminous wearing course (Bituminous Mix No. 1100T, 20AA) was placed over the leveling course. Because of the thickness of the separation course, it was necessary for safety purposes that at the end of each day, the separation course have the same point of ending on both lanes. The separation course was placed and compacted using the same type of equipment used for the bituminous leveling and wearing courses.

#### Evaluation

The following problems occurred during the placement of the Glasgrid reinforcement mesh.

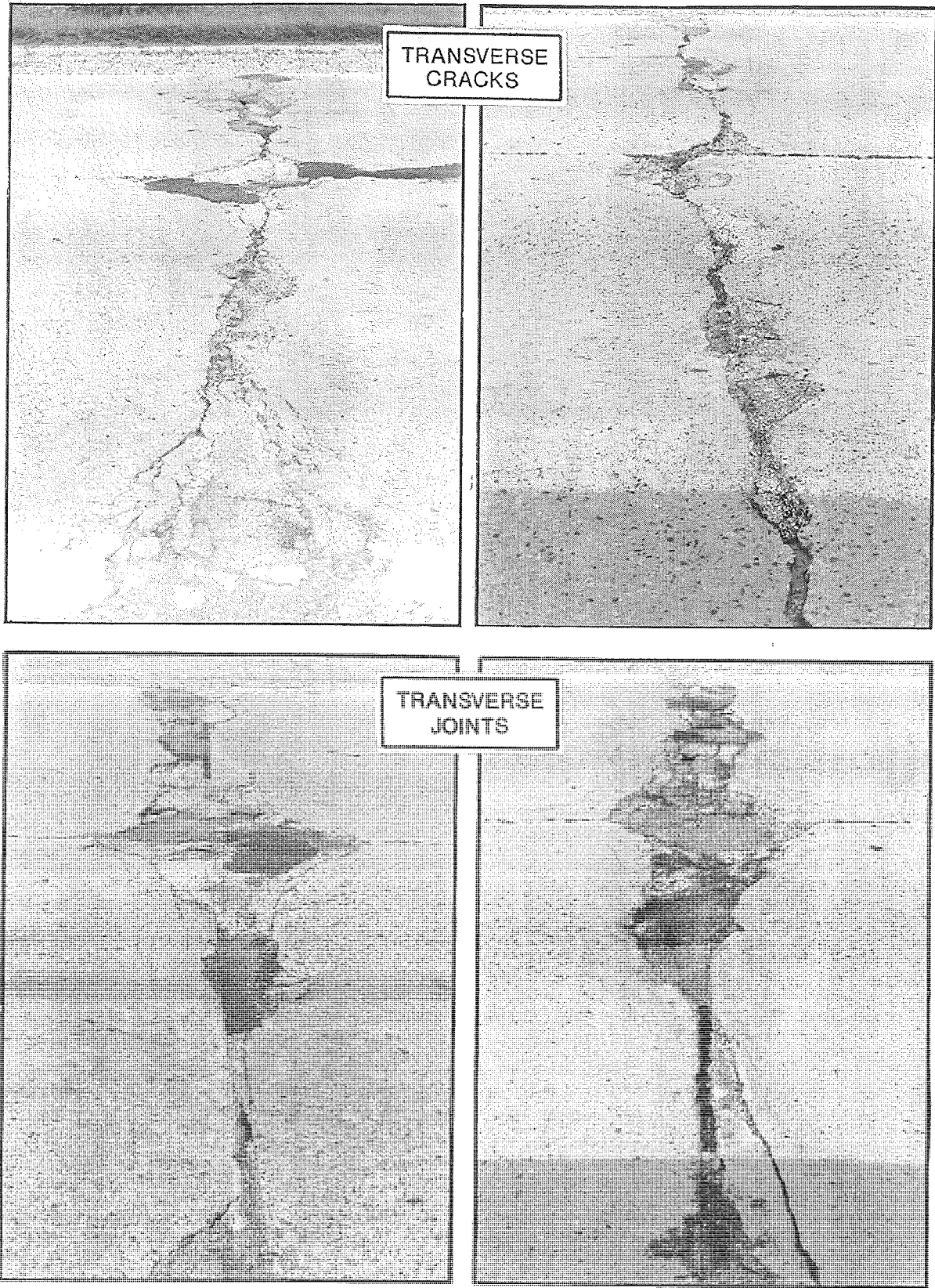


Figure 6. Typical conditions on M-52 prior to the start of construction.

