

Sulphur Extended Asphalt Field Trials On

MH 153, Brazos County, Texas

Progress Report No. 11

TTI Project 2536

FCIP Study No. 1-10-78-536

by

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Prepared for

The Texas State Department of Highways

and Public Transportation

and

The Sulphur Institute

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Sulphur Extended Asphalt Field Trails
On MH 153, Brazos County, Texas

Purpose

The major purpose of this project is to conduct both construction and post-construction testing and evaluation of sulphur extended asphalt (SEA) experimental test sections located on MH 153 (Wellborn Road in the cities of College Station and Bryan) in Brazos County, Texas. These test sections were in District 17 of the Texas State Department of Highways and Public Transportation (SDHPT) during the project planning and construction.

Background

During June, 1978, a 2700-foot (823-m), two-lane width section (half roadway section) of the four-lane roadway built as MH 153 (Municipal Highway 153) was utilized for a demonstration project of SEA mixtures. A schematic layout of this section is shown in Figure 1. The construction of this experimental demonstration was made possible by a "Field Change" in the MH 153 contract between the SDHPT and Young Brothers, Inc., Contractors, with District 17 providing the engineering for design and construction inspection and supervision.

In addition to the Field Change agreement, the Sulphur Institute and Young Brothers entered into a separate agreement. Here the Sulphur Institute provided reimbursement to the contractor for the extra costs required for handling and utilization of the sulphur over the normal bid price payments received from the SDHPT for the

Estimated Tons of Paving Mix Required:

Pavement: Finished width 26 ft (7.9 m); length 2,700 ft (823 m); area 7,800 sq yds (6522 m²)
 Mix: Quantity of mix/sq yd estimated at 660 lbs (300 kg); total tons 2, 574 (2337 Mkg)

Layout:

Southbound Lanes

2700 ft (823 m) Total Length
 (Direction of Travel →)

*(5.0)	40/60 SEA Job Mix Formula *(5.0)	40/60 SEA 75:25 Bank Run Gravel: Field Sand *(7.3)	30/70 SEA 75:25 Bank Run Gravel: Field Sand *(6.7)	30/70 SEA 75:25 Bank Run Gravel: Field Sand *(6.8)	40/60 SEA 50:50 Conc. Sand:Field Sand *(8.2)	30/70 SEA 50:50 Conc. Sand:Field Sand *(7.7)	*(5.0)
Section 2 450 ft (137 m)	Section 3 450 ft (137 m)	Section 4 450 ft (137 m)	Section 5 450 ft (137 m)	Section 6 450 ft (137 m)	Section 7 450 ft (137 m)	Section 8 (Control)	
48+00	52+50	57+00	61+50	66+00	70+50	75+00	

- Notes: 1) Sulphur-asphalt binder was optimized on a volume substitution basis
 2) Sulphur-asphalt binder for Section 5 was prepared by bypassing emulsion mill
 3) *Indicates binder content by weight

Nomenclature:

Job Mix Formula: 55:30:15 Bank Run Gravel:Pea Gravel:Field Sand with 5 wt pct asphalt
 (Mix used for conventional asphalt concrete in Section 1, etc.)

SEA: Sulphur-extended-asphalt - 30/70 and 40/60 are ratios of sulphur to asphalt by weight

Figure 1 General layout of field test sections, MH 153, Brazos County, Texas
 (South Bound Lanes)

placement of the conventional asphalt cement binder paving materials which the SEA binder materials replaced in the field trial sections.

The SEA field trials on MH 153 had the following objectives: (1) to compare mixtures with sulphur-asphalt emulsion binders as prepared by mixing in a colloid mill with another SEA mixture prepared by comingling molten sulphur and hot asphalt cement in a by pass line around the colloid mill and (2) to investigate the upgrading effects on mixtures obtained from adding the SEA binders to locally available but marginal blends of siliceous aggregates.

Two major reports are available concerning the MH 153 field trials. Report FHWA-TS-80-214 by Izatt and Gallaway (1) describes the design and construction details of the project. Report FHWA/TX-82/35+536-7 (2) describes testing and evaluation that have been accomplished on MH 153 from July, 1978 through November, 1981.

