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16. Abstract

This report is a part of the continuing post-construction evaluation of a sulphur extended asphalt field trial located on U. S. 69 near Lufkin, Texas.

It contains a discussion of the background and methods of testing. In-situ test results and laboratory test results on cores are presented in tabular form with respect to pavement age.

No distress in any of the pavement subsections has been evident to date.

Other post-construction reports on this test section include: (1) "Post Construction Evaluation of Sulphur-Asphalt Pavement Test Sections", Interim Report No. 1, January,1976; (2) "Post Construction Evaluation of Sulphur-Asphalt Pavement Test Sections", Interim Report No. 2, October, 1976; (3) "Post Construction Evaluation of Sulphur-Asphalt Pavement Test Sections", Interim Report No. 3, May, 1977; (4) "Post Construction Evaluation of U. S. 69 Sulphur-Asphalt Pavement Test Sections in Lufkin, Texas", Interim Report No. 4, October, 1977; (5) "Post Construction Evaluation of U. S. 69 Sulphur-Asphalt Pavement Test Sections in Lufkin, Texas", Interim Report No.5, September, 1978.

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POST CONSTRUCTION EVALUATION

OF

U.S. 69 SULPHUR-ASPHALT PAVEMENT TEST SECTIONS

IN

LUFKIN, TEXAS

Interim Report No. 6

FCIP Study No. 1-10-75-512

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Texas Transportation Institute

College Station, Texas

February 1979

POST CONSTRUCTION EVALUATION
OF
US 69 SULPHUR-ASPHALT PAVEMENT TEST SECTIONS
IN
LUFKIN, TEXAS

Introduction and Background

During September 1975, a 3,650 foot (1,113 m) section of roadway being constructed on US 69 in Angelina County, Texas under FCIP Study No. 1-10-75-512, Contract No. 199-4 was set aside for a demonstration test of hot-mixed sulphur-extended-asphalt (SEA) pavement sections. These sections were constructed with a sulphur-asphalt emulsion in accordance with a process developed by Societe Nationale des Petroles d'Aquitaine (SNPA).

After placement of the completed pavement, cores were taken by personnel of the State Department of Highways and Public Transportation (SDHPT) District 11 and testing was completed in accordance with the test matrix shown in Figure 1. This set of cores was designated as "Preliminary" in the identification scheme. Cores have been taken at approximately 6 month intervals since the initial testing period.

In November 1978, a sixth shipment of cores was obtained from District 11. These cores were taken from the road about 24 months after the road was opened to traffic (36 months after completion of construction).

Purpose

To comparatively evaluate post-construction performance of pavement test sections composed of sulphur-extended-asphalt (SEA) mixture and asphaltic concrete (AC) mixtures.

Test Procedures

Laboratory testing of cores followed the methods listed below.

ASTM D 2041-71	Test for Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures (Density)
ASTM D 1559-73	Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 1560-65	Tests for Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus
As per Schmidt	(1) Resilient Modulus
ASTM C 496-71	Test for Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM D 2041-71	Test for Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures (Rice Specific Gravity)

Table 1 is a summary of all filed core test results up to September 1978.

TEST DESCRIPTION	PRELIMINARY	INITIAL	6 Mo.	12 Mo.	18 Mo.	24 Mo.	36 Mo.
1. Traffic analysis							
a. Average daily traffic count		←———	———	CONTINUOUS	———	———	———→
b. Truck and axle weight distribution							
2. Visual inspection	Δ	Δ	Δ	Δ	Δ	Δ	Δ
3. Mays Meter (psi)	Δ	Δ	Δ	Δ	Δ	Δ	Δ
4. Benkelman Beam deflections	Δ	Δ	Δ	Δ	Δ	Δ	Δ
5. Dynaflect deflections	Δ	Δ	Δ	Δ	Δ	Δ	Δ
6. Core samples*							
a. Field density and Rice specific gravity	Δ	Δ	Δ	Δ	Δ	Δ	Δ
b. Stability, Marshall	Δ	Δ	Δ	Δ	Δ	Δ	Δ
c. Stability, Hveem	Δ	Δ	Δ	Δ	Δ	Δ	Δ
d. Resilient Modulus	Δ	Δ	Δ	Δ	Δ	Δ	Δ
e. Indirect Tension	Δ	Δ	Δ	Δ	Δ	Δ	Δ
f. Thermal expansion	Δ						
7. Skid resistance**	Δ						

Loadmeter survey, 1 week duration
Evaluations on both sulphur-asphalt and conventional asphaltic concrete
*Set of 6 cores (minimum) at each test section per sampling period
**Skid resistance measured on a sulphur-asphalt concrete surface placed outside of the test section

FIGURE 1. Test matrix for US 69, Lufkin, Texas, sulphur-asphalt trial

Table 1. Field core test results according to binder type and content for all test periods.