# RELATIVE EFFECTIVENESS OF VARIOUS

## TREATMENTS TO PREVENT REFLECTIVE CRACKING

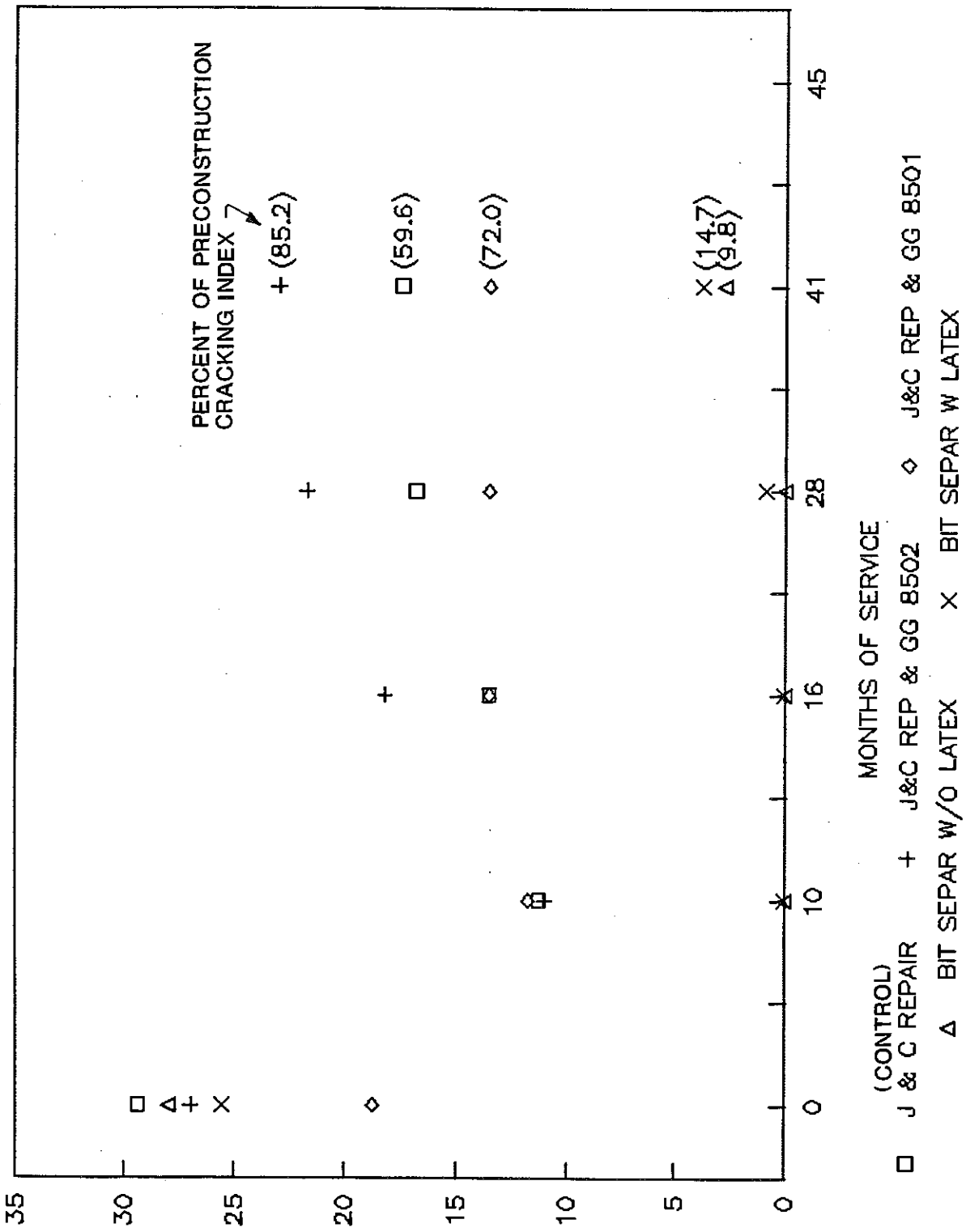


Figure 7.

TABLE 1 September 8, 1989  
RESEARCH PROJECT 88 NM-845, PLACEMENT OF GLASGRID ON M-52

**BITUMINOUS JOINT AND CRACK REPAIR TRANSVERSE REPAIR**

Station	Repair Detail for Southbound	Repair Length Edge of Metal to Centerline	Repair Detail for Northbound	Repair Length Edge of Metal to Centerline
250+22	8	11	7	11
251+15			7	4
251+90	8	11	8	11
252+31	7	2	7	11
252+90	8	11	8	11
253+35			7	11
254+41			7	11
254+90	8	11	8	11
255+90	8	11	8	11
256+87	8	11	8	11
257+88	8	11	8	11
258+25			7	11
258+87	8	11	8	11
259+85	8	11	8	11
260+85	8	11	8	11
262+77	8	11	7	11
263+77	8	11	8	11
264+75	8	11	8	11
265+75	8	11	8	11
266+70	8	11	8	11
267+30			7	6
267+67	8	11	8	11
268+68	8	11	8	11
270+67	8	11	8	11
271+65	8	11	8	11
272+63	8	11	8	11
273+61	8	11	8	11

TABLE 1 September 8, 1989  
**RESEARCH PROJECT 88 NM-845, PLACEMENT OF GLASGRID ON M-52**

**BITUMINOUS JOINT AND CRACK REPAIR TRANSVERSE REPAIR**

Station	Repair Detail for Southbound	Repair Length Edge of Metal to Centerline	Repair Detail for Northbound	Repair Length Edge of Metal to Centerline
274+70	8	11	8	11
275+60	8	11	8	11
276+60	8	11	8	11
278+60	8	11	8	11
280+47	8	11	8	11
281+50	8	11	8	11
282+00	8	11	8	11
283+00	8	11	8	11
283+97	8	11	8	11
284+97	8	11	8	11
286+95	8	11	8	11
287+95	8	11	8	11
288+93	8	11	8	11

**BITUMINOUS JOINT AND CRACK REPAIR LONGITUDINAL REPAIR**

Station to Station	Repair Detail	Distance Along Centerline
250+40	250+54	7
256+56	256+61	7
257+55	257+57	7
269+60	269+64	7

The BSCWL and BSCWOL were both placed in a single layer four inches in thickness across the roadway and then covered with a bituminous leveling course within 48 hours. The amount of latex in the bituminous separation course with latex was  $3 \pm 0.3$  percent by weight of the asphalt cement. The special provision for the bituminous separation course test sections was in the project proposal and is in Appendix B.

A condition survey, including crack mapping, was conducted on the old pavement before resurfacing as a basis for comparing the effectiveness of the two treatments in retarding reflective cracking. From that condition survey, the project was determined to be in poor condition. This determination was based on the amount of cracking observed on the roadway and the amount of distress associated with the joints and cracks. The distress associated with the joints and cracks consists of small cracking around the transverse or longitudinal crack or joint, and if any concrete material was missing along the crack or joint. The typical condition of the transverse cracks and joints at the time of the condition survey is shown in Figure 6. The joints and cracks that were treated with MDOT Detail 7 or MDOT Detail 8 joint and crack repair for the test and control sections are shown in Table 1. Visual inspections and crack surveys were made in September 1990, March 1991, April 1992, and April 1993 to monitor relative performance of the Glasgrid and the bituminous separation course with and without latex. Cracking Index (CI)<sup>1</sup> values for the several treatments are given in Table 2.

TABLE 2								May 3, 1994
RESEARCH PROJECTS 88 NM-845 AND 89 D-56								
SUMMARY OF CRACK SURVEYS ON M-52 FROM M-57 TO ST. CHARLES								
Type of Repair Before Overlay	Cracking Index							
	Pre-Const. <sup>1</sup>	Service Life, Months				41 Months % Of Preconst.	Ranking	
		10	16	28	41			
Joint & Crack Repair (Sta. 250+00 to Sta. 270+00)	29.4	11.3	13.5	16.9	17.5	59.6	3	

<sup>1</sup>CI is determined by counting the number of full-width (two lane) transverse cracks plus 1/2 of the one lane transverse cracks in a 500-ft section of pavement.

<p style="text-align: center;">TABLE 2 <span style="float: right;">May 3, 1994</span>  RESEARCH PROJECTS 88 NM-845 AND 89 D-56  SUMMARY OF CRACK SURVEYS ON M-52 FROM M-57 TO ST. CHARLES</p>							
Type of Repair Before Overlay	Cracking Index						
	Pre-Const. <sup>1</sup>	Service Life, Months				41 Months % Of Preconst.	Ranking
		10	16	28	41		
Joint & Crack Repair & Glasgrid Type 8502 Placed (Sta. 270+00 to Sta. 280+00)	27.0	11.0	18.3	21.8	23.0	85.2	5 Worst
Joint & Crack Repair & Glasgrid Type 8501 Placed (Sta. 280+00 to Sta. 290+00)	18.8	11.8	13.5	13.5	13.5	72.0	4
Bituminous Separation Course Without Latex (Sta. 420+00 to Sta. 440+00)	28.0	0.0	0.0	0.0	2.8	9.8	1 Best
Bituminous Separation Course With Latex (Sta. 440+00 to Sta. 460+00)	25.5	0.0	0.0	0.9	3.8	14.7	2

<sup>1</sup>In determining the cracking index for the preconstruction, the transverse joints were counted as full-width (two-lane) transverse cracks.

The relative effectiveness of each of the rehabilitation treatments is compared in Figure 7. Table 2 and Figure 7 indicate that none of the treatments completely eliminated reflective cracking. The bituminous separation course without latex, however, was more effective than the other treatments in delaying the reflective cracking coming through the overlay, the next best treatment being the bituminous separation course with latex. The relative effectiveness of the treatments is shown in the last column of Table 2 where the CI, after 41 months of service, is expressed as a percentage of the CI for the old roadway prior to rehabilitation. The CI values measured before

the rehabilitation ranged from 18.8 to 29.4 (Table 2) indicating that the control and test sections were similar prior to this evaluation.

