

EVALUATION OF "PENEPRIME" AS A STABILIZING AGENT
FOR AGGREGATE SHOULDERS



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MICHIGAN DEPARTMENT OF STATE HIGHWAYS

EVALUATION OF "PENEPRIME" AS A STABILIZING AGENT
FOR AGGREGATE SHOULDERS

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Research Laboratory Section
Testing and Research Division
Research Project 64 E-33
Research Report No. R-663

State of Michigan
Department of State Highways
Lansing, January 1968

EVALUATION OF "PENEPRIME" AS A STABILIZING AGENT FOR AGGREGATE SHOULDERS

The Testing and Research Division was requested by the Maintenance Division to test and evaluate the performance of a new asphaltic material designated commercially as "PENEPRIME," to determine its suitability for stabilizing aggregate shoulders when applied directly to the compacted surface. The material was to be tested by the Ann Arbor Laboratory while the performance of the treated shoulders was to be observed and reported by the Research Laboratory. The site selection and planning of the project was handled by the Maintenance Division. The Research Laboratory's portion of the work was performed under Research Project 64 E-33, inaugurated June 1, 1964.

Description of Penepriime

Penepriime is the trade name of a low viscosity cutback asphalt formulation produced by the Empire Petroleum Company and marketed in this area by Slurry Seal of Michigan, Inc. The producers claim the treatment will penetrate compacted aggregates to a depth sufficient to provide high-strength stability, waterproofing, and dust prevention. The material can be applied directly to the aggregate surface by normal distributor methods with no mechanical blending required. Recommended application temperature is 130 to 150 F.

A sample of Penepriime was tested by Paul Serafin at the Ann Arbor Testing Laboratory. A copy of his results, with producer's guide specifications, are included as Appendix A of this report.

The Test Project

A 1000-ft shoulder section of US 127 near Lansing (Control Section 33082) was selected by the Maintenance Division as the test area (Figure 1). This area was subdivided into three equal sections for treatment with different quantities of Penepriime in planned amounts of 0.5, 0.75, and 1.0 gal/sq yd, applied over a width of 8 ft.

Prior to applying Penepriime, the shoulder was improved by the addition of 23A aggregate over the old shoulder surfacing. The new aggregate varied in thickness from about 1 inch at the north end of the job to about 8 inches at the south end. The average thickness was about 3-3/4 inches. Underlying the new aggregate was the old shoulder material, a black and yellow sand with stones intermixed, varying in thickness from four to twelve inches. The grain size distribution curves of the old and new aggregates are shown in Figure 2. Below the shoulder aggregates, there is a medium yellow sand.

The average Rainhart density of the test area, obtained from ten random samples, was 128.4 pcf at an average moisture content of 5.4 percent. The range of these densities was 121 - 138 pcf. The average T-99 maximum density was 139 pcf at an optimum moisture content of 6.8 percent. The area was compacted to only 92.5 percent of maximum. The relatively loose