Mixture Type	Binder Content Percent	Density pcf	Air Voids, percent	Hveem Stability, percent	Marshall Stability, lbf	Marshall Flow, 0.01 in	Splitting Tensile, psi	Resilient Modulus, 10^6	Date	Rice Max Specific Gravity
		138	9	21	390	16	50	0.24	9/75(0)*	2.43
HMAC (AC)	4.8	140	8	27	610	14	155	0.07	8/76(11)	
		143	6	31	1200	13	120	0.55	3/77(18)	
		139	8	27	1140	13	180	0.63	9/77(24)	
		144	5	28	1200	14	150	0.60	9/78(36)	
		138	10	22	430	15	35	0.29	9/75(0)	2.45
		140	8	26	50	16	95	1.11	8/76(11)	
HMAC (SEA)	4.8	142	7	27	1230	13	115	0.51	3/77(18)	
		139	9	26	490	13	125	0.70	9/77(24)	
		143	6	29	970	14	115	0.74	3/78(30)	
		142	7	27	690	14	145	1.12	9/78(36)	
		136	11	19	210	14	35	0.24	9/75(0)	2.44
		142	7	28	690	13	135	0.66	8/76(11)	
HMAC (SEA)	5.65	144	5	30	1260	14	105	0.59	3/77(18)	
		144	5	31	660	14	170	0.82	9/77(24)	
		144	5	27	1410	13	134	0.61	3/78(30)	
		146	4	30	1000	13	185	1.02	9/78(36)	

1 pcf = 16.01 kg/m^3
1 lbf = 4.45 N
1 in = 25.4 mm
1 psi = 6/89 kPa
* Pavement age in months from date of construction

Table 1 (continued)

Mixture Type	Binder Content percent	Density pcf	Air Voids, percent	Hveem Stability, percent	Marshall Stability, lbf	Marshall Flow, 0.01 in	Splitting Tensile, psi	Resilient Modulus, 10^6 psi	Date	Rice Max Specific Gravity
Hot Sand AC	5.4	116	23	15	210	15	30	0.14	9/75(0)*	2.43
		120	21	19	970	17	90	0.26	8/76(11)	
		122	20	22	1110	14	95	0.29	3/77(18)	
		124	18	27	900	17	115	0.33	9/77(24)	
		122	20	23	1310	15	110	0.32	3/78(30)	
		121	20	19	1090	13	135	0.43	9/78(36)	
Hot Sand (SEA)	6.0	113	26	21	170	13	30	0.13	9/75(0)	2.45
		119	22	26	730	14	75	0.31	8/76(11)	
		120	22	21	910	13	70	0.26	3/77(18)	
		121	21	23	460	15	90	0.36	9/77(24)	
		122	20	19	1080	16	90	0.27	3/78(30)	
		121	21	20	580	11	135	0.33	9/78(36)	
Hot Sand (SEA)	6.35	115	24	20	20	15	30	0.14	9/75(0)	2.42
		122	19	24	980	13	95	0.30	8/76(11)	
		122	19	20	840	13	85	0.23	3/77(12)	
		129	15	22	500	10	110	0.24	9/77(24)	
		123	19	21	680	13	90	0.25	3/78(30)	
		124	18	23	470	11	89	0.31	9/78(36)	
Hot Sand (SEA)	7.1	117	23	24	140	18	30	0.20	9/75(0)	2.42
		122	19	22	510	14	20	0.29	8/76(11)	
		125	17	25	850	13	75	0.26	3/77(18)	
		126	17	22	540	12	115	0.27	9/77(24)	
		124	18	21	570	13	85	0.24	3/78(30)	
		124	18	19	440	11	100	0.32	9/78(36)	

1 pcf = 16.01 kg/m^3
1 lbd = 4.45 N
1 in = 25.4 mm
1 psi = 6.89 kPa
* Pavement age in months from date of construction

In-Situ Testing

A variety of condition and performance on-site testing was conducted by District 11. This testing included Dynaflect deflection and Mays Ride Meter. These data are reported according to the lane in which the tests were run. Lane A is the inside (passing) lane and lane B is the outside (travelling) lane.