Figures 8, 9 and 10 show the typical condition of each of the treatment sections after 41 months of service. As Figure 9 shows, there is less reflective cracking with the Glasgrid Type 8501 reinforcement mesh than with the Glasgrid Type 8502 reinforcement mesh, although the type 8502 mesh has a higher tensile strength than the type 8501 mesh. Figure 10 shows that there is less reflective cracking with the BSCWOL than the BSCWL.

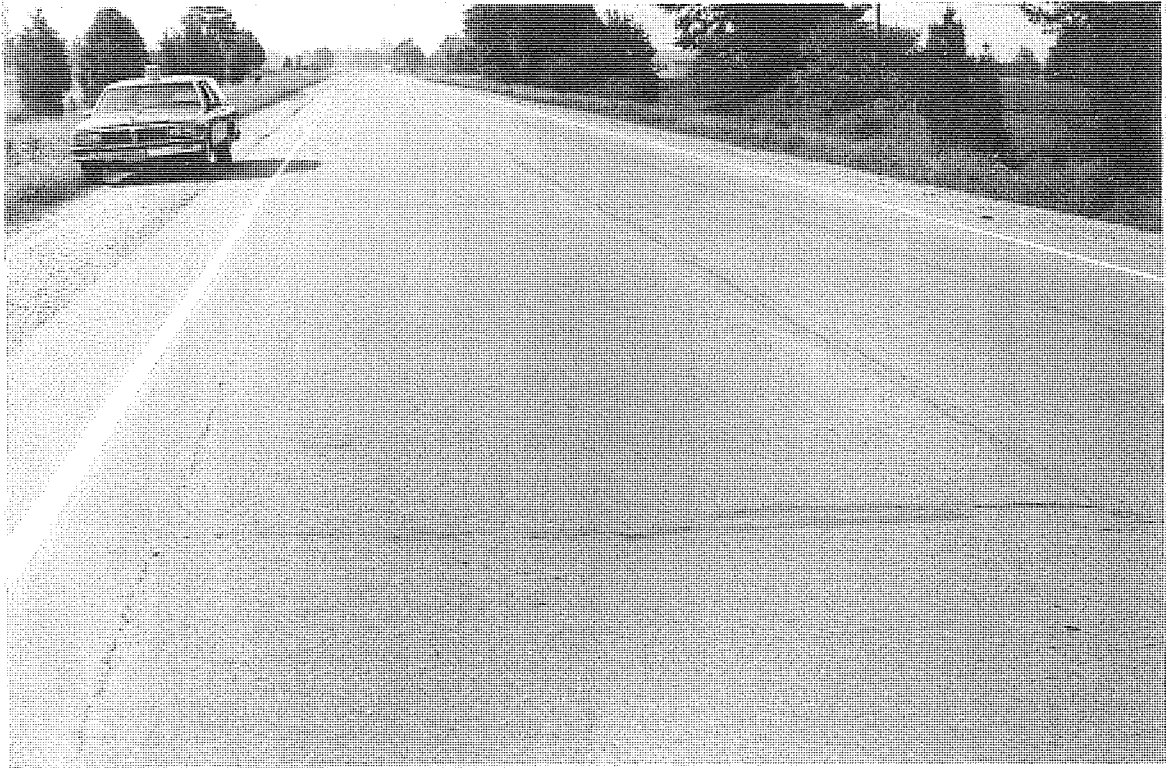
On August 31, 1993, core samples were taken on the project for the purpose of determining the condition of the two types of Glasgrid reinforcement mesh and of the bituminous separation course with and without latex. Core samples were taken through reflective cracking where the separation course or reinforcement mesh had been placed. The cores showed that both types of Glasgrid reinforcement mesh had failed to remain intact (Figure 11). There was lack of bond noted between the Glasgrid mesh and the top course of the bituminous overlay.

The BSCWL appears to have held together better than the BSCWOL, as shown in Figure 12. However, both mixtures appear to be providing a stable base for the bituminous overlay. Also, the fact that the BSCWOL did not appear to hold together as well as that with latex could account for less reflective cracking in the bituminous separation course without latex.

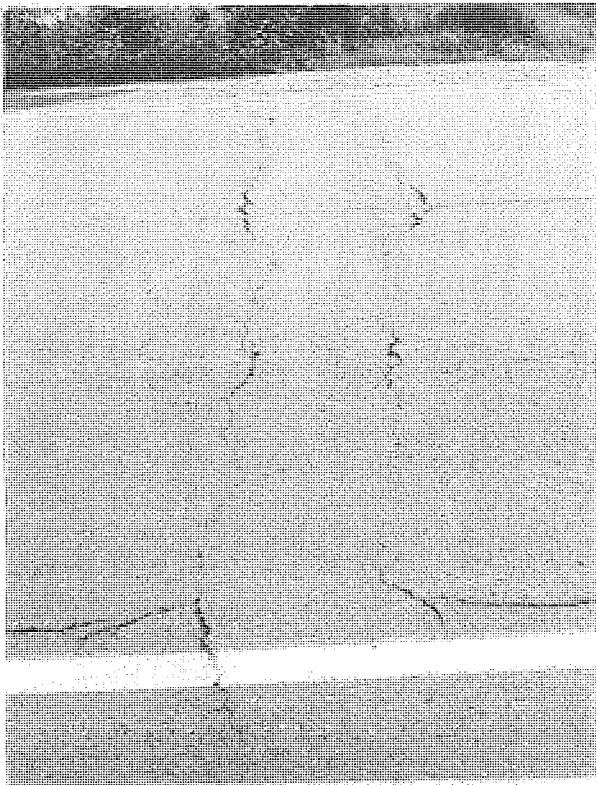
### Relative Effectiveness

The relative effectiveness of the several treatments is presented in Table 3, which shows relative reflective cracking after 41 months of service and the cost per square yard of the rehabilitation methods. Cost effectiveness is compared by considering the ratio of the treatment unit cost to percentage of reflective cracks that were prevented (using the preconstruction CI for each section as a base). This effectiveness ratio shows that the bituminous separation course without latex is the most cost effective, while the conventional joint and crack repair (MDOT Detail 7 and MDOT Detail 8) prior to resurfacing is the second most effective.





Typical condition of control section (joint & crack repair only). After 41 months of service.



Reflective cracking from Detail 8 joint repair in Control Section. After 41 months of service.

