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16. Abstract

The SMERP (Supplemental Maintenance Effectiveness Research Program) study was designed to study the types of maintenance treatments typically used in Texas. Six maintenance treatments and a control section were applied at twenty test locations throughout the state. Treatments included: asphalt rubber chip seal, polymer modified emulsion chip seal, latex modified asphalt chip seal, asphalt chip seal, and a micro-surfacing treatment. Considerable construction data was collected in order to determine the quality of treatment. The data collected and described herein can be used by the districts in Texas to see if they should be collecting any additional data and by researchers studying the effectiveness of the SMERP treatments.

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DEVELOPMENT AND CONSTRUCTION OF THE TEXAS SUPPLEMENTAL MAINTENANCE EFFECTIVENESS RESEARCH PROGRAM (SMERP) EXPERIMENT

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Research Report 1981-1F
Research Study Number 7-1981
Research Study Title: Tecnhical Assistance for the Texas Supplemental Maintenance Effectiveness Research Program (SMERP)

Sponsored by

Texas Department of Transportation

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843

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IMPLEMENTATION STATEMENT

This report describes the construction of and data collection for the Supplemental Maintenance Effectiveness Research Program (SMERP) test sections constructed by Keystone Services, Inc., of Bixby, Oklahoma with International Surfacing, Inc. as a subcontractor, for the Texas Department of Transportation. The data collected and described herein can be used by the districts in Texas to determine whether they should be collecting any additional data and by researchers studying the effectiveness of the SMERP treatments.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation. Additionally, this report is not intended for construction, bidding, or permit purposes. Thomas J. Freeman, P.E. (IL 062-044540) was the Principal Investigator for the project.

ACKNOWLEDGMENT

Special thanks is given to Larry Buttler, James Brown, and James Sassin of TxDOT for their assistant in the development and construction of the SMERP experiment.

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SUMMARY

A decision was made by the TxDOT administration in 1990 to develop and construct test sites of the various preventive maintenance treatments currently used in Texas. The primary objective for the research is to determine the optimum preventive maintenance strategies to prolong pavement life and to demonstrate positive rates of return on preventive maintenance funds.

1. Twelve Districts participated in the study. The Districts were: Paris (1), Amarillo (4), Odessa (6), Abilene (8), Waco (9), Tyler (10), Yoakum (13), San Antonio (15), Bryan (17), Atlanta (19), Beaumont (20), and Brownwood (23).

2. Twenty sites were constructed. Each site included a total of seven 700 foot (213.4 m) sections. The sections were micro-surfacing, fog seal, a control section, and four seal coat types: asphalt rubber, latex modified, polymer modified, and conventional. Two sites did not have a fog seal or a control section.

3. The contractor was Keystone Services, Inc. with International Surfacing, Inc as a subcontractor. State forces constructed the fog seal sections. Overall, the project was completed with a TxDOT rating of "Good."

4. Construction of the test sections began April 5, 1993 and was completed July 14, 1993.

5. The sections will be monitored until failure to accomplish the objective.

Considerable construction data was collected in order to determine the quality of treatment. The data collected and described herein can be used by the districts in Texas to see if they should be collecting any additional data and by researchers studying the effectiveness of the SMERP treatments.

CHAPTER 1. BACKGROUND AND OBJECTIVES

BACKGROUND

Now that most of the new road construction in the United States is complete, the major emphasis has switched to maintaining those roads. In an effort to improve the information on the performance of maintenance treatments, the Strategic Highway Research Program (SHRP) implemented research on the effectiveness of maintenance treatments. SHRP is gathering field performance data from pavement test sections spread over the various climatic regions of the United States. However, the SHRP data is not applicable to all pavement preventive maintenance treatments currently used in Texas.

The SHRP (Strategic Highway Research Program) H-101 Maintenance Effectiveness program studied the effects of selected preventive maintenance treatments (Ref. 1). Texas is in the SHRP Southern region. The SHRP Southern region has test sites throughout Texas, as far north as Tennessee, and as far east as Florida. The SHRP research required that the contractor use the same asphalt and aggregate at each site constructed within the specific SHRP region. In addition, the SHRP research studied the following maintenance treatments only: emulsified asphalt chip seal, crack seal, slurry seal, and a thin overlay. When SHRP personnel were looking for SHRP sites on which to build the Asphalt Maintenance Cost Effectiveness Study, Specific Pavement Study-3 (SPS-3), they offered to State Highway Agencies the option to build supplemental test sections adjoining the SPS-3 sections under the agreement that SHRP would monitor all test sections constructed. Interest was expressed by several Texas Districts after the SHRP offer. In fact, Texas agreed to fund the construction of fourteen SPS-3 treatments throughout the state. Texas has more SPS-3 sites than any other state and has more sites than the entire SHRP North Atlantic region. However, a combination of limited funding in the individual District's maintenance allocation and lack of consensus on which treatments to place resulted in a decision by the Administration to adjust the state's overall preventive maintenance program and develop a comprehensive preventive maintenance experiment.

The Texas Department of Transportation (TxDOT) spends approximately $450 million per year on its overall maintenance program and approximately $150 million per year on its Preventive Maintenance Program. The Texas Department of Transportation introduced the Texas Preventive Maintenance Research Program at the annual District SHRP Coordinators meeting in October 1990. The name of this program was later changed to SMERP (Supplemental Maintenance Effectiveness Research Program). One million dollars was allocated to the experiment to build test sections of preventive maintenance treatments of interest to Texas but not considered in the SHRP national experiment.

The SMERP study was designed to more closely study the types of maintenance treatments typically used in Texas, and it allowed the contractor to use local materials if desired. The treatments constructed in the SMERP study were an asphalt rubber chip seal, polymer modified emulsion chip seal, latex modified asphalt chip seal, asphalt chip seal, and a micro-surfacing treatment. All treatments were placed on test sections that were 700 feet (213.4 m) long. Both lanes were treated and, where they existed, the shoulders were treated. Shoulders were not treated under the SHRP SPS-3 study. A fog seal section was constructed by state forces and a control section was established on which no treatment was placed. In general, the SMERP contractor did not use local materials at each site but did use local sources of asphalt and aggregate where available.

The sites where the SMERP sites were to be constructed were identified by the districts that offered to participate in the study and accepted by the TxDOT Design Division. The districts marked the beginning and end of each treatment and provided signs along the roadway to indicate each of the SMERP treatments.

OBJECTIVES

The SHRP Asphalt Maintenance Effectiveness Study, (SPS-3) is studying thin AC overlays, slurry seals, crack seals, and seal coats at eighty-one sites nationwide, with fourteen sites in Texas. The primary goals of the SHRP SPS-3 program are listed below.

1. To establish the effectiveness of typical common maintenance treatments in prolonging the life of asphalt pavements,
2. To develop methods of evaluating the cost-effectiveness of maintenance treatments, and

3. To develop information on the effect of timing of the application treatments on the performance of the treatments.

The SMERP experiment consisted of constructing a total of twenty (20) test sites in twelve (12) TxDOT Districts. Each test site consists of a total of seven 700 foot (213.4 m) test sections of asphalt rubber chip seal, polymer modified emulsion chip seal, latex modified asphalt chip seal, asphalt chip seal, micro-surfacing treatment, fog seal, and a control section. Two locations do not have either the control or fog seal sections.