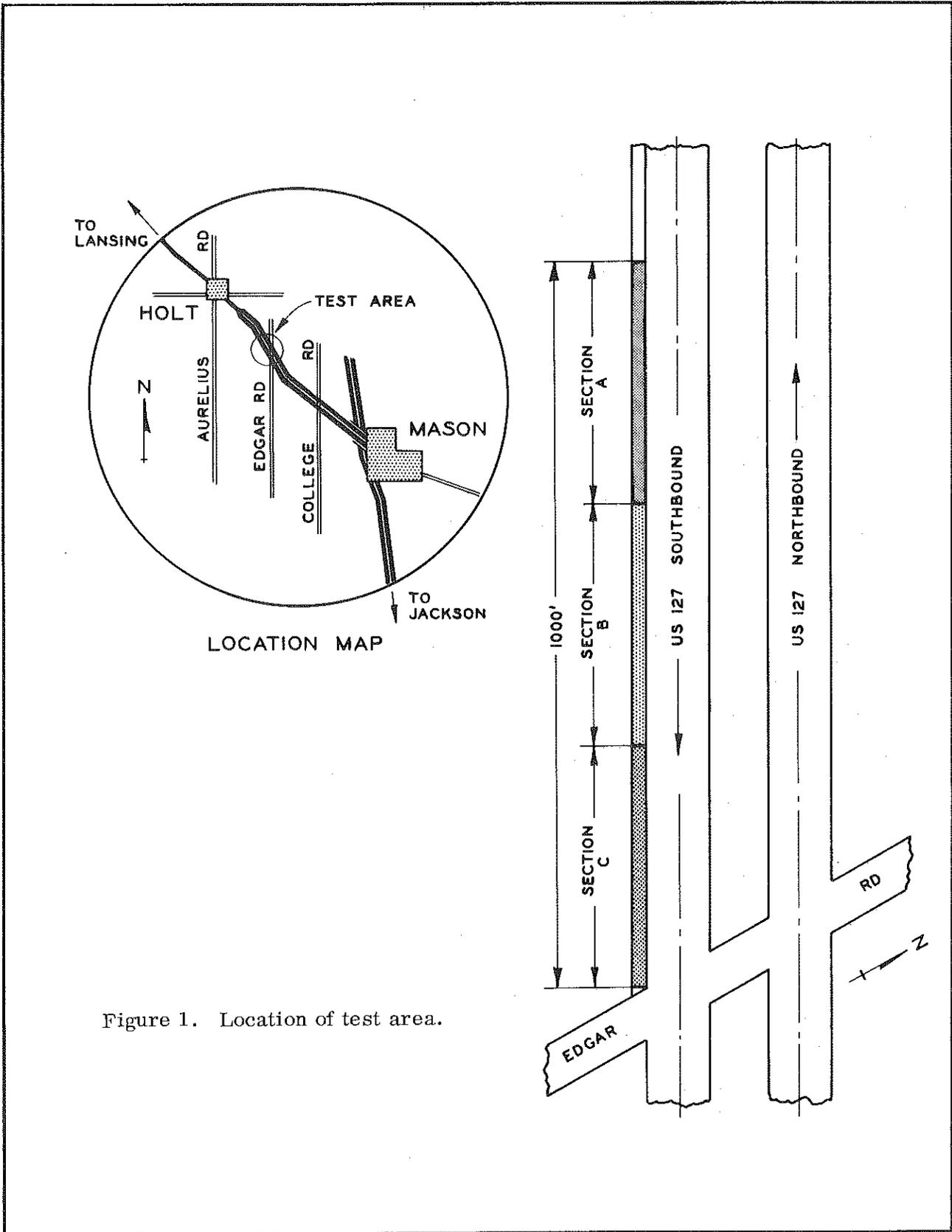


Figure 1. Location of test area.

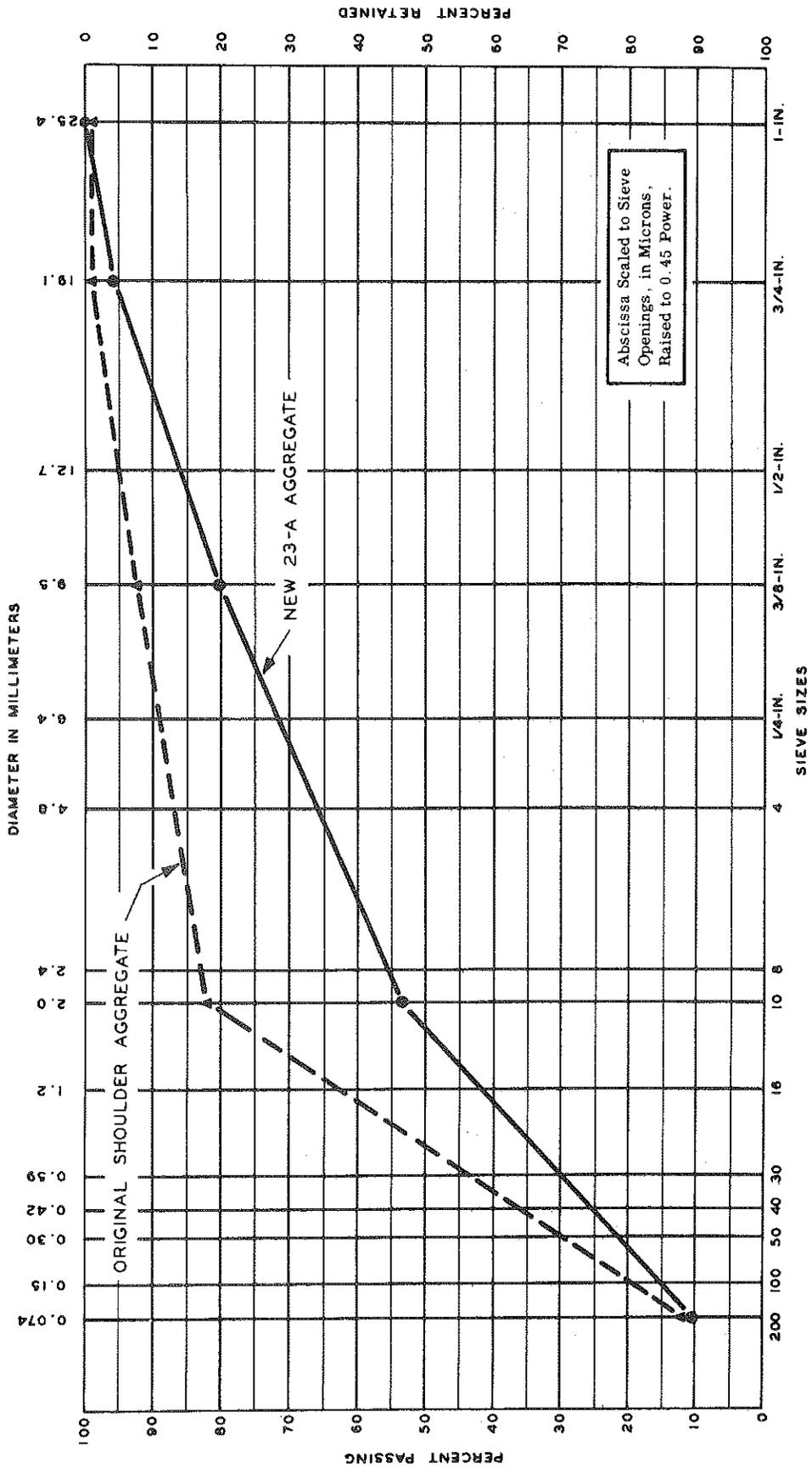


Figure 2. Grain size distribution of shoulder material.