Figure 8

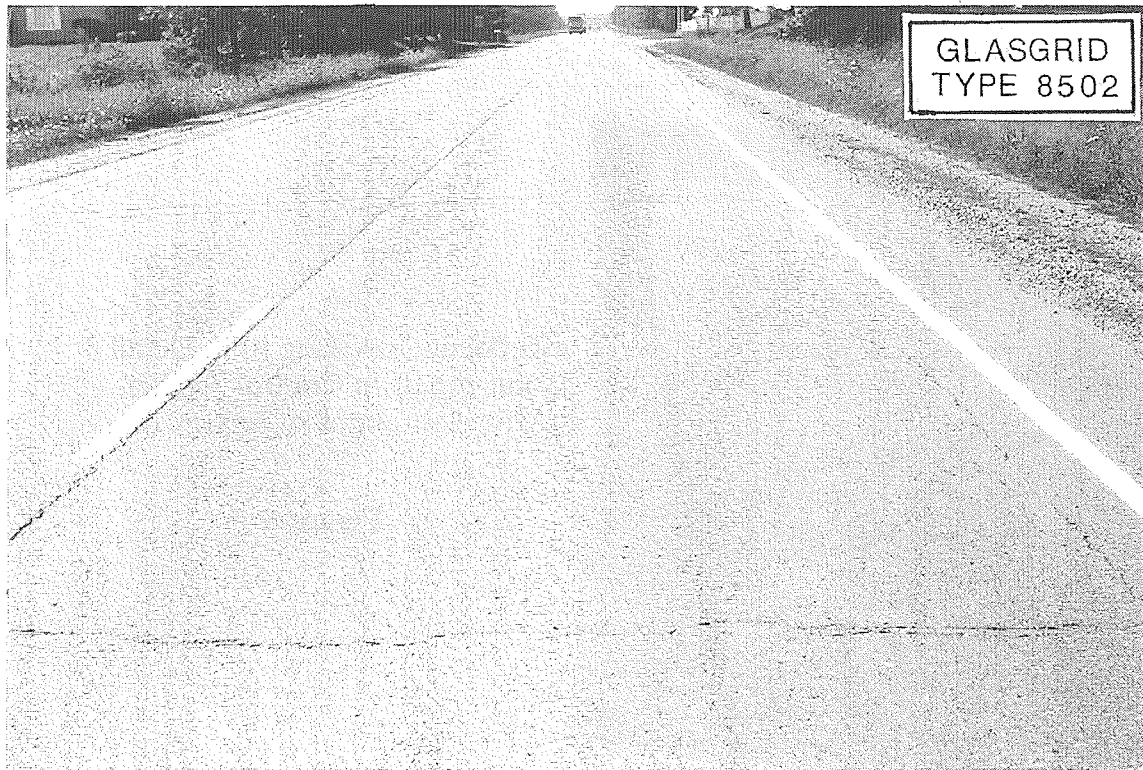
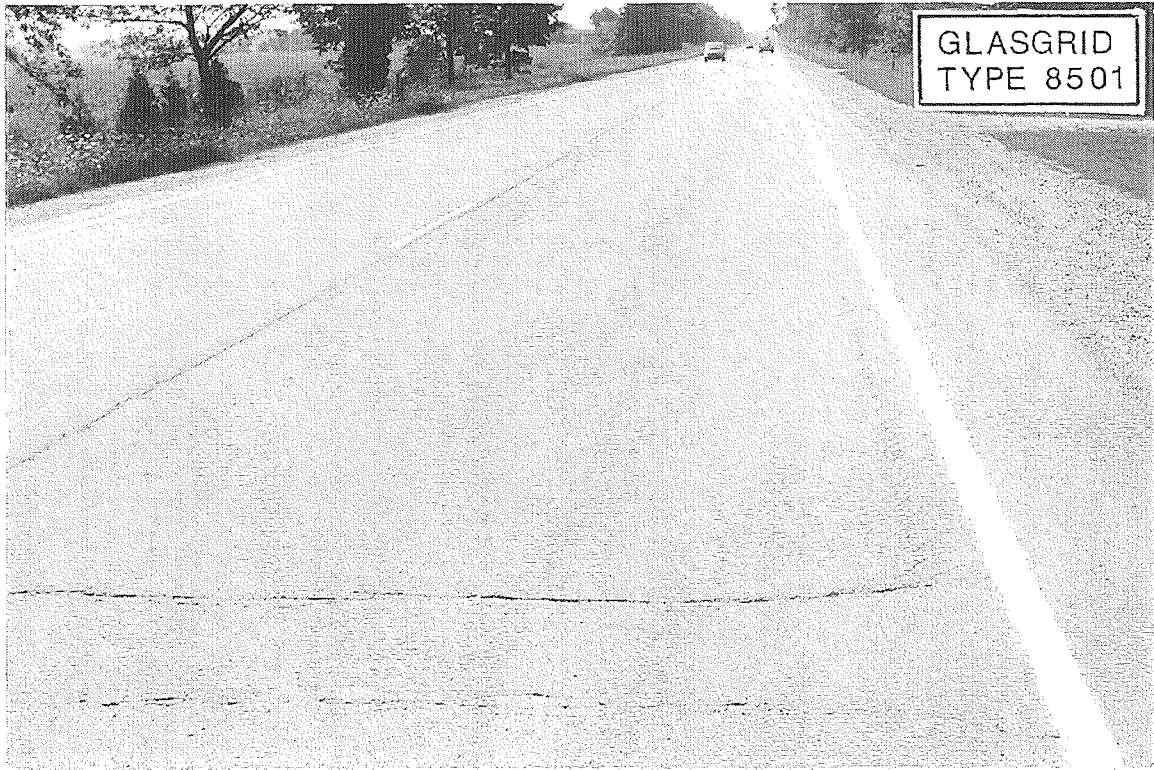


Figure 9 Typical condition of test area after 41 months of service.

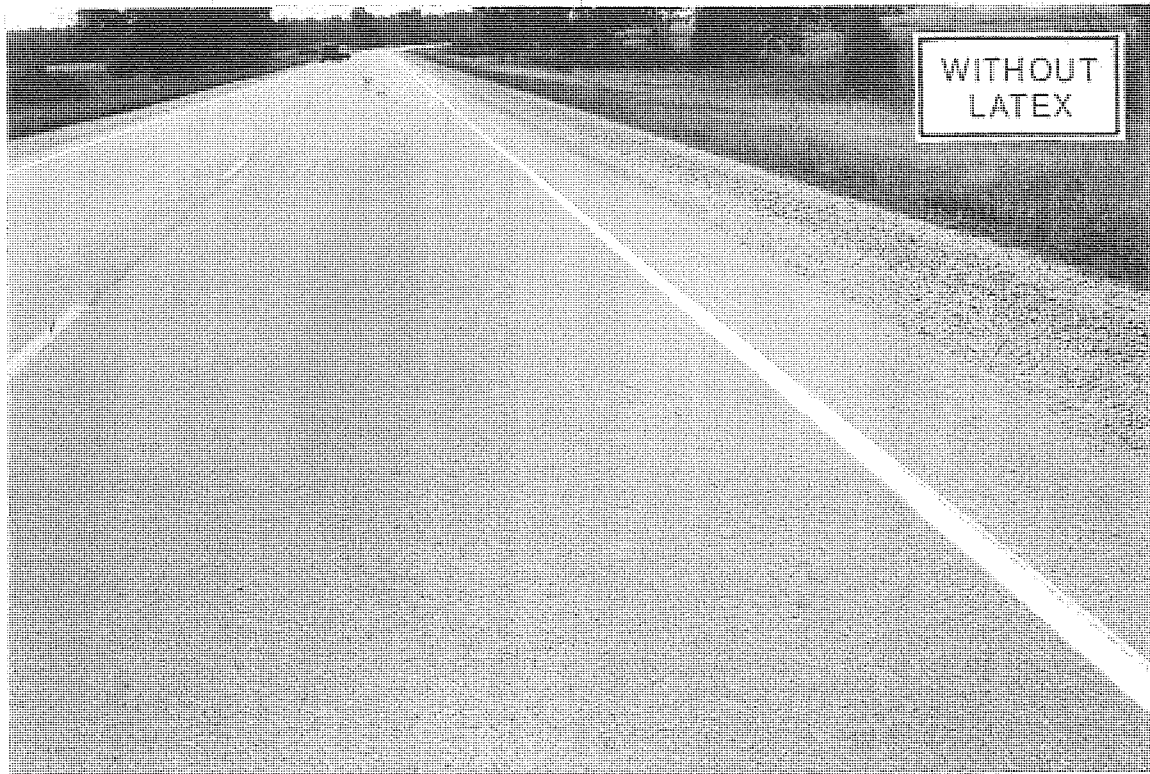


Figure 10 Typical condition of test area with bituminous separation course after 41 months of service.