Table 2 presents a summary of the stiffness coefficients of the subgrade and pavement for the various test sections. These were calculated by the STIF 2 computer program from Dynaflect deflections. Table 3 shows the maximum Dinaflect deflections and surface curvature indexes computed by STIF 2. The Dynaflect measurements were taken in accordance to the procedure set forth by Scrivner and Moore (2).

Table 4 is a presentation of the visual inspection and traffic analysis for the entire field trial. The traffic analysis was prepared by the SHDPT Planning Office in Austin, Texas. The pavement rating score (PRS) was determined by the method suggested by Epps, et al (3).

Table 5 shows the Benkelman Beam rebound measurements for the various test sections. The operation and data collection methods for the Benkelman Beam may be found in Reference 4.

Table 6 shows the serviceability index of each station as taken from Mays Ride Meter readings collected up to the present time. The operation of the Mays Ride Meter is discussed in Reference 5.

Discussion of the Results

From Table 1 it may be noted that the density of all the materials under consideration has increased with time. The most notable of the materials is the SEA mixture with the 5.65 percent binder content which has increased 10 pcf (160 Km/mm^3). This occurrence was due to the compaction of traffic for the past three years. Of the hot sand mixtures the most notable density increase, 9 pcf (144 Kg/mm^3), was in the SEA mixture with 6.35 percent binder.

The Hveem stabilities values for all hot-mix asphaltic concrete (HMAC) materials are comparable and average about 27 percent. Likewise, Hveem stabilities for all hot sand mixture are about 21. The Marshall stabilities of the HMAC mixture generally show comparable values between the AC mixture and the SEA mixtures with 5.65 percent binder content. The SEA mixture with 4.8 percent binder content shows a lower Marshall stability but yet well exceeds the recommended 500 lb (2225 N) minimum value (6). The hot sand AC mixture shows a history of Marshall stabilities higher than those of the hot sand SEA mixture. The Marshall stabilities between the SEA mixtures themselves are fairly consistent. It may be noted that the Marshall stabilities for all hot sand mixtures also exceed the recommended minimum.

For the HMAC mixture, the splitting tensile strength of the AC mixture is slightly higher than values for the SEA mixtures. Of the SEA mixtures, the one with 5.65 percent binder content has the highest value for splitting tensile strength. In the hot sand category, the highest

Table 2 Stiffness coefficients of subgrade and pavement as computed by STIF 2

Station	Total pavement depth (in)	Material	Thickness (in)	Stiffness coefficient of subgrade		Stiffness coefficient of subgrade		
				Lane A	Lane B	Lane A	Lane B	Date
				0.24	0.25	1.26	1.16	9/75(0)*
				0.24	0.26	1.35	1.13	3/76(6)
167+100	8.00	8% A.C. Lt.Wt.HMAC	1.00	0.26	0.26	0.86	0.98	9/76(12)
to		4.8 A.C. HMAC	7.00	0.25	0.25	1.19	1.02	3/77(18)
170+50				0.22	0.21	1.36	1.54	9/77(24)
				0.24	0.24	1.20	1.18	4/78(31)
				0.26	0.27	0.91	0.89	9/78(36)
				0.25	0.24	1.15	1.20	9/75(0)
				0.24	0.24	1.33	1.28	3/76(6)
170+50	8.0	8% A.C. Lt.Wt. HMAC	1.00	0.25	0.25	0.74	0.86	9/76(12)
to		5.65% SEA HMAC	3.00	0.25	0.25	1.12	0.96	3/77(18)
177+50			4.00	0.25	0.23	1.02	1.21	9/77(24)
				0.25	0.25	1.03	1.17	4/78(31)
				0.28	0.28	0.84	0.79	9/78(36)
				0.26	0.27	1.50	1.31	9/75(0)
				0.26	0.26	1.50	1.52	3/76(6)
177+50	6.0	8%A.C. Lt.Wt. HMAC	1.00	0.28	0.28	0.89	0.85	9/76(12)
to		5.4% A.C. Hot sand	5.00	0.26	0.28	1.19	0.91	3/77(18)
181+00				0.26	0.27	1.12	1.04	9/77(24)
				0.26	0.27	1.16	1.14	4/78(31)
				0.28	0.29	0.94	0.91	9/78(36)
				0.26	0.27	1.54	1.29	9/75(0)
				0.26	0.27	1.42	1.39	3/76(6)
181+00	6.0	8%A.C. Lt.Wt. HMAC	1.00	0.28	0.29	0.85	0.88	9/76(12)
to		6% SEA Hot sand	5.00	0.27	0.29	1.06	0.87	3/77(18)
184+50				0.27	0.27	1.03	1.19	9/77(24)
				0.28	0.28	0.97	1.14	4/78(31)
				0.29	0.30	0.87	0.90	9/78(36)