condition of the shoulders, a few days before the application of Penepriime, is shown in Figure 3.

Penepriime was applied during the afternoon of June 9, 1964, a clear, warm day. The test area was lightly moistened before the application and appeared as in Figure 4.

The producers recommended that the application rate should not exceed 0.5 gal/sq yd per pass of the equipment. All three sections were treated initially at this rate, resulting in an even spread with no run-off. An additional pass was made for Sections B and C to bring their application to 0.75 and 1.0 gal/sq yd, respectively. These second applications were made about 30 minutes after the first and yielded good penetration with no run-off (Figure 5). There was no pick-up on the distributor tires from the treated area during the second application.

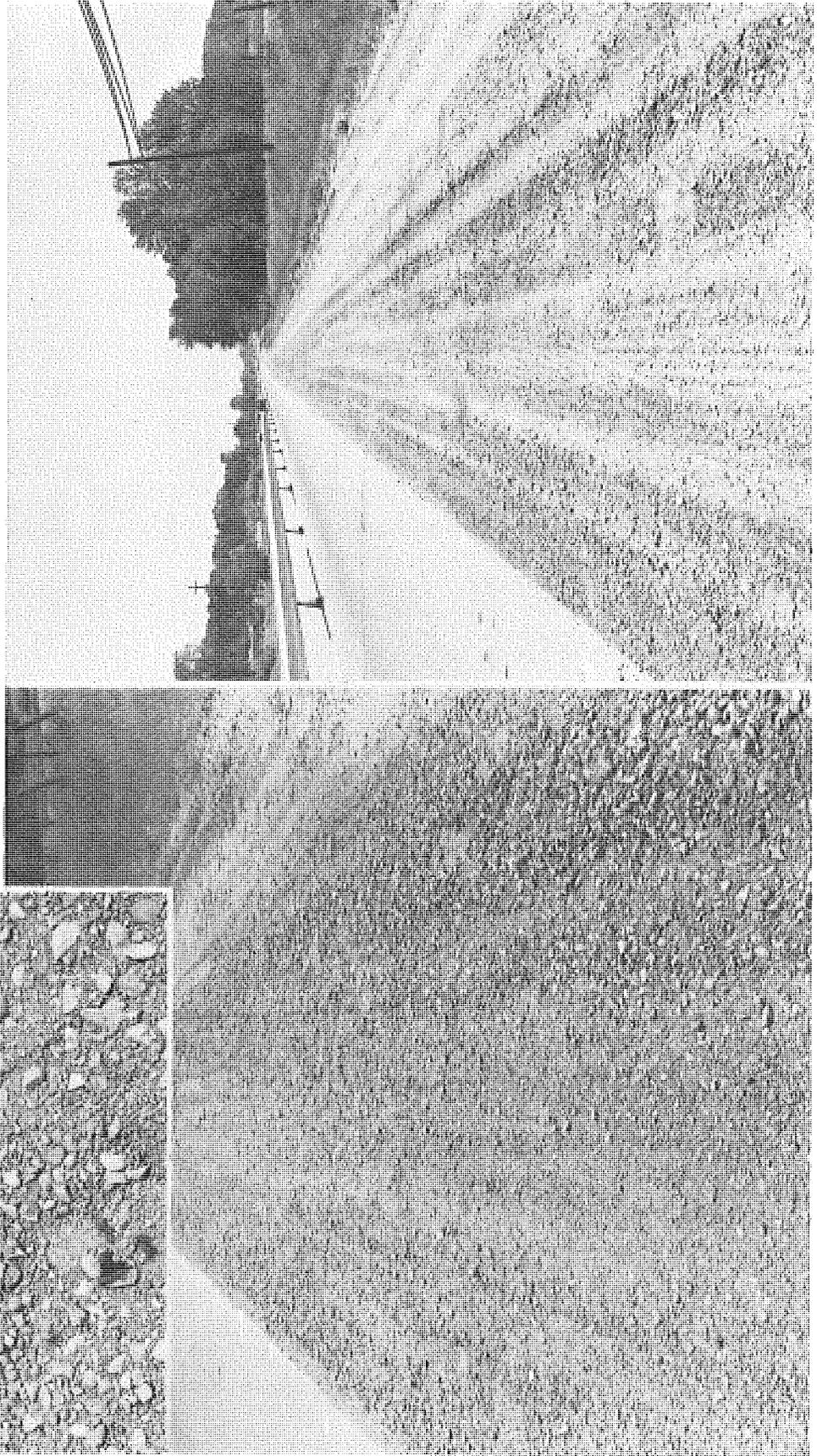
Although it was planned that the section be treated at rates of 0.5, 0.75, and 1.0 gal/sq yd, the actual treatment was somewhat less, being in the order of 0.45, 0.66, and 0.90 gal/sq yd, respectively.