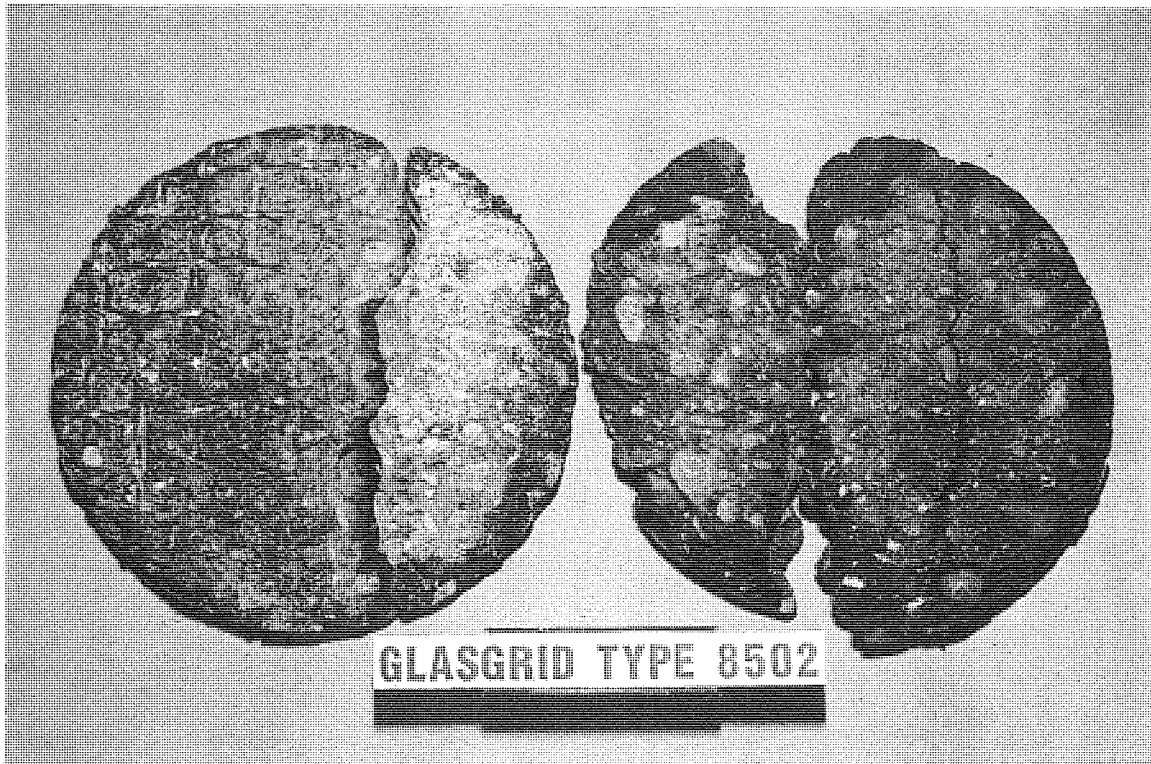
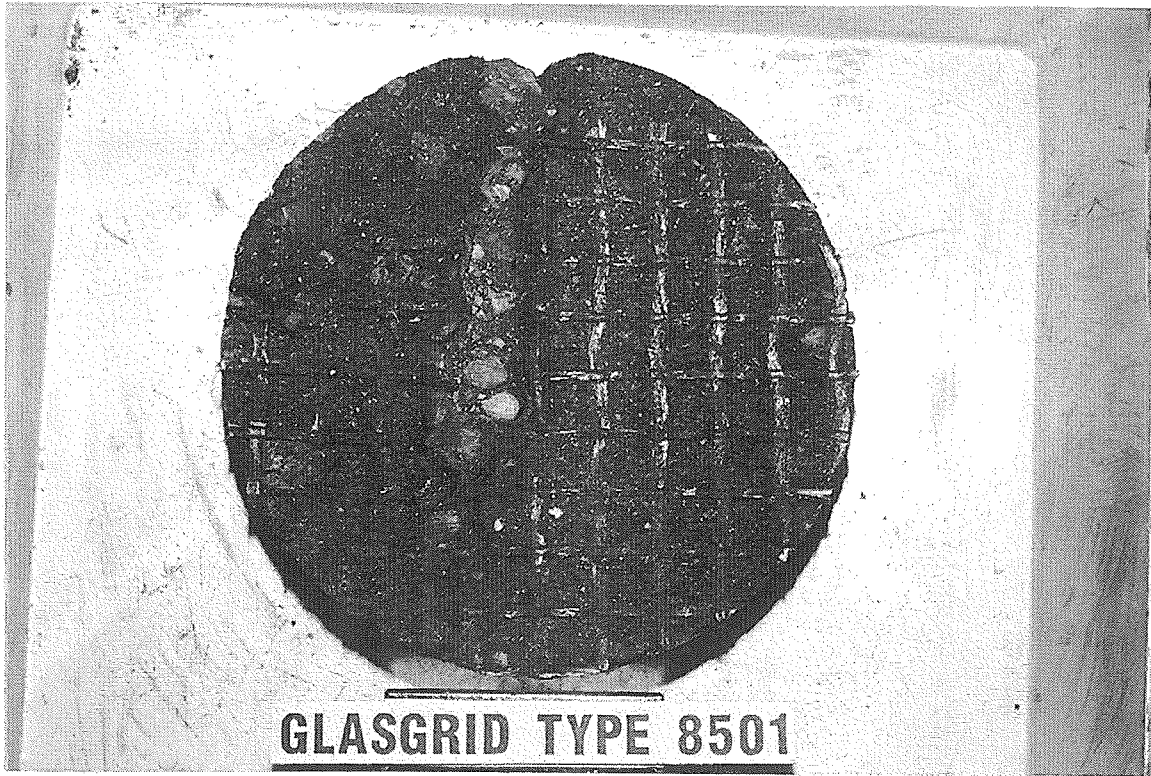


Figure 11 Typical condition of Glasgrid reinforcement mesh after 41 months of service.



Figure 12 Typical condition of Bituminous Separator Course after 41 month of service.