1 in = 25.4 mm

* Pavement age in months from date of construction

Table 2 (continued)

Station	Total pavement depth(in)	Material	Thickness (in)	Stiffness coefficient of subgrade		Stiffness coefficient of subgrade		
				Lane A	Lane B	Lane A	Lane B	Date
				0.26	0.25	1.26	1.16	9/75(0)*
				0.26	0.26	1.41	1.50	3/76(6)
184+50	6.00	8% A.C. Lt.Wt. HMAC	1.00	0.28	0.28	0.88	0.82	9/76(12)
to		6% SEA Hot Sand	5.00	0.27	0.29	1.07	0.79	3/77(18)
188+00				0.28	0.28	1.02	0.95	9/77(24)
				0.27	0.28	1.04	1.05	4/78(31)
				0.30	0.30	0.81	0.84	9/78(30)
				0.26	0.27	1.15	1.07	9/75(0)
				0.30	0.29	0.80	0.87	3/76(6)
188+00	8.00	8%A.C. Lt.Wt. HMAC	1.00	0.29	0.29	0.67	0.71	9/76(12)
to		7.1% SEA Hot sand	7.00	0.28	0.30	0.84	0.73	3/77(18)
193+00				0.28	0.28	0.86	0.98	9/77(24)
				0.28	0.27	0.89	1.01	4/78(31)
				0.30	0.30	0.68	0.70	9/78(34)
				0.27	0.28	0.96	0.93	9/75/(6)
				0.29	0.29	0.78	0.85	3/76(6)
193+00	8.00	8% A.C. Lt. Wt. HMAC	1.00	0.29	0.29	0.63	0.68	9/76(12)
to		5.65% SEA HMAC	3.00	0.27	0.29	0.85	0.71	3/77(18)
200+00		6% SEA Hot Sand	4.00	0.29	0.29	0.73	0.80	9/77(24)
				0.27	0.28	0.91	0.91	4/78(31)
				0.30	0.30	0.73	0.72	9/78(36)
				0.26	0.28	1.06	0.89	9/75(0)
				0.25	0.28	1.24	0.94	3/76(6)
200+00	8.00	8% A.C. Lt.Wt. HMAC	1.00	0.29	0.28	0.63	0.68	9/76(12)
to		4.8% A.C. HMAC	3.00	0.27	0.28	0.84	0.74	3/77(18)
203+50		5.4% A.C. Hot sand	4.00	0.27	0.26	0.97	0.91	9/77(24)
				0.27	0.27	0.92	0.90	4/78(31)
				0.29	0.30	0.77	0.74	9/78(36)

1 in = 25.4 mm

* Pavement age in months from date of construction

Table 3 Maximum Dynaflect deflections and surface curvature index as computed by STIF 2