There were no problems encountered during the Penepriime application and all sections looked good at the completion of operations. No run-off or tackiness of the surface was noticeable. It was decided to allow the treatment to penetrate and cure before further observations were made.



Figure 3. Appearance of shoulder prior to application of Peneprime.

Figure 4. Appearance of moistened shoulder immediately before application of Peneprime.



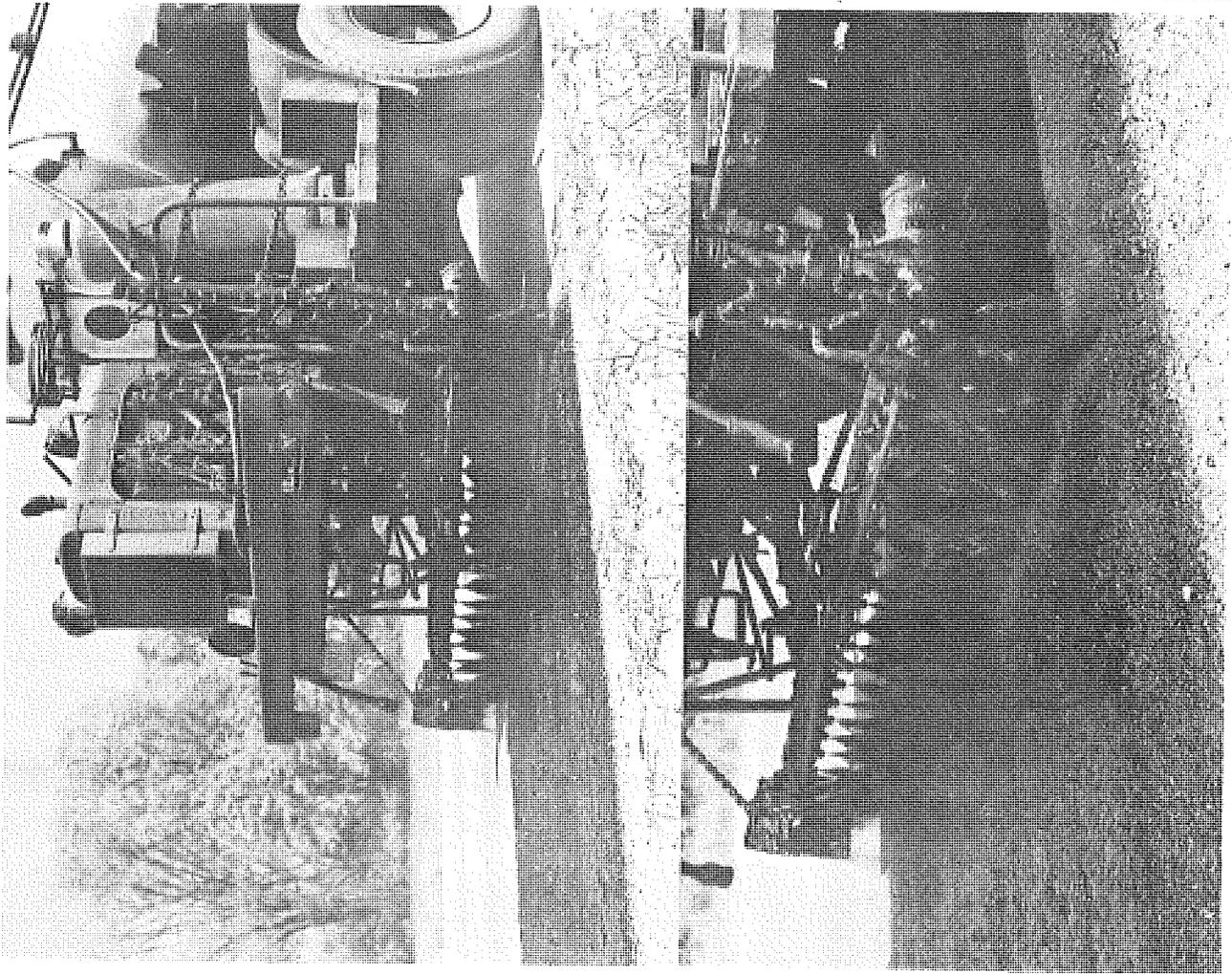
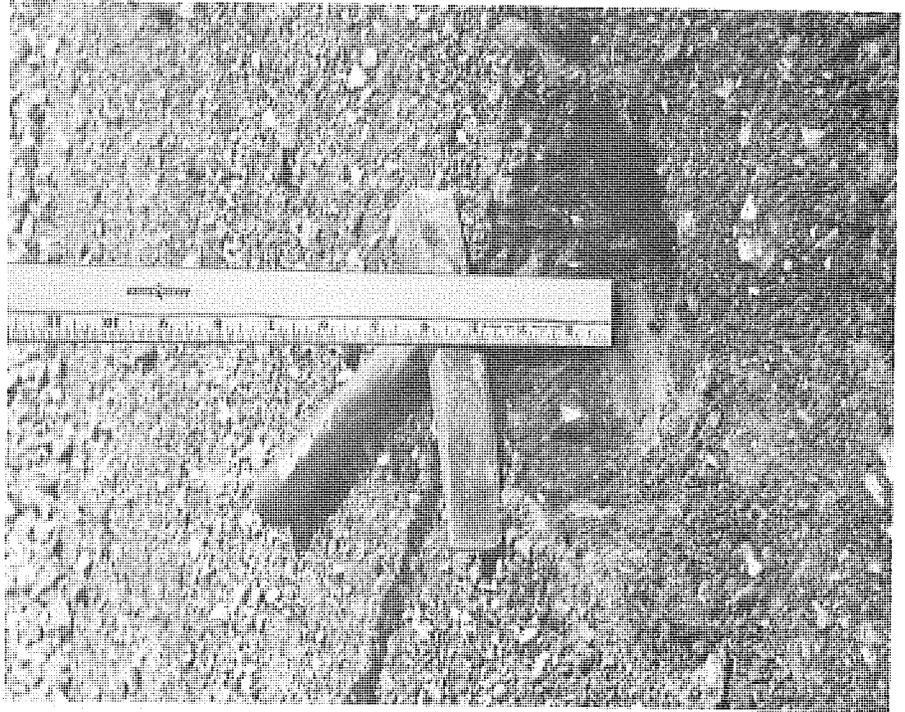