The goal for the SMERP Experiment is to establish the cost effectiveness of typical and promising maintenance treatments used in Texas in prolonging the life of asphalt pavements.

Factors contributing to increased maintenance effectiveness and optimum pavement life-cycle cost are maintenance planning, spending, and performance monitoring. TxDOT will be able to address these factors by using the pavement management system and the data collected from the SHRP SPS-3 and SMERP studies. By combining the data and analysis of both programs, the department will be assured optimal planning strategies in selecting preventive maintenance treatments. Once again, the primary objective is to determine optimum preventive maintenance strategies that prolong pavement life and to demonstrate positive rates of return on preventive maintenance funds.

CHAPTER 2. CONDUCTING THE EXPERIMENT

DEVELOPMENT OF THE EXPERIMENTAL DESIGN

After the decision was made by TxDOT to develop and construct the experiment, a letter was sent out to the districts explaining the objectives of the experiment and requesting their participation. Twelve districts elected to participate: Paris (1), Amarillo (4), Odessa (6), Abilene (8), Waco (9), Tyler (10), Yoakum (13), San Antonio (15), Bryan (17), Atlanta (19), Beaumont (20), and Brownwood (23). Representatives from the districts and TxDOT divisions met in Austin on February 12, 1991, to finalize the experiment design and begin coordinating the activities for constructing the projects. It was decided that the experiment design should incorporate factors considered to be key variables in the analysis and that the basic design matrix should be similar to the one developed for the SHRP study. At that point, it was decided to fill the matrix with candidate projects that fit the following criteria:

A. Performance Regions
West, East, South, NorthWest, and Central.

B. Pavement Condition
Good and Fair.

C. Traffic
Low and high.

After reviewing all of the sites submitted, the goal of filling all of the above criteria could not be met. However, the performance regions criteria were met. Not all of the pavement condition and traffic criteria were met, but the sites were typical candidates to receive preventive maintenance treatments. The final list of sites is shown in Table 1, and the geographical distribution of the sites is shown in Figure 1.

Table 1. Test Site Locations

PROJ REF NO.	DIST	ROAD	COUNTY	STATION		REF MRKR		LOCATION	
				FROM	TO	FROM	TO	FROM	TO
1	1	SH 11	Grayson	324+16.50	364+16.50	600+0.00	600+0.80	2.8 mi S. of FM 637	0.76 mi S.
2	1	SH 19	Hopkins	197+78.54	237+78.54	246+0.00	246+0.76	Sulphur Springs City Limits	0.76 mi S.
3	4	US 385	Deaf Smith	785+65.00	625+00.00	116+0.00	116+1.00	FM 1412	FM 1062
4	4	FM 1061	Potter	0+00.00	105+60.00	102+0.00	104+0.00	0.75 mi E. of FM 2381	2.0 mi E.
5	6	FM 181	Ector	0+00.00	557+11.89	326+0.00	336+0.50	Andrews County Line	Near SH 158
6	6	SH 349	Martin	1235+50.0	2171+35.4	288+0.00	302+1.85	Near FM 87	Dawson Co.
7	8	SH 36	Taylor	105+00.00	403+93.00	296+7.00	302+3.00	Abilene City Limits	Callahan Co.
8	8	US 84	Scurry	450+98.00	598+00.00	407+1.74	404+4.00	Snyder City Limits	US 180
9	9	FM 933	McLennan	63+07.00	105+31.00	356+1.367	358+0.161	FM 3051	0.8 mi S.
10	10	SH 135	Smith	61+00.00	103+00.00	302+1.962	304+1.752	0.26 mi NE of SH 64	0.79 mi NE
11	13	SH 35	Calhoun	347+42.33	570+68.64	602+0.00	606+0.26	Jackson Co. Line	FM 1593
12	13	SH 71	Fayette	292+85.13	506+90.00	644+0.283	648+0.310	Baylor Creek	FM 955
13	15	SH 46	Bandera	395+40.00	623+48.5	472+0.442	468+0.042	Kendall Co. Line	SH 16
14	15	FM 484	Comal	10+00.00	167+38.2	462+0.041	464+0.988	FM 32	FM 306
15	17	US 190	Milam	731+30.00	773+30.00	628+0.685	628+1.485	1.9 mi S. of US 77	0.8 mi S.
16	19	SH 49	Titus	501+43.33	536+43.33	700+1.111	700+1.774	1.1 mi W. of Morris Co.	Morris Co.
17	19	SH 315	Panola	303+46.60	338+46.60	738+0.709	738+1.37	1.4 mi W. of SH 149	0.3 mi W. of SH 149
18	20	FM 105	Jasper	0+00.00	79+20.00	424+0.000	424+1.500	US 96	1.5 mi S.
19	23	US 67	Brown	637+91.00	686+91.00	558+0.54	558+1.47	Blanket Creek Bridge	1.0 mi N.
20	23	US 377	McCulloch	72+82.3	121+82.3	472+1.908	474+0.836	1.0 mi N. of FM 2996 S.	FM 2996