TABLE 3 EFFECTIVENESS OF THE REHABILITATION METHODS				
May 5, 1994				
Treatment (Including Resurfacing)	Unit Cost \$/syd	CI (% of Pre-Const.)	Cost Effectiveness	
			Ratio <sup>5</sup>	Ranking
Joint & Crack Repair <sup>4</sup>	3.48 <sup>1</sup>	59.6	8.61	2
Glasgrid Type 8502 <sup>3</sup> / Joint & Crack Repair <sup>4</sup>	7.07 <sup>2</sup>	85.2	47.72	5 Worst
Glasgrid Type 8501 <sup>3</sup> / Joint & Crack Repair <sup>4</sup>	7.07 <sup>2</sup>	72.0	25.25	4
Bituminous Separation Without Latex	7.55 <sup>1</sup>	9.8	8.37	1 Best
Bituminous Separation With Latex	8.05 <sup>1</sup>	14.7	9.44	3

<sup>1</sup>Including cost of 270 lb/syd bituminous surfacing at \$2.87/syd.

<sup>2</sup>Including cost of 300 lb/syd bituminous surfacing at \$3.21/syd.

<sup>3</sup>The cost of the Glasgrid Type 8501 and Glasgrid Type 8502 is \$3.25/syd.

<sup>4</sup>The cost of the Detail 7 Joint and Crack repair is \$0.25/syd, and the cost of the Detail 8 Joint and Crack repair is \$0.37/syd.

<sup>5</sup>Cost effectiveness ratio = Unit Cost/[1-[CI(% of Pre-Const.)/100]].

## CONCLUSIONS

Glasgrid Type 8502 reinforcement mesh was the least effective and most costly method of reducing reflective cracking. Glasgrid Type 8501 reinforcement mesh was fourth best in reducing reflective cracking and was also fourth in cost effectiveness.

The most cost-effective measure was the bituminous separation course without latex, which was also best in reducing reflective cracking. The bituminous separation course with latex was second best in reducing reflective cracking and third best in cost effectiveness.

The conventional joint and crack repair (MDOT Detail 7 and Detail 8) was second best in cost effectiveness and third best in reducing reflective cracking.

As of the April 1993 inspection the reflective cracks in all of the sections had not spalled at the edges or faulted.

## RECOMMENDATIONS

Based on the results of this field trial further use of Glasgrid reinforcement mesh should not be considered.

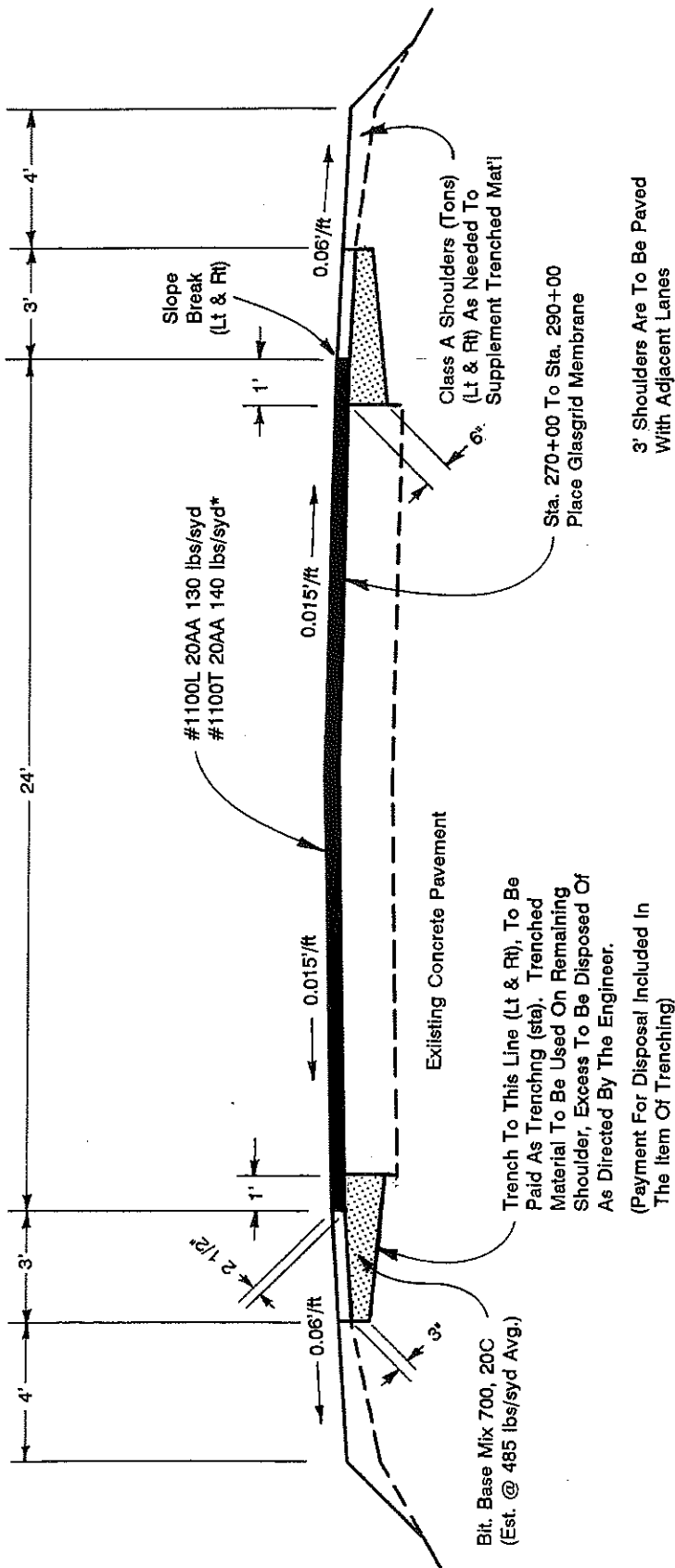
Joint and crack repair, such as the conventional partial and full depth (MDOT Detail 7 and Detail 8) used on sections of this job, and bituminous separation course with and without latex can be recommended on the basis of this evaluation.

## REFERENCES

1. "Geogrid Reinforcement of Asphalt Pavement and Verification of Elastic Theory," A. O. Abdel Halim, Ralph Hass, and William A. Phang, Transportation Research Record No. 949, P.P. 55-65.
2. "Soil-Aggregate Cushions for Prevention of Reflective Cracking of Resurfaced Pavements," F. Copple, Michigan Department of Transportation Research Reports 423, 470, 599 R and 649.
3. "Michigan Investigation of Soil-Aggregate Cushions and Reinforced Asphaltic Concrete for Prevention or Reducing Reflective Cracking of Resurfaced Pavements," F. Copple and L. T. Oehler, Michigan Department of Transportation Research Report 649 and Highway Research Record No. 239.
4. "Evaluation of Tensar Bituminous Pavement Reinforcement," J. H. DeFoe, Michigan Department of Transportation Research Report R-1307.