Figure 5. Initial application of Peneprime (0.5 gal/sq yd) and second application of Peneprime (required in sections B and C to obtain 0.75 and 1.0 gal/sq yd).

Figure 6. Measuring penetration of Peneprime (1.0 gal/sq yd section).



Evaluation of the Project

The project was inspected about one month after completion and found to be in excellent shape. There was some loose cover on all of the sections but less on Sections B and C with the heavier Penepriime treatment. There was no apparent difference in the appearances of the 0.75 and 1.0 gal/sq yd treated areas. The depth of penetration of Penepriime was checked by 10 measurements in each section (Figure 6). The average depths of treatment were:

Section A	0.8 inches
Section B	1.60 inches
Section C	1.90 inches

After one year of service (August, 1965) the test areas were again inspected and appeared as shown in Figure 7. There was no apparent difference between the surface condition of Sections B and C. Both were well bonded, very dark in appearance, and had about the same amount of loose material on their top. Section A was more loosely bonded and contained more loose stones on its surface than did the more heavily treated ones. However, there was noticeable drop-off at the edge of the concrete pavement and the treated shoulder aggregates in Section C and part of Section B. Bituminous patching had been applied in Section C and in the south end of Section B to bring the shoulder up to the pavement edge. The edge drop-off condition was most severe near the Edgar Road intersection, the southern part of the project. Typical patching in Section C is visible in Figure 7. The