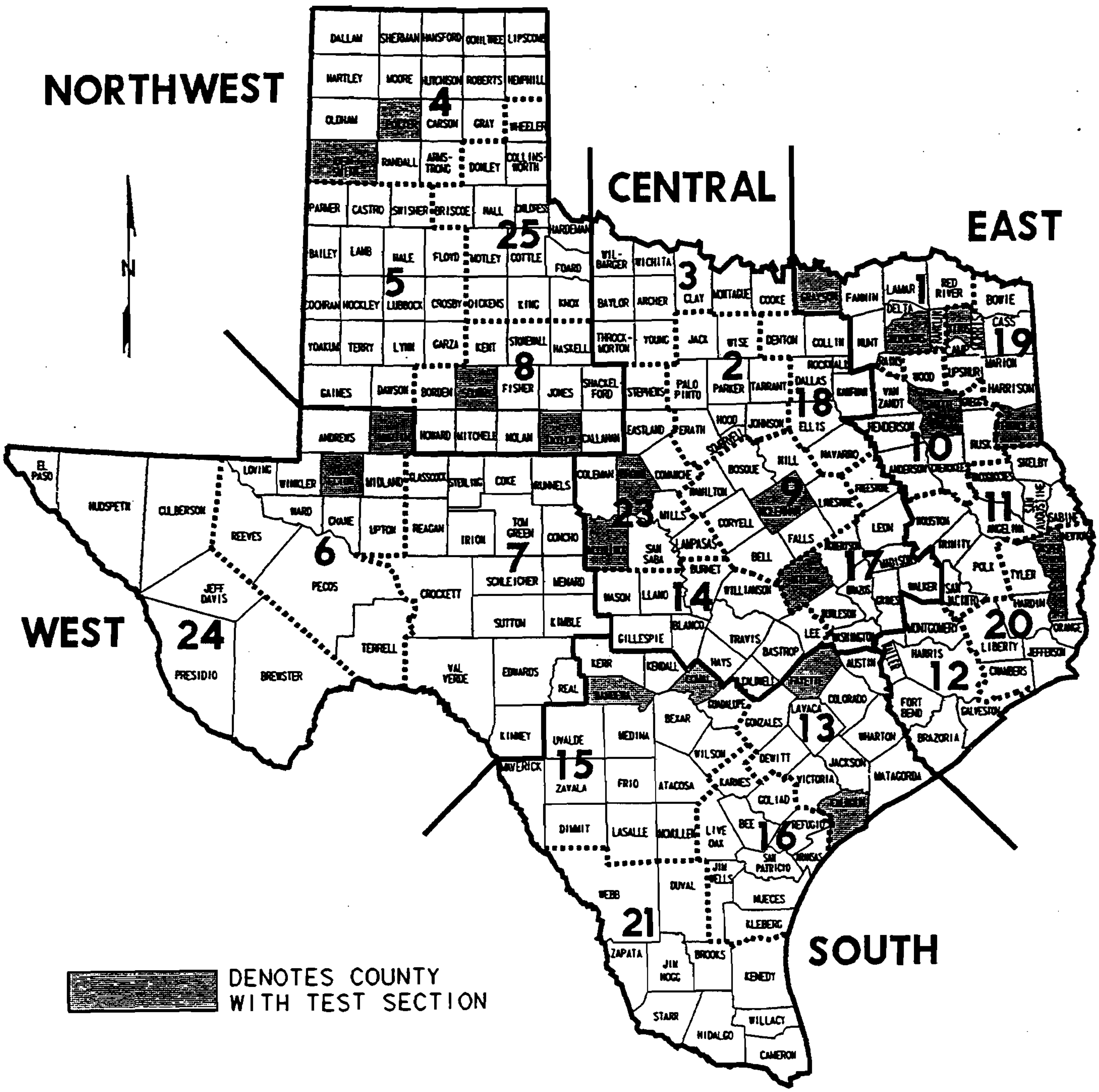

Figure 1. Locations of SMERP Sites

LAYOUT, MARKING, AND SIGNING TEST SECTIONS

Figure 2 shows the typical layout of test sections within each site. All sections are grouped together unless there is a change in pavement structure, traffic, or condition. The monitoring section will be 500 feet (152.4 m) long and only in the designated lane. However, visual distress data has been collected on all lanes, and the evaluation may include both lanes.

To alert the public to the existence of a test site, a sign was installed alongside the test section 6 feet (1.8 m) to the right of the shoulder and 200 feet (61.0 m) before the first test section. This sign reads "TEST SITE NEXT 1 MILE." Signs identifying the specific treatment type were installed near the right-of-way line at the beginning of each section. Each sign listed SMERP, test section number, treatment type, and section number.

White **non-reflectorized** traffic buttons were placed on the edge of the shoulder at the beginning of every section and at every 100 feet (30.5 m). If a site did not have a shoulder, buttons were not installed.

A white paint stripe (3-4 inches wide [0.076 m - 0.102 m]) was placed at the beginning and end of each treatment across the treatment lane. A white stripe (3-4 inches wide [0.076 m - 0.102 m]) was also placed at the beginning and end of the monitoring section across the treatment lane. The stripe at the end of a treatment was used for the beginning of the next treatment if the two treatments were adjacent.

White crosses were painted at the beginning and end of the monitoring section and at every 100 feet (30.5 m) within the monitoring section. The station numbers (0, 1, 2, 3, 4, and 5) were painted to the right of the crosses to aid in location for distress surveys and other data collection efforts.

The section number was painted to the right of the white stripe at the beginning of the monitoring test section (the numbers and letters were about 5 inches high [0.127 m]). The section numbering scheme of the SMERP sections is similar to the SHRP scheme. The numbering of a site consists of four parts. The first two digits (48) represent the state code for Texas. The next character is the site number expressed alphabetically (i.e., A is site 1, B is site 2, C is site 3, etc.). The next two digits signify the TxDOT district where the site is located. The final character is the site type. Table 2 lists the site types and their appropriate description.

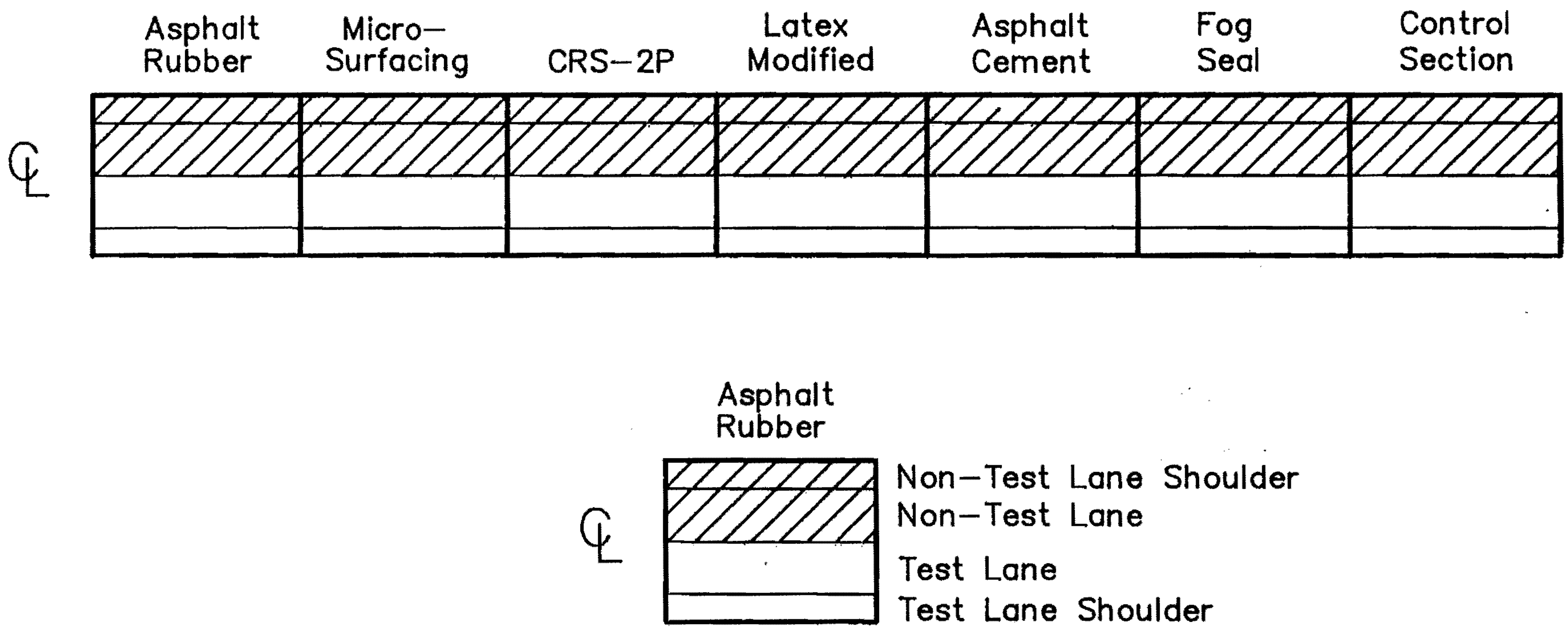

Figure 2. Typical SMERP Site Layout

Table 2. Site Numbering Description

Example: 48A01H

H -	Asphalt Rubber Test Lane	R -	Asphalt Rubber Non-Test Lane
M -	Micro-Surfacing Test Lane	I -	Micro-Surfacing Non-Test Lane
E -	CRS-2P Test Lane	U -	CRS-2P Non-Test Lane
L -	Latex Modified Test Lane	T -	Latex Modified Non-Test Lane
C -	Straight AC Test Lane	O -	Straight AC Non-Test Lane
F -	Fog Seal Test Lane	G -	Fog Seal Non-Test Lane
X -	Control Section Test Lane	N -	Control Section Non-Test Lane