**APPENDIX A**



TO APPLY  
 STA 190+00 TO STA 333+00  
 STA 343+00 TO STA 368+00

\*Use 1100T 20AA 170/lbs syd Where  
 Glasgrid Membrane Is Placed

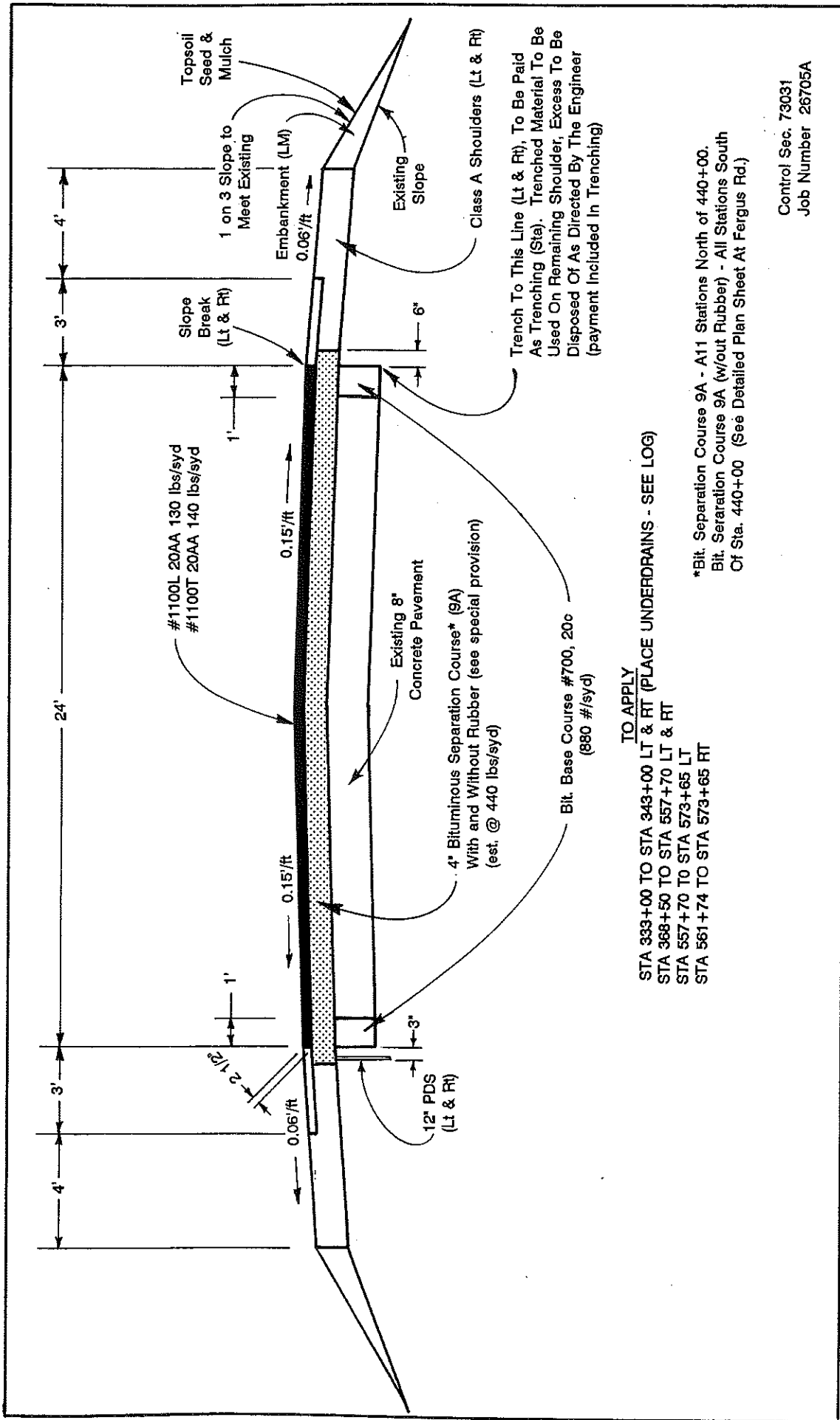
Trench To This Line (Lt & Rt), To Be  
 Paid As Trenching (sta). Trenched  
 Material To Be Used On Remaining  
 Shoulder, Excess To Be Disposed Of  
 As Directed By The Engineer.  
 (Payment For Disposal Included In  
 The Item Of Trenching)

3' Shoulders Are To Be Paved  
 With Adjacent Lanes

Sta. 270+00 To Sta. 290+00  
 Place Glasgrid Membrane

Note: Dowelled Concrete Repairs And Detail 7 & 8  
 Repairs As Per Log Prior To Resurfacing.

Control Sec. M73031  
 Job Number 26705A



TO APPLY  
 STA 333+00 TO STA 343+00 LT & RT (PLACE UNDERDRAINS - SEE LOG)  
 STA 368+50 TO STA 557+70 LT & RT  
 STA 557+70 TO STA 573+65 LT  
 STA 561+74 TO STA 573+65 RT

\*Bit. Separation Course 9A - A11 Stations North of 440+00.  
 Bit. Separation Course 9A (w/out Rubber) - All Stations South  
 Of Sta. 440+00 (See Detailed Plan Sheet At Fergus Rd.)

Control Sec. 73031  
 Job Number 26705A

## BITUMINOUS APPLICATION CHART

ITEM	APP. RATE LBS/SYD	ESTIMATED THICKNESS	ASPHALT PENETRATION	REMARKS
BITUMINOUS MIX. NO. 1100T, 20AA	140	1 1/4"	120 - 150	
BITUMINOUS MIX. NO. 1100T, 20AA	170	1 1/2"	120 - 150	
BITUMINOUS MIX. NO. 1100L, 20AA	130	1 1/4"	120 - 150	
BITUMINOUS MIX. NO. 700, 20C	330	3"	120 - 150	
BITUMINOUS MIX. NO. 700, 20C	660	6"	120 - 150	
BITUMINOUS MIX. NO. 700, 20C	880	8"	120 - 150	
BITUMINOUS SEPARATION COURSE 9A	440	4"	120 - 150	
BITUMINOUS SEPARATION COURSE 9A (w/out Rubber)	440	4"	120 - 150	
BITUMINOUS BOND COAT O.O - 0.1 GAL/SYD (FOR INFORMATION ONLY NOT A BID ITEM)				

**APPENDIX B**

MICHIGAN  
DEPARTMENT OF TRANSPORTATION  
BUREAU OF HIGHWAYS

SPECIAL PROVISION  
FOR  
CONSTRUCTION OF BITUMINOUS PAVEMENT  
REINFORCED WITH GLASGRID MATERIAL

D:PMC:blr

1 of 2

5/25/88

**Description:**

This work consists of the placement of GLASGRID bituminous pavement reinforcement. The GLASGRID is to be placed from station 270+00 to Station 290+00 between the bituminous concrete leveling and wearing courses. Coverage will include traffic lanes plus 3 (three) feet of paved shoulder on each side for a total width of 30 (thirty) feet.

**Materials:**

Glasgrid will be purchased from Bay Mills Limited, 277 Lakeshore Road, Suite 400, Oakville, Ontario. Bay Mills will provide the GLASGRID at a cost of \$3.25 per sq. yds (which includes the use of a mechanical fabric placement tractor and the operator) delivered to the job site. Inquiries and arrangements concerning GLASGRID should be made to Mr. Jon H. Woolstencroft, Project Manager at (416)842-8308.

**Glasgrid Material:**

Roll Width	60 in.
Roll Length	330 ft.
Roll Weight	183 lb.