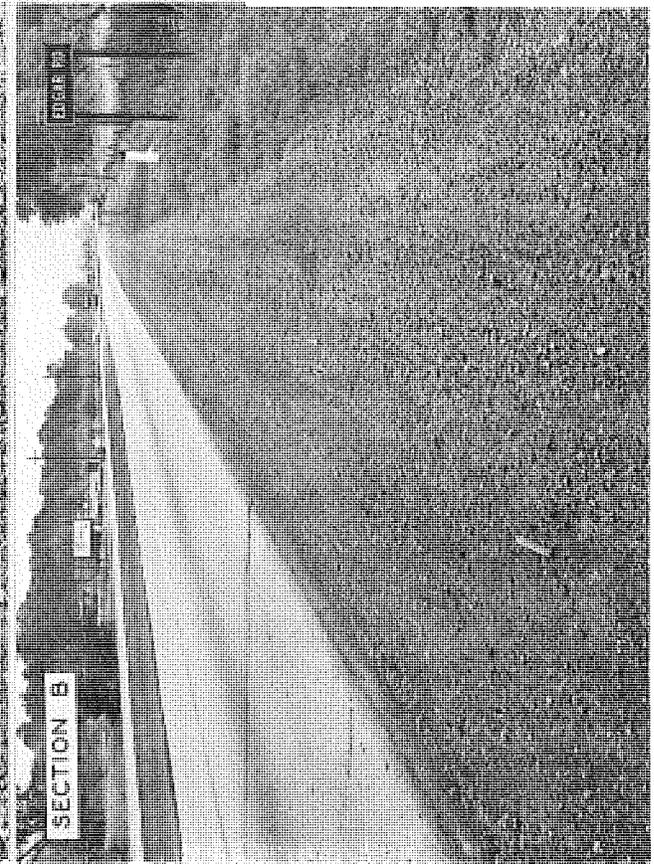
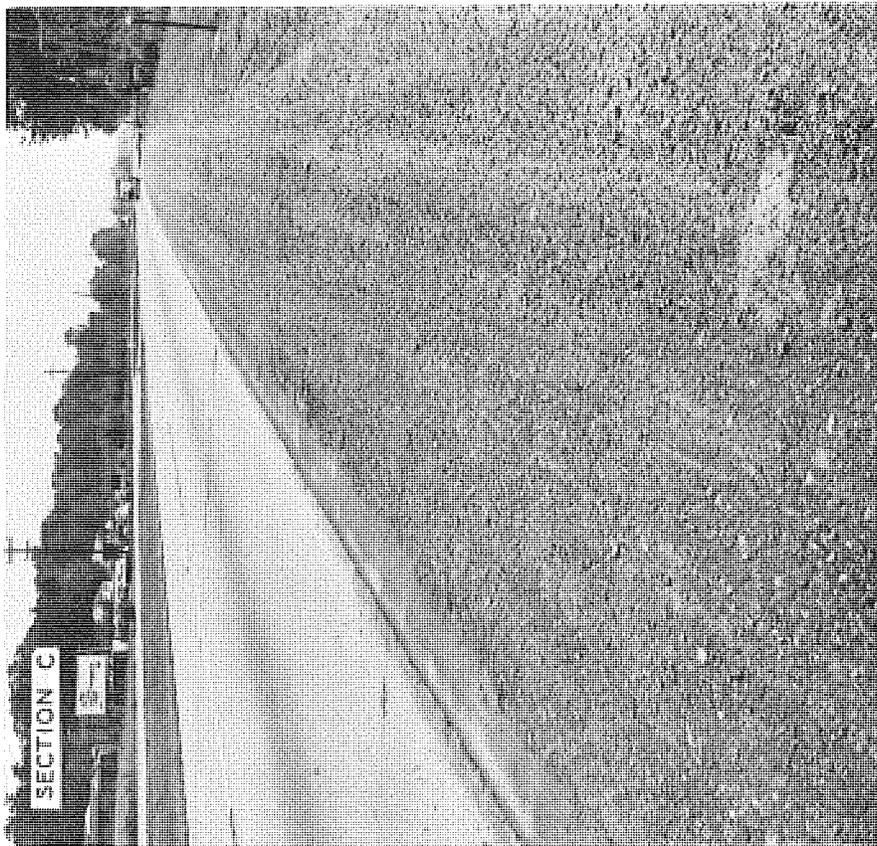


Figure 7. Condition of test sections after one year (August 1965).

greater consolidation of aggregate at the southern end of the test sections probably is due to the use of this area by cars turning right onto Edgar Road. A contributing cause could be the greater thickness of new aggregate added to this part of the job and which had been compacted to only 92.5 percent of maximum density prior to the application of Penepriime.

After three years, in the Fall of 1967, the test areas appeared as in Figure 8. Very little difference from the first year was noted. Although still fairly well cemented, the treated shoulder areas had considerable loose float on their surfaces. The higher treatment sections, B and C, were the better bonded. Other than the bituminous patching at the pavement edge, there was no maintenance on the treated sections during the three years of test. The untreated adjacent shoulders were bladed and shaped at least twice each summer by the Ingham County Road Commission and were in good condition (Figure 9).

At the end of the three-year period, there was no additional drop-off of the test areas at the edge of the concrete pavement, indicating that all consolidation had taken place during the first year of the test. As shown in Figure 10, there was also drop-off at the pavement edge in the untreated shoulder. Again, however, this was most noticeable where cars used the shoulder in turning onto Edgar Road. (In this case, from the northbound lane of US 127).