Station	Total pavement depth (in)	Material	Thickness (in)	Maximum Dynaflect deflection (10^{-3}in)		Surface curvature index		
				Lane A	Lane B	Lane A	Lane B	Date
				0.900	0.900	0.175	0.195	9/75(0)
				0.780	0.810	0.135	0.180	3/76(6)
167+00	8.00	8% A.C. Lt.Wt. HMAC	1.00	1.020	1.008	0.268	0.226	9/76(12)
to		4.8% A.C. HMAC	7.00	0.753	0.880	0.130	0.188	3/77(18)
170+50				0.963	0.900	0.163	0.108	9/77(24)
				0.797	0.817	0.135	0.145	4/78(31)
				0.780	0.793	0.178	0.208	9/78(36)
				0.978	0.942	0.212	0.192	9/75(0)
				0.816	0.852	0.144	0.156	3/76(6)
170+50	8.00	8%A.C. Lt.Wt. HMAC	1.00	1.130	1.160	0.353	0.307	9/76(12)
to		5.65% SEA HMAC	3.00	0.785	0.975	0.148	0.227	3/77(18)
177+50		4.8% SEA HMAC	4.00	0.900	0.920	0.195	0.160	9/77(34)
				0.825	0.752	0.177	0.133	4/78(31)
				0.765	0.808	0.310	0.253	9/78(36)
				0.850	0.885	0.205	0.250	9/75(0)
				0.885	0.840	0.210	0.195	3/76(6)
177+50	6.00	8%A.C. Lt.Wt. HMAC	1.00	1.075	0.165	0.368	0.375	9/76(12)
to		5.4% A.C. Hot Sand	5.00	0.895	1.000	0.223	0.332	3/77(18)
181+00				1.020	0.915	0.283	0.268	9/77(24)
				1.030	0.823	0.273	0.223	4/78(31)
				0.873	0.803	0.282	0.267	9/78(36)
				0.840	0.825	0.190	0.230	9/75(0)
				0.840	0.810	0.210	0.210	3/76(6)
181+00	6.00	8% A.C. Lt.Wt. HMAC	1.00	1.000	0.910	0.352	0.310	9/76(12)
to		6% SEA Hot Sand	5.00	0.862	0.865	0.245	0.248	3/77(18)
				0.895	0.825	0.267	0.207	9/77(31)
				0.906	0.717	0.282	0.188	4/78(31)
				0.852	0.747	0.296	0.252	9/78(36)

1 in = 25.4 mm
* Pavement age in months from date of construction

Table 3 (continued)

Station	Total pavement depth	Material	Thickness (in)	Maximum Dynaflect deflection (10^{-3}) Lane A	Lane B	Surface curvature index Lane A	Lane B	Date
				0.990	0.885	0.265	0.240	9/75(0)*
				0.885	0.885	0.225	0.210	3/76(6)
184+50	6.00	8% A.C. Lt. Wt. HMAC	1.00	1.020	1.015	0.347	0.367	9/76(12)
to		6% SEA Hot Sand	5.00	0.847	0.935	0.240	0.352	3/77(18)
188+00				0.890	0.950	0.272	0.308	9/77(24)
				0.900	0.803	0.268	0.237	4/78(31)
				0.870	0.805	0.320	0.288	9/78(36)
				0.695	0.680	0.150	0.162	9/75(0)
				0.680	0.712	0.223	0.215	3/76(6)
188+00	8.00	8% A.C. Lt. Wt. HMAC	1.00	0.840	0.778	0.295	0.260	9/76(12)
to		7.1% SEA Hot Sand	7.00	0.692	0.695	0.190	0.227	3/77(18)
193+00				0.722	0.632	0.198	0.148	9/77(24)
				0.723	0.625	0.185	0.147	4/78(31)
				0.752	0.673	0.262	0.230	9/78(36)
				0.788	0.768	0.215	0.217	9/75(6)
				0.780	0.765	0.262	0.237	3/76(6)
193+00	8.00	8% A.C. Lt. Wt. HMAC	1.00	0.955	0.847	0.353	0.292	9/76(12)
to		5.65% SEA HMAC	3.00	0.782	0.798	0.212	0.263	3/77(18)
200+00		6% SEA Hot Sand	4.00	0.793	0.762	0.273	0.263	9/77(24)
				0.722	0.693	0.180	0.173	4/78(31)
				0.662	0.645	0.215	0.212	9/78(36)
				0.810	0.885	0.195	0.250	9/75(0)
				0.810	0.795	0.165	0.220	3/76(6)
200+00	8.00	8% A.C. Lt. Wt. HMAC	1.00	1.005	1.000	0.368	0.343	9/76(12)
to		4.8% A.C. HMAC	3.00	0.845	0.950	0.232	0.300	3/77(18)
203+50		5.4% A.C. Hot Sand	4.00	0.742	0.855	0.173	0.217	9/77(24)
				0.783	0.783	0.193	0.202	4/78(31)
				0.680	0.673	0.208	0.213	9/78(36)