CONDITION SURVEYS

Prior to construction of the SMERP treatments, a manual condition survey and an automated distress survey using the Automated Road Analyzer (ARAN) (video image analysis) were conducted. In the initial survey, only the test lane was surveyed. Future manual distress surveys will be conducted on both lanes of the test sections. The manual survey was conducted in accordance with the procedures set up for a SHRP LTPP distress survey (Ref 3.). In addition to measuring the number and quantity of each distress at each severity level, a crack map showing the location of each distress was also produced. An example of a completed form is shown in Figure 3.

The distress data from the manual surveys were summarized and entered into a spreadsheet. The data were also placed in an ASCII file in a format that is compatible with the output from the SHRP LTPP database. The results of the distress survey are included in Table 3. For clarity and ease of reading, distress quantities of zero (0) have been replaced with a dash (-). If a particular distress type-severity combination was not present at any of the test sections, that column was omitted. For example, since there were no sections containing any reflection cracking, those columns were omitted from this table.

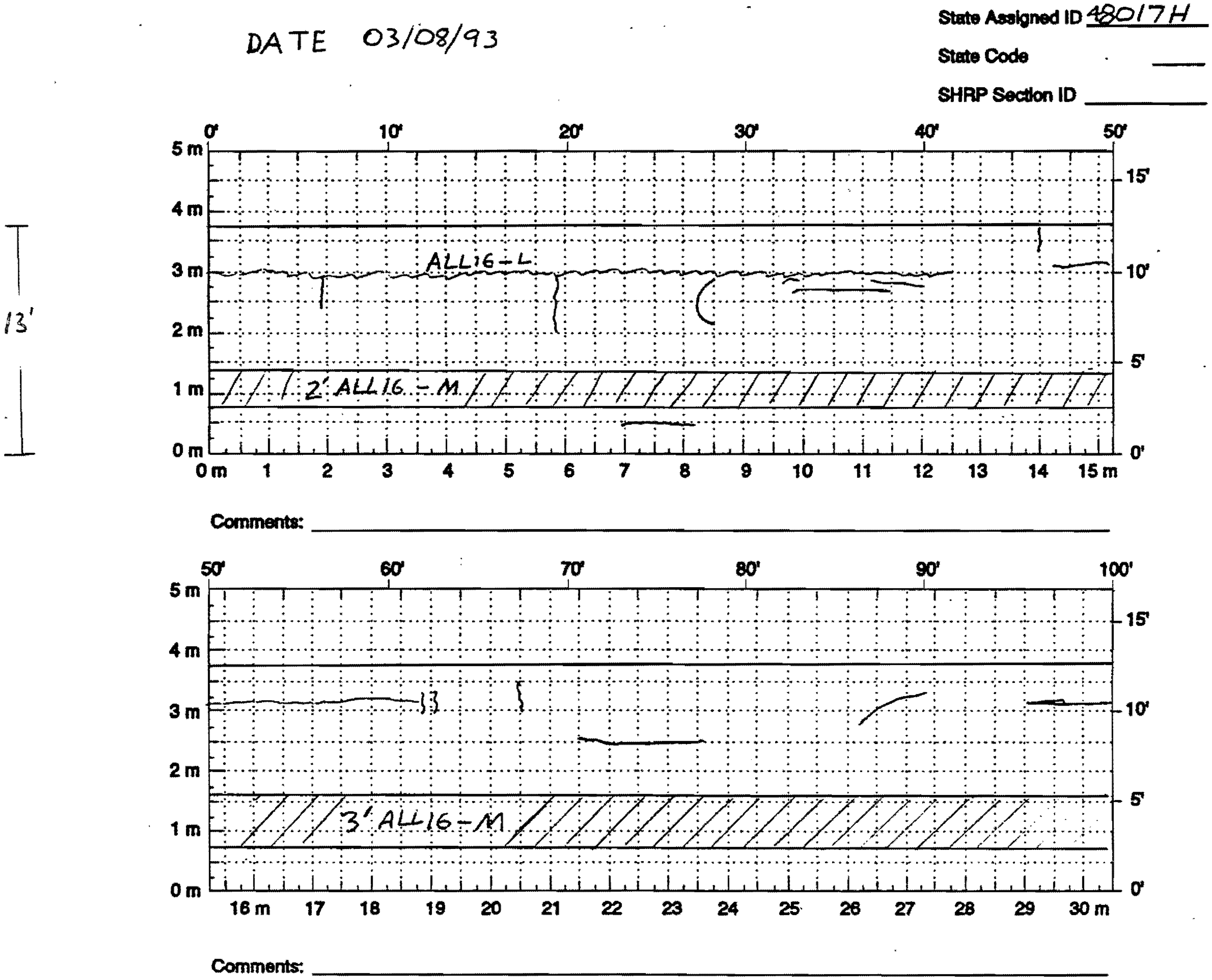

Figure 3. Completed SHRP LTPP Condition Survey Form

Table 3. Results of Pre-Construction Distress Survey

SITE	DIST	TYPE	ALLGATOR CR L	ALLGATOR CR M	ALLGATOR CR H	BLOCK L	BLOCK M	EDGE L	EDGE M	LONGITUDINAL WHEEL PATH UNSEAL L	LONGITUDINAL WHEEL PATH UNSEAL M	LONGITUDINAL WHEEL PATH SEAL L	LONGITUDINAL NON WHEEL PATH UNSEAL L	LONGITUDINAL NON WHEEL PATH UNSEAL M	LONG L	NUM TRANSVE L	NUM TRANSVE M	NUM TRANSVE H	TRAN CR UNS L	TRAN CR UNS M	TRAN CR UNS H	SEAL M	PATCHES NUM L	PATCHES NUM M	PATCH L	SF M	POTHOLE NUM L	SF L	BLEEDING L	BLEEDING M	BLEEDING H	RAVELING L	RAVELING M	RAVELING H
1	1	H	-	-	-	6500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	128	3347	-	-	-	-
1	1	M	-	-	-	5850	-	-	-	-	-	-	-	-	-	4	-	-	44	-	-	-	-	-	-	-	-	-	636	3509	-	-	-	-
1	1	E	-	-	-	5681	-	-	-	2	-	-	5	-	-	4	-	-	27	-	-	-	7	-	10	-	-	-	350	4650	-	-	-	-
1	1	L	-	-	-	6032	-	-	-	-	-	-	-	-	-	2	-	-	7	-	-	-	-	-	-	-	-	-	1000	4000	-	-	-	-
1	1	C	-	-	-	6500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	325	4675	-	-	-	4
1	1	F	-	-	-	936	-	-	-	-	-	-	8	-	-	21	-	-	239	-	-	-	-	-	-	-	-	-	4000	2000	-	-	-	-
1	1	X	-	-	-	2600	-	-	-	38	-	-	11	-	-	27	-	-	210	-	-	-	-	-	-	-	-	-	750	2750	-	-	-	-
2	1	H	-	-	-	-	-	-	-	-	-	-	19	-	-	1	-	-	2	-	-	-	1	-	9	-	-	-	150	1640	-	-	-	-
2	1	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	850	-	-	-	-
2	1	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	832	198	-	-	-	-
2	1	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	186	796	1804	-	-	-
2	1	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	350	1020	-	-	-	-
2	1	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	270	585	1892	-	-	-
2	1	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	267	383	-	-	-	-