Following construction, Texas Transportation Institute personnel have collected pavement cores and conducted testing according to the activities specified in the testing matrix shown in Figure 2. The type of testing conducted during each period is as shown in Figure 2.

This present report provides an updating on the surface condition of the MH 153 test sections based on visual evaluations, rut depth measurements and slide pictures taken on June 27, 1984. The visual evaluations were used to determine PRS, pavement rating score, values for the test sections.

Test Results

Table 1 provides a summary of the PRS values that have been determined from seven visual evaluations that have been made on the MH

Test Description	Evaluation Within One Week After Open to Traffic (T_0)				
	November 1978 $T_0 + 6^0$ mo.	June 1979 $T_0 + 12$ mo.	June 1980 $T_0 + 24$ mo.	November 1981 $T_0 + 41$ mo.	March 1982 $T_0 + 45$ mo.
1. Traffic Analysis					
a. Average Daily Traffic Count					
b. Truck and Axle Weight Distribution (Loadmeter survey for one week)	x		continuous		x
2. Visual Evaluation	x	x	x	x	x
3. Mays Meter	x	x	x	x	x
4. Dynaflect Deflections	x	x	x	x	x
5. Core Samples**					
a. Density	x	x	x	x	x
b. Stability, Marshall	x	x	x	x	x
c. Stability, Hveem	x	x	x	x	x
d. Resilient Modulus	x	x	x	x	x
e. Indirect Tension	x	x	x	x	x
f. Rice Specific Gravity	x				
6. Progress Reports	x	x	x	x	x
7. Interim Report		x			
8. Final Report					x

Figure 2. Testing matrix for MH 153.

(Continued)

Figure 2. Continued.

	December 1983 T ₀ + 54 mo.	June 1983 T ₀ + 60 mo.	December 1983 T ₀ + 66 mo.	June 1984 T ₀ + 72 mo.	December 1984 T ₀ + 78 mo.	June 1985 T ₀ + 84 mo.
1. Traffic Analysis						
a. Average Daily Traffic Count	x		x			
b. Truck and Axle Weight Distribution (Loadmeter survey for one week)	x		x			
2. Visual Evaluation (*including slide pictures)	x*	x*	x*	x*		
3. Mays Meter		x				
4. Dynflect Deflections		x				
5. Core Samples**						
a. Density		x				
b. Stability, Marshall		x				
c. Stability, Hveem		x				
d. Resilient Modulus		x				
e. Indirect Tension		x				
f. Rice Specific Gravity		x				
6. Progress Reports	x	x	x	x		
7. Interim Reports						
8. Final Report						

**Coring and testing involved only Test Sections 2 through 8.

153 test section surfaces from December 1978 through June 1984. These evaluations have been made in the outside or travelled lane of the MH 153 southbound lanes. A copy of the filled-out June 1978 evaluation form is appended to this report.

Table 2 is provided to give an indication of the average rut depths existing in the test section surfaces. In this table, average rut depths are compared for the last two evaluation periods on MH 153.

Discussion of Results

As shown in Table 1, PRS scores have changed little since November 1983, and the impression gained is that the road surface has not changed appreciably, either. One change that has occurred is that the city of Bryan has sealed most of the larger cracks in the travelled lane in Sections 2 through 5 or to the south city limit with College Station. This action should help "hold" the test sections near their present PRS levels (as is initially indicated by the June 1984 results).

College Station has not sealed its cracks in Sections 6 through 8. However, cracking is not as extensive as in Bryan, especially for Sections 6 and 7.

Rut depths as shown in Table 2 indicate little change from November 1983 to June 1984. The most severe rutting is shown to be in the left wheel paths of Sections 2, 3 and 4. However, even these depths are not considered excessive and are apparently causing no problems on the roadway in wet weather.

Table 1. Pavement rating scores (PRS) for MH 153.