1 in = 25.4 mm

* Pavement age in months from date of construction

Table 4 Visual inspection & traffic analysis for highway design, U.S. 69, Lufkin

FROM: The Cherokee County Line

TO: SH 7

	1975	1977	1978	1979
ADT:		4950	5200	5450
Directional distribution factor:			60-40%	60-40%
Design hourly volume:			11.5%	11.5%
Percent trucks				
1) ADT:			20.3	20.3
2) DHT:			14.0	14.0
Anticipated annual growth rate:			5.1%	5.1%
Average ten heaviest wheel loads (ATHWLD), lbs			11,300 (5,136 kg)	11,300 (5,136 kg)
Percent tandem axles in ATHWLD			60%	60%
Total number of equivalent 18K single				
Axle load applications, one direction:				
1) Flexible pavement (1 year)			142,000	203,000
2) Rigid pavement (2 years)			291,000	416,000
Pavement rating scores				
1) SEA	100%	97%	99%	
2) AC	100%	97%	98%	

Table 5 Benkelman Beam rebound deflections for Lufkin field trials

Station	Total pavement depth	Material	Thickness (in)	Rebound deflections (in) Lane A		Lane B		
				Left wheel path	Right wheel path	Left wheel path	Right wheel path	Date
167+00 to 170+50	8.00	8% A.C. Lt. Wt. HMAC 4.8% H.C. HMAC	1.00 7.00	0.0078	0.0072	0.0080	0.0088	11/20/75(2)*
				0.0082	0.0058	0.0102	0.0047	10/19/76(13)
				0.0105	0.0080	0.0067	0.0063	3/28/77(18)
				0.0067	0.0063	0.0057	0.0053	11/2/77(26)
				0.0095	0.0087	0.0077	0.0068	4/11/78(31)
				0.0127	0.0105	0.0088	0.0098	10/12/78(37)
170+50 to 177+50	8.00	8% A.C. Lt. Wt. HMAC 5.65% SEA HMAC 4.8% SEA HMAC	1.00 3.00 4.00	0.0083	0.0078	0.0098	0.0117	11/20/75(2)
				0.0092	0.0073	0.0115	0.0067	10/19/76(13)
				0.0114	0.0108	0.0117	0.0110	3/28/77(18)
				0.0085	0.0061	0.0084	0.0083	11/2/77(26)
				0.0099	0.0095	0.0113	0.0111	4/11/78(31)
				0.0124	0.0119	0.0121	0.0125	10/12/78(37)
177+50 to 181+00	6.00	8% A.C. Lt. Wt. HMAC 5.4% A.C. Hot Sand	1.00 5.00	0.0082	0.0085	0.0092	0.0105	11/20/75(2)
				0.0077	0.0074	0.0043	0.0048	10/19/76(13)
				0.0126	0.0104	0.0088	0.0097	3/28/77(18)
				0.0091	0.0074	0.0073	0.0095	11/2/77(26)
				0.0099	0.0092	0.0094	0.0096	4/11/78(31)
				0.0126	0.0097	0.0100	0.0124	10/12/78(37)
181+00 to 184+50	6.00	8% A.C. Lt. Wt. HMAC 6% SEA Hot Sand	1.00 5.00	0.0076	0.0075	0.0077	0.0088	11/20/75(2)
				0.0060	0.0055	0.0058	0.0043	10/19/76(13)
				0.0085	0.0087	0.0063	0.0068	3/28/77(18)
				0.0073	0.0058	0.0065	0.0070	11/2/77(26)
				0.0175	0.0145	0.0120	0.0112	4/11/78(31)
				0.0127	0.0092	0.0120	0.0107	10/12/78(37)

1 in = 25.4 mm
* Pavement age in months from date of construction

Table 5 (continued)