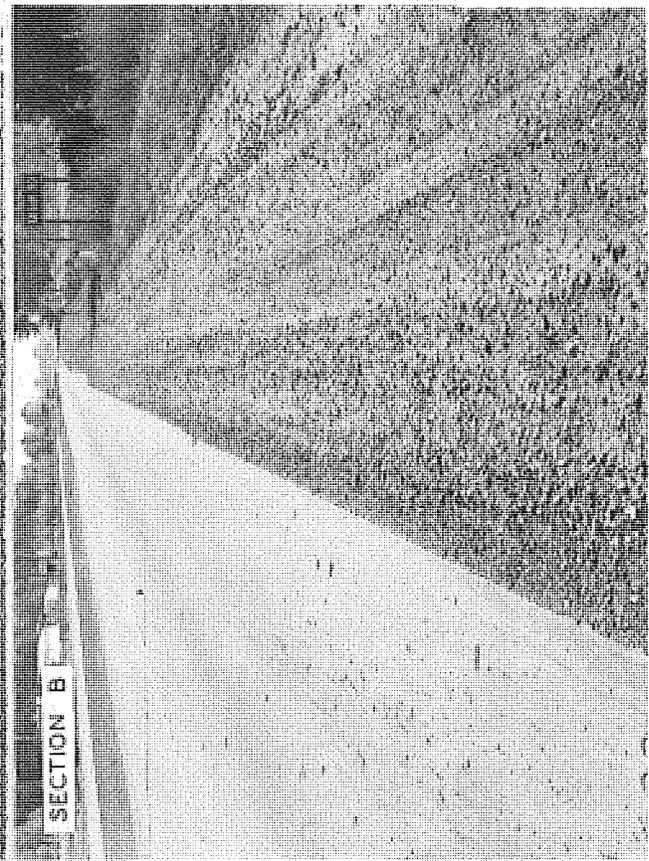
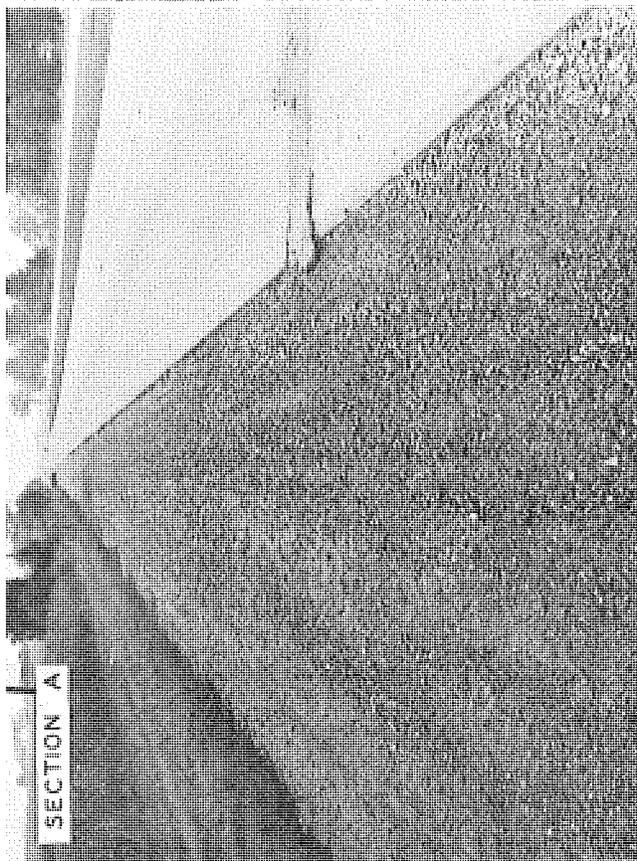


Figure 8. Condition of test sections after three years (Fall 1967).

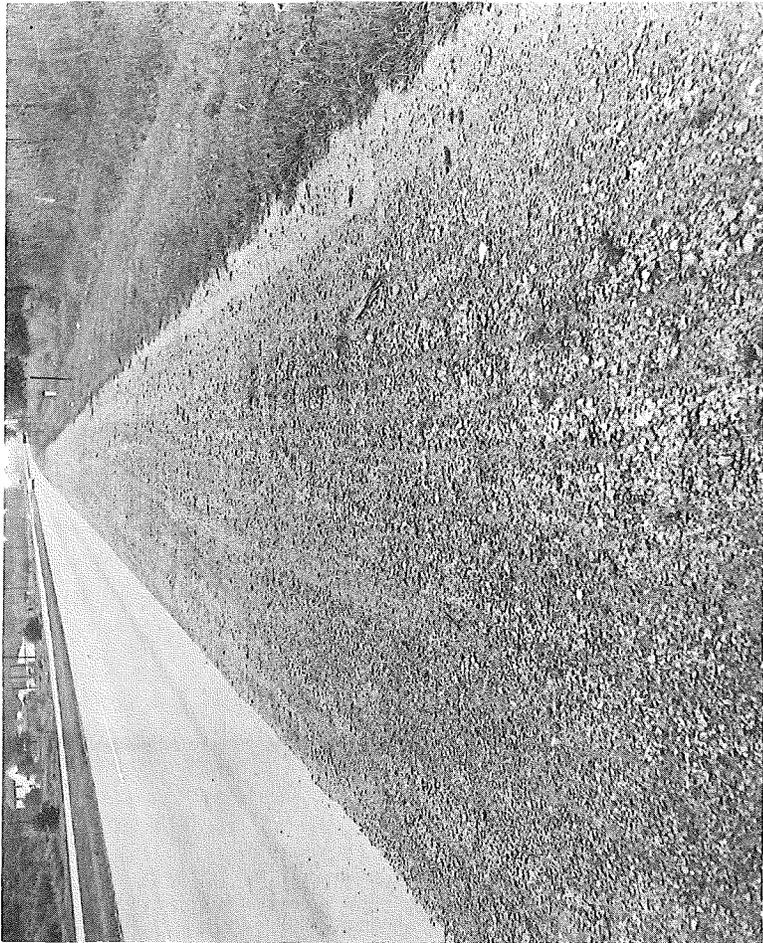


Figure 9. Untreated shoulder adjacent to, and North of, test areas (Fall 1967).