3	4	H	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	83	-	-	-	-	-	-	-	-	-	33	-	-	-	-	-
3	4	M	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	133	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	4	E	-	-	-	-	-	-	-	10	-	-	-	-	-	10	-	-	74	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-
3	4	L	-	-	-	-	-	-	-	-	-	-	71	-	-	21	-	-	169	-	-	-	-	-	-	-	-	-	392	-	-	-	-	-
3	4	C	-	-	-	-	-	-	-	-	-	-	55	-	-	20	-	-	158	-	-	-	-	-	-	-	-	-	629	-	-	-	-	-
3	4	F	-	-	-	-	-	-	-	-	-	-	14	-	-	30	-	-	235	-	-	-	-	-	-	-	-	-	214	-	-	-	-	-
3	4	X	-	-	-	-	-	-	-	-	-	-	225	-	-	20	-	-	215	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-
4	4	H	76	-	-	-	-	59	34	17	-	-	11	-	-	57	-	-	342	-	-	-	-	-	-	-	-	-	-	1000	-	-	-	-
4	4	M	-	-	-	-	-	6	-	21	-	-	138	-	-	48	-	-	288	-	-	-	-	-	-	-	-	-	860	1750	-	-	-	-
4	4	E	-	-	-	-	-	36	-	15	-	-	92	-	-	52	-	-	332	-	-	-	-	-	-	-	-	-	2500	-	4	-	-	-
4	4	L	-	-	-	-	-	23	-	-	-	-	9	-	-	13	-	-	69	-	-	-	-	-	-	-	-	-	1400	1301	100	-	-	-
4	4	C	-	-	-	-	-	19	-	21	-	-	84	-	-	29	-	-	194	-	-	-	-	-	-	-	-	-	2300	-	-	-	-	-
4	4	F	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	4	-	-	-	1	-	10	2425	-	-	-	4165	-	-	-	-
4	4	X	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2750	3750	-	-	-	-
5	6	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1075	2000	-	-	-	-
5	6	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	490	2128	-	-	-	-
5	6	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1532	2593	-	-	-	-
5	6	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	646	2392	-	-	-	-
5	6	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	3600	-	-	-	-
5	6	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3370	-	-	-	-
5	6	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1300	2700	-	-	-	-
6	6	H	-	-	-	-	-	-	-	4	-	-	-	-	-	21	7	-	161	84	-	7	7	-	356	-	1	1	-	-	-	-	-	-
6	6	M	-	18	-	-	-	-	-	-	-	-	3	-	-	23	5	-	212	62	-	5	47	-	293	-	1	-	-	-	-	-	-	-
6	6	E	14	-	-	-	-	-	-	-	-	-	-	-	-	27	1	-	233	12	-	-	2	-	120	-	2	-	-	-	-	-	-	-
6	6	L	-	-	-	-	-	-	-	54	-	-	-	-	-	41	1	-	354	12	-	-	3	-	188	-	-	-	-	-	-	-	-	-
6	6	C	-	-	-	-	-	-	-	-	-	-	4	-	-	33	2	-	280	24	-	-	5	-	436	-	-	-	-	-	-	-	-	-
6	6	F	-	-	-	-	-	-	-	1	-	-	7	-	-	31	2	-	271	24	-	-	3	-	136	-	-	-	-	-	-	-	-	-
6	6	X	-	-	-	-	-	-	-	1	-	-	-	-	-	34	-	-	303	-	-	-	4	-	192	-	-	-	-	-	-	-	-	-
7	8	H	-	-	-	-	-	-	-	110	-	-	230	250	-	38	1	-	212	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	8	M	7	-	-	-	-	-	-	12	-	-	141	215	-	29	1	-	178	13	-	-	-	-	-	-	-	-	-	-	-	98	-	-
7	8	E	12	-	-	-	-	-	-	50	-	-	356	80	-	44	1	-	256	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	8	L	-	-	-	-	-	-	-	21	-	-	145	272	-	30	-	-	191	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	8	C	-	-	-	-	-	-	-	37	-	-	216	330	-	39	-	-	158	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	8	F	-	15	-	-	-	-	-	30	-	-	179	102	-	43	-	-	203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	8	X	-	-	-	-	-	-	-	58	-	-	364	-	-	49	-	-	178	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3. Results of Pre-Construction Distress Survey (Continued)