Station	Total pavement depth	Material	Thickness (in)	Rebound deflections (in) Lane A Left wheel path	Lane A Right wheel path	Lane B Left wheel path	Lane B Right wheel path	Date
				0.0085	0.0082	0.0095	0.0010	11/20/75(2)*
				0.0062	0.0052	0.0068	0.0058	10/19/76(13)
184+50		8% A.C. Lt. Wt. HMAC	1.00	0.0078	0.0070	0.0078	0.0085	3/28/77(18)
to	6.00	6.35% SEA Hot Sand	5.00	0.0088	0.0058	0.0068	0.0085	11/2/77(26)
188+00				0.0233	0.0177	0.0128	0.0162	4/11/78(31)
				0.0158	0.0120	0.0122	0.0158	10/12/78(37)
				0.0073	0.0068	0.0064	0.0075	11/20/75(2)
				0.0040	0.0031	0.0059	0.0040	10/19/76(13)
188+00		8% A.C. Lt. Wt. HMAC	1.00	0.0062	0.0057	0.0058	0.0060	3/28/77(18)
to	8.00	7.1% SEA Hot Sand	7.00	0.0053	0.0038	0.0057	0.0063	11/2/77(26)
193+00				0.0172	0.0143	0.0130	0.0112	4/11/78(31)
				0.0160	0.0135	0.0092	0.0112	10/12/78(37)
				0.0072	0.0078	0.0083	0.0092	11/20/75(2)
193+00		8% A.C. Lt. Wt. HMAC	1.00	0.0047	0.0042	0.0070	0.0053	10/19/76(13)
to	8.00	5.65% SEA HMAC	3.00	0.0075	0.0077	0.0075	0.0065	3/28/77(18)
200+00		6% SEA Hot Sand	4.00	0.0075	0.0057	0.0080	0.0070	11/2/77(26)
				0.0125	0.0162	0.0140	0.0118	4/11/78(31)
				0.0110	0.0123	0.0098	0.0088	10/12/78(37)
				0.0087	0.0087	0.0092	0.0092	11/20/75(2)
				0.0052	0.0058	0.0070	0.0063	10/19/76(13)
200+00	8.00	8% A.C. Lt. Wt. HMAC	1.00	0.0083	0.0067	0.0082	0.0090	3/28/77(18)
to		4.8% A.C. HMAC	3.00	0.0067	0.0062	0.0075	0.0083	11/2/77(26)
203+50		5.4% A.C. Hot Sand	4.00	0.0138	0.0130	0.0130	0.0130	4/11/78(31)
				0.0120	0.0097	0.0110	0.0137	10/12/78(37)

* Pavement age in months from date of construction
1 in = 25.4 mm

Table 6 Mays Ride Meter results expressed as serviceability

Station	Total Pavement depth	Material	Thickness (in)	Serviceability index Lane A	Lane B	Date
167+00 to 170+50	8.00	8% A.C. Lt. Wt. HMAC	1.00	4.0	4.9	4/5/76(7)*
		4.8% A.C. HMAC	7.00	3.9	4.5	9/17/76(12)
				4.4	4.3	4/14/77(19)
				4.4	4.1	8/25/77(23)
				4.1	3.9	4/14/78(31)
				4.2	4.3	7/31/78(35)
				3.9	3.9	11/3/78(39)
170+50 to 177+50	8.00	8% A.C. Lt. Wt. HMAC	1.00	4.7	4.7	4/5/76(7)
		5.65% SEA HMAC	3.00	4.7	4.4	9/17/76(12)
		4.8% SEA HMAC	4.00	4.5	4.6	4/14/77(19)
				4.5	4.2	8/25/77(23)
				4.0	3.7	4/14/78(31)
				4.4	4.2	7/31/78(35)
				4.4	3.7	11/3/78(39)
177+50 to 181+00	6.00	8% A.C. Lt. Wt. HMAC	1.00	3.7	4.4	4/5/76(7)
		5.4% A.C. Hot Sand	5.00	3.7	4.8	9/17/76(12)
				3.4	4.2	4/14/77(19)
				4.2	4.0	8/25/77(23)
				3.7	4.0	4/14/78(31)
				4.2	4.2	7/31/78(35)
				4.2	3.9	11/3/78(39)
181+00 to 184+00	6.00	8% A.C. Lt. Wt. HMAC	1.00	3.9	4.5	4/5/77(7)
		6% SEA Hot Sand	5.00	4.1	4.6	9/17/76(12)
				3.8	4.4	4/14/77(19)
				3.9	4.0	8/25/77(23)
				4.0	3.9	4/14/78(31)
				4.1	4.0	7/31/78(35)
				3.9	3.7	11/3/78(39)

* Pavement age in months from date of construction

1 in = 25.4mm

Table 6 (continued)