**Glasgrid Installation:**

Glasgrid shall be installed on the leveling course in accordance with the following procedures:

The leveling course shall be made clean, smooth, dry and free of fines, oil, grease and loose or foreign material.

The placement of the Glasgrid should proceed within 30 (thirty) minutes of the placement of the wearing course. A mechanical fabric placement tractor (which meets the manufactures specifications) shall be used for applying Glasgrid to ensure a smooth, tight application, free of any wrinkles. The longitudinal overlap for strips of Glasgrid must be 2 (two) inches and the transverse overlap for strips of Glasgrid must be a minimum of 6 (six) inches. Centerline overlap is not required.

Glasgrid shall be seated with a rubber tire roller to eliminate any placement discontinuities and insure a good bonding between the Glasgrid and the leveling course.

The asphalt spreader shall not be turned sharply on the road and the hauling units shall stop and turn with care to prevent shifting of the Glasgrid.

Wearing course application and compaction may be performed in the usual manner after Glasgrid placement has been completed.

It is recommended that gloves be worn when handling this product.

A pre-bid meeting will be scheduled by MDOT to discuss Glasgrid installation.

The contractor shall be responsible for scheduling the placement of Glasgrid with Bay Mills Limited.

**Open to Traffic:**

The area where the Glasgrid was placed may be opened to construction traffic in accordance with the manufacturer's specification or as directed by the Engineer. No general traffic shall be allowed on the area where the Glasgrid was placed until the wearing course has been placed.

**Measurement and Payment:**

The completed work as measured for BITUMINOUS PAVEMENT REINFORCEMENT will be paid for at the contract unit prices for the following contract item (pay item).

<u>Pay Item</u>	<u>Pay Unit</u>
Glasgrid	Square Yard

Glasgrid will be measured by area in square yards with no allowances for necessary laps and splices.

MICHIGAN  
DEPARTMENT OF TRANSPORTATION  
BUREAU OF HIGHWAYS

SPECIAL PROVISION  
FOR  
SEPARATION COURSE 9A

a. Description.—This work shall consist of furnishing materials, blending them in the proper proportions and placing them in the specified manner. This work shall be done in accordance with the applicable requirements of Sections 4.00, 7.10, and 8.02 of the 1984 Standard Specifications, except as otherwise specified herein.

Separation Course Mixture

b. Materials.—The materials shall meet the requirements specified herein or shall meet the requirements specified in the section of the 1984 Standard Specifications designated, as follows:

1. Bituminous Materials 8.04

2. Aggregate (9A Gradation and Physical Requirements) 8.02

3. Rubber Compound.—The rubber compound to be used in the bituminous concrete mixture shall be an approved unvulcanized virgin synthetic rubber in the liquid latex form. The Manufacturer of the rubber compound shall provide a written certification showing the target value for total rubber solids content of the rubber compound and containing actual test results showing compliance with the following requirements for ash content and viscosity:

Allowable Range of Target Value for Total

Rubber Solids, % by Weight.....45-72%

Allowable Variation from Target Value for

Total Rubber Solids, % by Weight.....± 1%

Ash, % of Total Rubber Solids, ASTM D297, maximum.....3.5%

Viscosity, Brookfield Units, Model RVF,

Spindle No. 2 at 20 rpm at 25C, maximum.....2000

The rubber compound shall be compatible with the reference asphalt such that the following properties are exhibited:

Softening Point, C Raise from Reference

Asphalt, ASTM D 36, minimum.....8

Penetration at 25C, 100 g, 5 sec., mm/20

drop from Reference Asphalt, ASTM D 5, minimum.....6

Viscosity, Poises, 60C, minimum.....2500

Penetration at 4C, 200 g, 60 sec, mm/10 increase

from Reference Asphalt, ASTM D5, minimum.....1

Ductility at 4C., 1 cm/min., ASTM D113.....150+

The rubber compound shall be compatible with the reference asphalt and reference aggregates such that the following properties are exhibited:

Dispersion of Rubber: Number of remaining black

particles visible to the naked eye.....None

c. Composition of the Bituminous Mixture.—The 9A aggregate will be blended with the bituminous material of the grade specified at the following proportions (by total weight):

9A Aggregate 97% to 98 1/2%

Bituminous Material 1-1/2% to 3% \*

\*The Engineer can increase the percentage of asphalt cement above 3% if needed to ensure coating of aggregates.



The mixture shall be produced as per Section 7.10 of the 1984 Standard Specifications except as herein specified.

d. Rubber Compound Handling Equipment.-The rubber insertion equipment shall be capable of precisely metering and uniformly distributing the latex into the asphalt mixture. The insertion system shall be calibrated in order to verify that the output rate is matched with the plant production rate within the specified tolerance.

e. Bituminous Plant.-The use of a surge bin for the storage of bituminous mixtures will be permitted. The maximum time material may be stored in a surge bin is 30 minutes. If drainage of the asphalt from the mixtures occurs during the use of the surge bin, the time allowed for storage shall be reduced until there is no drainage of the rubber-asphalt separation course.

f. Composition of Rubber-Asphalt Mixture.-The rubber-asphalt required for the mixture shall contain rubber solids whose weight equals  $3 \pm 0.3$  percent of the weight of the asphalt cement. The asphalt cement shall be penetration grade 120/150 asphalt cement or viscosity grade AC-5. In batch plants the rubber compound shall be added to the pugmill approximately 10 seconds after the addition of the asphalt cement. In drum plants the rubber compound shall be added at a point after the aggregate has been coated with asphalt cement but at a distance from the discharge end of the drum adequate to insure thorough mixing.

g. Mixture Temperature Limitations.-The temperature of the aggregate when introduced into the mixture shall not exceed 380 F; this maximum temperature limit for the aggregate will be lowered if it is found that the rubber-asphalt binder is separating from the aggregate while transporting to the job site. The mixture shall be placed at a temperature of not less than 300 F nor greater than 350 F as measured in the hauling unit just prior to unloading into the spreader when rubber is present in the mixture.

h. Weather Limitations.-The mixtures shall not be placed unless the surface to be paved is dry. The minimum air temperature for placement shall be 50 F.

i. The pavement section from the Pickerel River Bridge (station 368+50+) northerly to station 440+00 shall not have the rubber compound added to the Separation Course 9A. Asphalt cement of the proper grade only shall be used in the mixture.

#### Construction Methods

Construction methods shall meet the requirements of Section 4.00 of the 1984 Standard Specifications for Construction, except as otherwise specified herein. The separation course shall be Plant-Mixed and placed directly over the prepared existing concrete pavement, aggregate shoulders or bituminous base mixture in one course of 440 pounds per square yard and shall provide a mat approximately four inches thick.

Bond Coat: Bond coat will be required at a rate as specified by the engineer.

Placing Separation Course Mixtures.-The work shall be planned such at the completion of each day's paving operations, all lanes will have been resurfaced with the same point-of-ending. A temporary bituminous construction joint, 25 feet in length, shall be placed at the end of each day's resurfacing sections prior to placement of traffic. The joint shall be of a bituminous mixture suitable for a smooth transition. The joint shall be removed prior to commencing the subsequent paving operation.