SITE	DIST	TYPE	ALLGATOR CR L	ALLGATOR CR M	ALLGATOR CR H	BLOCK L	BLOCK M	EDGE L	EDGE M	LONGITUDINAL WHEEL PATH UNSEAL L	LONGITUDINAL WHEEL PATH UNSEAL M	LONGITUDINAL WHEEL PATH SEAL L	LONGITUDINAL NON WHEEL PATH UNSEAL L	LONGITUDINAL NON WHEEL PATH UNSEAL M	LONGITUDINAL NON WHEEL PATH LONG L	NUM TRANSVE L	NUM TRANSVE M	NUM TRANSVE H	TRAN CR UNS L	TRAN CR UNS M	TRAN CR UNS H	SEAL M	PATCHES NUM L	PATCHES NUM M	PATCHES PATCH SF L	PATCHES PATCH SF M	POTHOLE NUM L	POTHOLE SF L	BLEEDING L	BLEEDING M	BLEEDING H	RAVELING L	RAVELING M	RAVELING H
8	8	H	25	-	-	1950	-	-	-	24	-	-	68	-	-	35	2	-	190	26	-	-	-	-	-	-	-	-	-	5500	-	-	-	-
8	8	M	30	50	-	3250	-	-	-	98	-	-	21	-	-	15	2	-	85	20	-	-	-	-	-	-	-	-	5500	-	-	-	-	-
8	8	E	4	12	-	1950	650	-	-	18	-	-	166	-	-	28	7	-	138	60	-	-	-	-	-	-	-	-	-	6500	-	-	-	-
8	8	L	-	-	-	-	5655	-	-	-	-	-	-	-	-	1	2	-	9	26	-	-	-	-	-	-	-	-	-	5000	-	-	-	-
8	8	C	-	-	-	4160	-	-	-	-	-	-	121	-	-	15	1	-	92	13	-	-	-	-	-	-	-	-	-	6000	-	-	-	-
8	8	F	5	-	-	910	2002	-	-	25	-	-	33	-	-	7	7	-	54	91	-	-	-	-	-	-	-	-	-	6300	-	-	-	-
8	8	X	-	-	-	3900	1300	-	-	-	-	-	72	-	-	8	-	-	48	-	-	-	-	-	-	-	-	-	-	5000	-	-	-	-
9	9	H	-	-	-	-	-	-	-	17	-	-	64	-	-	16	-	-	57	-	-	-	-	-	-	-	-	-	-	-	-	66	-	-
9	9	M	5	-	-	-	-	-	-	12	-	-	134	-	-	5	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	9	E	-	-	-	-	-	-	-	193	-	-	45	-	-	21	-	-	91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	9	L	-	-	-	-	-	-	-	151	-	-	-	-	-	13	-	-	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	9	C	-	-	-	-	-	-	-	28	-	-	27	10	-	17	-	-	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	9	F	-	-	-	-	-	-	-	30	-	-	56	-	-	12	-	-	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	9	X	-	-	-	-	-	-	-	-	-	-	5	-	-	17	-	-	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	10	H	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	10	M	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	10	E	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	476	130	-
10	10	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	630
10	10	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	750	300	1
10	10	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	800	-	-
10	10	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	13	H	-	-	-	-	-	-	-	459	-	-	-	-	-	13	11	-	109	130	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	13	M	30	-	-	-	-	-	-	255	-	-	-	-	-	25	3	-	210	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	13	E	23	-	-	-	-	-	-	431	-	-	-	-	-	19	6	-	179	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	13	L	5	-	-	-	-	-	-	380	-	-	5	-	-	30	2	-	248	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	13	C	343	-	-	-	-	-	-	137	-	-	12	-	-	28	1	-	250	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	13	F	10	-	-	-	-	-	-	401	-	-	-	-	-	24	2	2	252	18	21	-	-	-	-	-	-	-	-	-	-	-	-	-
11	13	X	-	-	-	-	-	-	-	256	-	-	-	-	-	26	-	-	239	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	13	H	-	-	-	-	-	-	-	17	-	-	49	-	-	4	-	-	11	-	-	-	-	-	-	-	-	-	1019	400	-	-	-	-
12	13	M	-	30	-	-	-	-	-	5	-	-	47	12	-	10	1	-	36	5	-	-	-	-	-	-	-	-	885	1050	-	-	-	-
12	13	E	-	-	-	-	-	-	-	-	-	-	3	-	-	3	-	-	5	-	-	-	-	-	-	-	-	-	3380	-	-	-	-	-
12	13	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1300	-	-	1100	-	-
12	13	C	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	4	-	-	-	-	-	10	-	-	-	1403	1099	-	-	-	-
12	13	F	-	-	-	-	-	-	-	6	-	-	-	-	-	1	-	-	4	-	-	-	-	-	-	-	-	-	1535	700	-	-	-	-
12	13	X	-	-	-	-	-	-	-	-	-	-	2	-	-	5	-	-	23	-	-	-	-	-	-	-	-	-	925	1875	-	-	-	-
13	15	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	250	-	-	-	-	-
13	15	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1282	388	-	-	-	-
13	15	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	4	-	-	-	316	1388	-	-	-	-
13	15	L	-	-	-	-	-	-	-	2	3	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	974	270	-	-	-	-
13	15	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	582	-	-	-	-	-
13	15	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1905	300	-	-	-	-
13	15	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3. Results of Pre-Construction Distress Survey (Continued)

SITE	DIST	TYPE	ALLGATOR CR			BLOCK		EDGE		LONGITUDINAL WHEEL PATH UNSEAL		LONGITUDINAL WHEEL PATH SEAL	LONGITUDINAL NON WHEEL PATH UNSEAL		LONGITUDINAL NON WHEEL PATH LONG	NUM TRANSVE			TRAN CR UNS			SEAL	PATCHES NUM		PATCH SF		POTHOLE NUM	POTHOLE SF	BLEEDING			RAVELING		
			L	M	H	L	M	L	M	L	M	L	L	M	L	L	M	H	L	M	H	M	L	M	L	M	L	L	L	M	H	L	M	H
14	15	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	671	490	-	25	-	-
14	15	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	659	-	-	450	-	-
14	15	E	-	-	-	-	-	3	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1375	-	-	360	-	-
14	15	L	-	-	-	-	-	3	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2200	-	-	-	-	-
14	15	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1100	-	-	335	-	-
14	15	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1520	-	-	293	-	-
14	15	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1515	500	-	655	50	-15
14	17	H	595	788	-	-	-	-	-	407	-	-	29	-	-	20	-	-	51	-	-	-	2	-	6	-	2	3	-	-	-	-	-	-
15	17	M	1422	166	-	-	-	-	-	228	-	-	130	20	-	18	-	-	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	17	E	1216	-	-	-	-	-	-	409	-	-	126	-	-	12	-	-	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	17	L	2255	-	-	-	-	-	-	173	-	-	118	-	-	24	-	-	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	17	C	1149	-	-	-	-	-	-	630	-	-	145	-	-	26	-	-	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	17	F	2255	-	-	-	-	-	-	485	-	-	15	-	-	7	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	17	X	1608	-	-	-	-	-	-	500	-	-	11	-	-	6	-	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	19	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2400	1200	-	-	-	-
16	19	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2790	160	-	-	-	-
16	19	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	800	2600	-	-	-	-
16	19	L	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	7	-	-	-	-	-	-	-	-	-	150	4000	-	-	-	-
16	19	C	42	96	-	-	-	-	-	36	-	-	122	-	-	16	-	-	73	-	-	-	-	-	-	-	-	-	1594	1627	-	-	-	-
17	19	H	74	633	8	-	-	-	-	40	-	-	34	-	-	6	-	-	15	-	-	-	2	1	75	27	-	-	300	2700	-	-	-	-
17	19	M	118	528	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2100	1400	-	-	-
17	19	E	72	12	-	-	-	-	-	45	-	-	-	-	-	1	-	-	5	-	-	-	-	-	-	-	-	-	890	1882	-	250	200	-
17	19	L	220	4700	606	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	6	-	-	-	850	-	-	-	-
17	19	C	28	3110	857	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	119	-	-	-	-	725	-	-	-	-
18	20	H	12	49	-	-	-	-	-	17	-	-	-	-	-	10	-	-	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	20	M	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	11	-	-	-	1	-	6	-	-	-	-	-	-	-	-	-
18	20	E	37	24	-	-	-	-	-	35	-	-	8	-	-	28	-	-	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	20	L	98	47	-	-	-	-	-	145	-	-	12	-	-	55	-	-	132	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	20	C	-	-	-	-	-	-	-	109	-	-	-	-	-	29	-	-	68	-	-	-	1	-	3	-	-	-	-	-	-	-	-	-
18	20	F	22	735	-	-	-	-	-	95	-	-	-	-	-	33	-	-	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	20	X	649	1040	-	-	-	-	-	32	-	-	-	-	-	49	-	-	168	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	23	H	30	-	-	-	-	-	-	-	-	-	69	-	48	58	-	-	198	-	-	-	1	-	3135	-	-	-	-	-	-	-	-	-
19	23	M	-	-	-	-	-	-	-	18	-	223	21	-	12	39	-	-	246	-	-	-	-	-	-	-	-	-	66	95	-	-	-	-
19	23	E	21	-	-	-	-	-	-	-	-	72	20	-	258	35	-	-	204	-	-	-	-	-	-	-	-	-	3000	-	-	-	-	-
19	23	L	-	-	-	-	-	-	-	-	-	40	52	-	212	42	-	-	318	-	-	-	-	-	-	-	-	-	3000	-	-	-	-	-
19	23	C	-	-	-	-	-	-	-	-	-	67	-	-	308	45	-	-	255	-	-	-	-	-	-	-	-	-	2370	630	-	-	-	-
19	23	F	-	-	-	-	-	-	-	-	-	42	-	-	219	24	-	-	192	-	-	-	-	-	-	-	-	-	3000	-	-	-	-	-
19	23	X	-	-	-	-	-	-	-	-	-	33	-	-	438	27	-	-	165	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	23	H	-	-	-	525	-	-	-	-	-	20	27	-	169	24	-	-	264	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	23	M	-	-	-	-	-	-	-	-	-	6	-	-	70	39	-	-	272	-	-	-	-	-	-	-	-	-	390	2255	-	-	-	-
20	23	E	-	-	-	-	-	-	-	-	-	34	-	-	43	34	-	-	257	-	-	-	-	-	-	-	-	-	1758	1622	-	-	-	-
20	23	L	-	-	-	2980	-	-	-	-	-	-	56	-	110	18	-	-	156	-	-	-	-	-	-	-	-	-	1800	1200	-	-	-	-
20	23	C	-	-	-	3450	-	-	-	-	-	-	-	-	39	27	-	-	220	-	-	-	-	-	-	-	-	-	700	-	-	-	-	-
20	23	F	-	-	-	625	-	-	-	-	-	-	51	-	-	49	-	-	330	-	-	-	-	-	-	-	-	-	2500	-	-	-	-	-
20	23	X	-	-	-	-	-	-	-	15	-	-	41	-	-	63	-	-	378	-	-	-	-	-	-	-	-	-	3000	-	-	-	-	-