Figure 10. Untreated shoulder of Northbound approach to Edgar Road showing drop-off at pavement edge.

Conclusions

Although not set up primarily as a research project, surveys and studies of the experimental Penepriime application indicate the following conclusions:

1. Penepriime was easy to apply with a standard asphalt distributor and penetrated the surface aggregate to a depth of 0.8 to 1.9 inches, depending upon the rate of application.

2. Good, dust-free bonding of the treated aggregate was apparent during a three-year observation period. Bonding was greatest at the higher application rate. There was, however, considerable loose stone on the surface of the treated shoulders.

3. The use of Penepriime did not prevent consolidation of newly placed aggregates in areas subjected to traffic (turnoff onto crossroad). Some of this consolidation could have been due to original low compaction of newly placed aggregate.

4. Although no comparative tests were made, it is felt that equal benefits could be obtained with cheaper, conventional cutback asphalt treatment. Therefore, unless the cost of Penepriime should compare favorably with conventional cutback asphalt formulations, it is recommended that no further consideration be given to the use of this material by the Department.

5. Information obtained from this study is based on the surface application of asphalt. Results obtained by these procedures might not compare with those obtained from mixed-in-place operations.

APPENDIX A

OFFICE MEMORANDUM



MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

April 22, 1964

To: R. L. Greenman, Asst. Testing and Research Engineer
Office of Testing and Research

From: Paul J. Serafin

Subject: "Penepriime"

In accordance with your instructions, we have tested the sample of "Penepriime" material produced by Empire Petroleum Company, Sheboygan, Wisconsin, submitted by Mr. W. V. Lessels, Slurry Seal of Michigan, Inc., Lansing, Michigan, who handles this product.

Attached is Laboratory Report No. 64B-493 showing the test results on this material which shows conformance with the producers specifications (attached).

This material is essentially a cutback asphalt about an RC-1 grade with regard to viscosity and flash point, but having a residue with a penetration range of 10 to 30 which is considerably harder than the 80 to 120 specified for RC cutbacks.

No evaluation of this material is being offered, on the basis of these laboratory test results, since it is felt a field performance test would be advisable. This would be necessary to ascertain the claims made by the producer with regard to the material's ability to penetrate dense gravel surfaces and offer subsequent stability and durability.

OFFICE OF TESTING AND RESEARCH

Paul J. Serafin,
Bituminous Engineer
Testing Laboratory Division

PJS:mm

Attachments

cc: C. J. Olsen

REPORT OF TEST

Report on sample of PENEPRIME
Laboratory Number 64B-493

GENERAL CHARACTERISTICS _____ Liquid
SPECIFIC GRAVITY, 15.5/15.5 C _____ 0.970
FLASH POINT, CLEVELAND, TAGLIABUE, OPEN CUP, C_ 150
VISCOSITY, SAYBOLT FUROL
@ 25 C, seconds _____
@ 50 C, seconds _____ 96.2

DISTILLATION TEST

Percent by vol of total distillate to 360 C

1. To 190 C _____
2. To 225 C 437 F _____ 25
3. To 260 C 500 F _____ 60
4. To 315.5 C 600 F _____ 86

Total distillate to 360 C, percent by vol _____ 43.5

TEST ON DISTILLATION RESIDUE

Penetration at 77 F, 100 g, 5 sec _____ 11

TEST ON 100 PENETRATION RESIDUE

Thin film loss on heating 160 C, 5 hrs, 50 g, percent ____ 2.284

Penetration of residue at 115 F, 50 g, 5 sec _____ 25

Penetration of residue at 77 F, 100 g, 5 sec _____ 5

REMARKS

Tested for information

PRODUCERS SPECIFICATION

GUIDE SPECIFICATIONS FOR PENEPRIME ASPHALT

STABILIZER

The following Guide Specifications are submitted for bidding purposes only and will be met by Penepriime asphalt stabilizer, a proprietary product. However, the characteristics and properties of Penepriime are not limited by these Guide Specifications.

The base of the asphalt stabilizer shall be asphalt refined from petroleum crude oil.

	<u>Min.</u>	<u>Max.</u>
Flash, Tag Open Cup	80° F	--
Viscosity, Sec. S. F., 122° F	40	200
Distillation, ASTM D5		
to 437° F.	5	40
to 500° F.	50	80
to 600° F.	80	--
Residue from Distillation:		
to 680° F.		
Volume percent by difference	40	
Penetration of residue, 77° F.,		
100 gms, 5 sec.	10	30
Penetration after Thin Film Oven Test		
77° F., 100 gms., 5 sec.	3	
115° F., 50 gms., 5 sec.	12	55

The supplier shall hold the purchaser harmless in the event of patent or trademark infringement.

Empire Petroleum Company and its licensees do not represent that manufacture by others of asphalt stabilizer under this specification will meet the performance of Penepriime.