Station	Total pavement depth (in)	Material	Thickness (in)	Serviceability Index Lane A	Lane B	Date
				4.1	4.3	4/5/76(7)*
				4.1	4.5	9/17/76(12)
184+00	6.00	8% A.C. Lt. Wt. HMAC	1.00	3.5	4.3	4/14/77(19)
to		6.35% SEA Hot Sand	5.00	4.0	3.7	8/25/77(23)
188+00				3.6	3.9	4/14/78(31)
				3.9	4.0	7/31/78(35)
				3.9	3.8	11/3/78(39)
				4.4	4.6	4/5/76(7)
				4.4	3.9	9/17/76(12)
188+00	8.00	8% A.C. Lt. Wt. HMAC	1.00	3.9	4.2	4/14/77(19)
to		7.2% SEA Hot Sand	7.00	3.7	4.1	8/25/77(23)
193+00				3.7	3.8	4/14/78(31)
				3.8	4.0	7/31/78(35)
				4.1	3.7	11/3/78(39)
				4.4	4.4	4/5/76(7)
				4.5	4.5	9/17/76(12)
193+00	8.00	8% A.C. Lt. Wt. HMAC	1.00	4.0	4.2	4/14/77(19)
to		5.56% SEA HMAC	3.00	4.2	4.2	8/25/77(23)
200+00		6% SEA Hot Sand	4.00	3.7	3.8	4/14/78(31)
				4.3	4.1	7/31/78(35)
				4.0	3.9	11/3/78(39)
				4.4	4.5	4/5/76(7)
				4.9	4.7	9/17/76(12)
200+00	8.00	8% A.C. Lt. Wt. HMAC	1.00	4.1	4.2	4/14/76(19)
to		4.8% A.C. HMAC	3.00	4.2	4.2	8/25/77(23)
203+50		5.4% A.C. Hot Sand	4.00	3.4	4.4	4/14/78(31)
				4.3	4.0	7/31/78(35)
				4.1	3.9	11/3/78(39)

* Pavement age in months from date of construction

1 in = 25.4 mm

splitting tensile strengths are observed to be in the AC mixture with the SEA mixture with 6.35 percent binder content having the next highest values.

The SEA mixtures possess higher resilient moduli than do the AC mixtures for the HMAC types. In the hot sand types the highest resilient moduli are observed in the AC mixture. The hot sand SEA mixtures all have about the same resilient modulus values.

From Table 2 it may be noted that the lowest pavement stiffness coefficients were computed for the section with 3 inches (76 mm) of SEA HMAC over 4 inches (10 mm) of SEA hot sand. This result was not expected and is subject to question since the subgrade stiffness which was assigned by STIF 2 is consistently higher here than in the other test sections. Conversely, it may be noted that some of the higher pavement stiffness coefficients were lowered by STIF 2. The stiffness coefficients presented in Table 2 should be considered with caution.

In Table 3 the lowest maximum Dynaflect deflections may be observed in the section which has the 7 inch (178 mm) base of 7.1 percent SEA hot sand mixture. This result is somewhat surprising since it was expected that one of the HMAC bases would have the lower maximum Dynaflect deflections. The greatest deflections noted occurred in the section with the 5 inch (127 mm) of 5.4 percent AC hot sand mixture.

In Table 4 it may be noted that the pavement rating scores of both the SEA sections and the AC sections are still quite high. In these ratings it was noted that there was no cracking and only a minor amount of rutting.

In Table 5 it can be seen than the largest Benkelman Beam rebound readings occurred in the 5 inch (127 mm) base sections. Of these, the largest deflections have occurred in the base having a 6.35 percent SEA hot sand mixture. The lowest deflections in the 5 inch (127 mm) base sections were in the 5.4 percent AC hot sand mixture. Of the 7 inch (178 mm) base sections, the largest rebound readings occurred in the full-depth 7.1 percent SEA hot sand mixture and the smallest was in the full-depth AC HMAC.

There are no significant differences in the serviceability indexes of the various test sections as may be seen in Table 6. For the last testing period they range from about 3.7 to 4.4. As might be expected, the higher values occur on the inside lane (lane A).

Conclusions

To date there is very little evidence to indicate that the test sections in this field trial are undergoing any major distress. Even the test sections which were designed for early failure exhibit relatively good pavement characteristics some 40 months after construction.

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