Binder and Aggregate Type	PRS	Date
40/60 SEA Job Mix, Section 2	100	12/18/78
	100	6/29/79
	83	12/12/80
	83	12/ 1/81
	80	6/30/83
	84	11/29/83
	84	6/27/84
40/60 SEA 75:25 Bank Run Gravel: Field Sand Section 3	100	12/18/78
	98	6/29/79
	88	12/12/80
	85	12/ 1/81
	75*	6/30/83
	81	11/29/83
	80	6/27/84
30/70 SEA 75:25 Bank Run Gravel: Field Sand Section 4	100	12/18/78
	97	6/29/79
	93	12/12/80
	85	12/ 1/81
	80	6/30/83
	80	11/29/83
	78	6/27/84

*This value is questionable.

(Continued)

Table 1. Continued.

Binder and Aggregate Type	PRS	Date
30/70 SEA 75:25 Bank Run * Gravel:Field Sand Section 5	100	12/18/78
	98	6/29/79
	93	12/12/80
	85	12/ 1/82
	85	6/30/73
	88	11/29/83
	87	6/27/84
40/60 SEA 50:50 Concrete Sand:Field Sand Section 6	100	12/18/78
	100	6/29/79
	93	12/12/80
	88	12/ 1/81
	87	6/30/83
	92	11/29/83
	90	6/27/84
30/70 SEA 50:50 Concrete Sand:Field Sand Section 7	100	12/18/78
	100	6/29/79
	88	12/12/80
	80	12/ 1/81
	85	6/30/83
	87	11/29/83
	84	6/27/84
0/100 AC Control Section 8	100	12/18/78
	100	6/29/79
	93	12/12/80
	85	12/ 1/81
	90	6/30/83
	85	11/29/83
	88	6/27/84

* Sulphur-asphalt binder was prepared by bypassing the colloid mill.

Table 2. Average Rut Depths for MH 153 Test Section Traveled Lanes,
Millimeters

Date	<u>11-29-83(1)</u>		<u>6-27-84(2)</u>	
	<u>LWP</u>	<u>RWP</u>	<u>LWP</u>	<u>RWP</u>
Section Number				
2	9	8	11	6
3	10	7	11	7
4	10	4	10	6
5	4	5	3	3
6	5	8	4	7
7	7	6	7	4
8	3	5	4	6

(1) Based on six measurements

(2) Based on five measurements

Financial Statement for Project 2536

Total Funds Authorized 1983-1984	\$3,265.00
Funds Expended to July 1, 1984	<u>3,265.00</u>
Remaining Balance	\$ 00.00

Conclusions

Based on the visual evaluations and rut depths obtained in June, 1984, it is apparent that the conditions of the test sections have changed little since early 1983. All sections are functioning satisfactorily. From a lack of visual distress standpoint, Sections 5, 6 and 8 appear to be performing the best. The reader is reminded that these sections were constructed using marginal aggregates.

References

1. Izatt, J. O. and Gallaway, B. M., "Sulphur Extended Asphalt Field Trials - MH 153 Brazos County, Texas, a detailed construction report", Report FHWA-TS-80-214, prepared by the Texas Transportation Institute for the Federal Highway Administration, Offices of Research Development, Implementation Division (HDV-22), Washington, D.C., 20590, December, 1979.
2. Benson, F. C. and Gallaway, B. M., "Sulphur-Extended-Asphalt Field Trails - MH 153 Brazos County, Texas", Report FHWA/TX-82/36+536-7, prepared by Texas Transportation Institute for the Federal Highway Administration, Office of Research, Development and Technology, Washington, D.C., 20590, November, 1982.

Selected Reference

1. Epps, J. A., Meyer, A. H., Larrimore, I. E., Jr., and Jones, H. L., "Roadway Maintenance Evaluation Users Manual", Research Report 151-2, Texas Transportation Institute, September, 1974.

FLEXIBLE PAVEMENT EVALUATION

FORM NO. 1505-1 9/80

1/2

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2R Cracks sealed with asphalt

3R Cracks sealed, slightly more trace of alligating

4R Cracks sealed. A little more fine cracks than 3 > 2.

*5R Cracks sealed. On low side of 100 to 200 or high side of 0-100. Spots of alligating more pronounced.

*6R No cracks sealed.

7R Cracks not sealed.

8R Cracks not sealed.

*City limit accounts probably in crack sealing.