MATERIALS

The intention of the project was to use local materials and the contractor made an effort to use local sources where applicable. Table 4 shows the type of materials and equipment used. Table 5 lists the gradation for each type of aggregate used.

CONSTRUCTION

After preparation of the plans, specifications, and special provisions, bid documents were distributed to interested parties. Upon receipt and opening of the bids, Keystone Services, Bixby, Oklahoma, was selected as the prime contractor to perform the work. Keystone Services is primarily a slurry seal and micro-surfacing contractor that performs work throughout the south central United States.

Prior to beginning construction, a pre-construction meeting was held in Austin, with the contractor, representatives from the districts, members of the Highway Design division, and researchers from the Texas Transportation Institute (TTI). This meeting was held to finalize plans for construction, to discuss the sequence of operations, and to finalize the construction schedule.

Table 4. Materials and Equipment Used

TREATMENT	MATERIALS		EQUIPMENT
	Type of Asphaltic Material	Type of Aggregate	
Seal Coat, Conventional	AC-5 and AC-10	Light Weight Grade 4 and Precoated (PB) Grade 4	Asphalt Distributor, Aggregate Spreader, and 2 Rollers
Seal Coat, Polymer Modified	Emulsion with 2% Polymer	Light Weight Grade 4 and Precoated (PB) Grade 4	Asphalt Distributor, Aggregate Spreader, and 2 Rollers
Seal Coat, Latex Modified	AC-5 with 2% Latex	Light Weight Grade 4 and Precoated (PB) Grade 4	Asphalt Distributor, Aggregate Spreader, and 2 Rollers
Seal Coat, Rubber Modified	AC-10 with 20% Rubber	Light Weight Grade 4, Precoated (PB) Grade 4 and Precoated Grade 3 Modified	Asphalt Distributor, Aggregate Spreader, and 2 Rollers
Micro-Surfacing	Emulsion with 2% SBR and additives	Micro-Surfacing Grade 2	Micro-Surfacing Mixer, and spreading box.
Fog Seal	Emulsion	None	Asphalt Distributer
Control	None	None	None

Table 5. Gradation of Aggregates Used

SIEVE	AGGREGATE GRADATION			
	PB GRADE 3 Modified	PB GRADE 4	LT WT GRADE 4	GRADE 2
Retained on 3/4"				
Retained on 5/8"	0-2	0	0	
Retained on 1/2"	20-40	0-2	0-5	0
Retained on 3/8"	80-100	20-35	20-40	0-1
Retained on 1/4"	95-100			
Retained on No. 4		95-100	95-100	6-14
Retained on No. 8				
Retained on No. 10	99-100	99-100	98-100	
Retained on No. 16				54-75
Retained on No. 30				65-85
Retained on No. 50				75-90
Retained on No.100				82-93
Retained on No. 200				85-95

Construction of the SMERP project started April 5, 1993, and was completed July 14, 1993. The contractor was Keystone Services, Inc. (KS) and the subcontractor was International Surfacing, Inc. (ISI). KS constructed the micro-surfacing and three chip seals sections: polymer modified, latex modified, and conventional. ISI constructed the asphalt rubber chip seal section. The fog seal sections were constructed by the local districts. No treatment was applied to the control section. This treatment will explain the "do nothing" approach.

The contractor was given 45 work days to complete the project. A workday is defined as a calendar day in which weather or other conditions not under the control of the contractor will permit the performance of the principal unit work underway for a continuous period of not less than 7 hours between 7 a.m. and 6 p.m. If the contractor chooses to work on Saturdays, Sundays, or legal holidays, a workday is charged.

Construction began on SH 35, Yoakum District, and began moving north because of rainy weather. The contractor constructed all five test sections within each site before moving to the next site. The contractor provided all materials and equipment to construct all sections and provided traffic control throughout construction.

Prior to beginning construction at each site, the contractor would meet with the design division personnel and the local district to review all construction details. After the meeting, the construction of the site was turned over to the local inspector and the site was constructed according to the normal construction procedures of the local district.

The contractor would always begin work on the non-test lane and shoulder. The traffic was then switched to the treated lane and the test lane and shoulder were then treated. The reason behind treating the non-test lane first was to make sure everything was working properly by the time the test section was constructed. It usually took two days to construct the five treatments on both lanes and shoulders within a site. Usually three sections were treated the first day and the other two sections were treated the next day. Sometimes the contractor was able to construct four treatments the first day.

The following are the average target rates for the individual materials. The actual rate to be used for the sites in that district was provided by the local district. Target rates were modified in the field as necessary to ensure a high quality treatment.

Table 6. Target Application Rates

Asphalt Rubber	.50 - .60 Gal/SY	(2.3 - 2.7 l/m^2)
Polymer Modified Emulsion	.30 - .40 Gal/SY	(1.4 - 1.8 l/m^2)
Asphalt Cement With Latex	.30 - .40 Gal/SY	(1.4 - 1.8 l/m^2)
Straight Asphalt Cement	.30 - .40 Gal/SY	(1.4 - 1.8 l/m^2)
Combined Micro-Surfacing	25 Lbs/SY	(13.6 Kg/m^2)
Lightweight Grade 4	12 Lbs/SY	(6.5 Kg/m^2)
Precoat Grade 4	21 - 23 Lbs/SY	(11.4 - 12.5 Kg/m^2)
Precoat Grade 3	23 - 30 Lbs/SY	(12.5 - 16.3 Kg/m^2)

At a typical site, shown in Figure 2, the actual sequence of operations was as follows.

The first treatment placed was the Asphalt Rubber chip seal, non-test section.

1. Traffic control was established with traffic routed off of the non-test lane. A pilot car guided the traffic through the construction area while keeping the speed reduced to below 30 mph (48.3 Km/Hr).

2. The non-test lane was swept using a power broom. Traffic buttons and lane markers were covered with cardboard to prevent them from being coated with asphalt. Plastic covered, reflective, lane marker tabs were placed along the centerline.

3. Roofing felt was placed at each end of the 700 foot (213.4 m) non-test section.

4. The quantity of asphalt in the distributor was measured by inserting a calibrated measuring stick into the distributor tank and noting the quantity of asphalt.

5. The chip spreader and dump trucks were filled and positioned. The two rubber tire rollers were aligned.

6. A test application of the asphalt rubber onto the roofing felt was made to ensure that all nozzles were working properly and that end nozzles were properly positioned.

7. Application of the asphalt rubber began. The roofing felt was removed, and the chip spreader and dump truck began applying aggregate. In addition to the chip spreader, a flat bed was driven along the section and used to shovel extra aggregate onto locations where aggregate was insufficient due to being picked up on tires, streaking, etc.

8. Rollers began embedding the aggregate into the fresh asphalt rubber.

9. At the end of the test section, the flow of asphalt from the asphalt distributor was shut off, and the felt paper was removed.

10. The quantity of asphalt in the distributor was measured by inserting the calibrated measuring stick into the distributor tank and noting the quantity of asphalt.

11. The aggregate spreader continued until just past the end of the test section, and the flow of aggregate was then shut off.

12. The rollers continued until past the end of the section and then reversed direction and continued to roll until the desired number of passes had been completed. This was usually five passes for each roller, with the final pass normally being in the direction of traffic.

13. Aggregate was added during rolling if needed. Extra aggregate that was spilled or placed before the beginning of the test section, or past the end of the test section, was swept away using the power broom.

14. If a paved shoulder existed, it was treated next.

15. Traffic control was changed to direct traffic onto the previously completed non-test lane; and the construction sequence was repeated on the actual test lane. The plastic covers were removed from the reflective lane markers and the cardboard covers were removed.

After completing the Asphalt Rubber chip seal test section, construction of the chip seal with viscosity graded asphalt cement binder (Asphalt Cement) was begun. The previously described sequence of operations was followed for the Asphalt Cement chip seal section. The next treatment to be completed was the chip seal with polymer modified cationic rapid set emulsified asphalt cement (CRS-2P) chip seal test section. For this treatment, there was a planned delay between many of the steps.

For example, the chip spreader was held back until the emulsion had begun to break and a 1/4" trough made in the surface would hold its shape for more than a few seconds. The rollers were also delayed, usually about ten minutes. Fewer passes, usually three, were made. These delays were initiated by the contractor to help reduce some of the construction problems that were encountered, including having the aggregate ball-up on the tires of the chip spreader, dump truck, and rollers. After completing both sides of the CRS-2P emulsified asphalt chip seal, construction was usually halted until the next day. Prior to leaving the site, all chip seal sections except for the CRS-2P emulsified asphalt chip seal section were swept to remove loose rock. The emulsion test section was usually swept the next day.

Operation the next day typically began with the above construction sequence being performed on the chip seal with the Latex Modified asphalt cement binder (Latex Modified). After completing the Latex Modified chip seal, the Micro-Surfacing treatment was begun. The treatment sequence was, typically, as follows:

1. Traffic control was established with traffic routed off the non-test lane. A pilot car routed the traffic through the construction area while keeping the speed reduced to below 30 mph.

2. The non-test lane shoulder was swept using a power broom, and traffic buttons and lane markers were removed.

3. The micro-surfacing was applied to the shoulder. However, the width of the spreader box was not changed, so the micro-surfacing was typically extended well into the non-test lane.

4. After waiting approximately one hour, to let the micro-surfacing cure enough to handle the load of the spreader box, the non-test lane was treated. The reason for treating the shoulder first was so that when the lane was constructed, the centerline could be used as a guide to construct a straight, smooth joint.

5. Again, after about one hour, the traffic was switched and construction began first on the test lane shoulder and then the test lane.

COST

The bid price to construct twenty sites with five sections per site was $959,807. The actual final cost after the project was completed was $976,488. Since 100 test sections were built, the average cost per section was about $9,765. Table 7 shows the bid price and the actual price for all work performed.

Table 7. Bid Price and Actual Price for Work Performed

Description	Unit	Estimated Quantity	Actual Quantity	Contract Price ($)	Amount ($)
Asphalt (AC-5)	Gal	8,646.00	8,280.00	2.00	16,560.00
Asphalt (AC-10)	Gal	11,699.00	10,855.00	3.00	32,565.00
Asphalt (AC Latex Additive)	Gal	20,563.00	19,030.00	2.50	47,575.00
Asphalt (CRS-2P)	Gal	22,536.00	22,640.00	2.50	56,600.00
Hot Asphalt Rubber	Ton	123.41	126.38	1500.00	189,577.50
Micro-Surfacing (Polymer Mod, Grade 2)	Ton	734.00	784.91	333.25	261,571.26
Aggregate Type PB Grade 4	CY	285.00	136.00	60.00	8,160.00
Aggregate Type PB Grade 4 or Lightweight	CY	1370.00	1526.58	60.00	91,594.80
Aggregate Type PB Grade 3 Modified	CY	97.00	119.00	60.00	7,140.00
Aggregate Type PB Grade 4 or Lightweight Grade 4 for Asphalt Rubber	CY	478.00	476.61	60.00	28,596.60
Roller (Medium Pneumatic Tire Type B)	LS	1.00	1.00	41,630.00	41,630.00
Mobilization	LS	1.00	1.00	176,000.00	176,000.00
Work Zone Pavement Marking Tabs Type Y-2	EA	1,760.00	1,959.00	2.00	3,918.00
Barricades, Signs, and Traffic Handling	Mo	3.00	3.00	5,000.00	15,000.00
Total					976,488.16

DATA COLLECTION DURING CONSTRUCTION

During construction, the local inspectors collected normal construction data and daily diaries. Additional data were collected during construction by TTI researchers in an effort to document the construction, to isolate the effects of certain data items as they relate to performance, and to evaluate the quality of construction. Special attention was given to those items out of specification or contrary to standard construction practices. The data items that were collected and the data sheets used to collect the data are included in Appendix A. All data collection and storage was designed to be recorded in formats compatible with the SHRP LTPP data (Ref 3). With the data in these formats, SMERP data can be analyzed along with the SHRP H-101 SPS-3 (Asphalt Concrete Maintenance Effectiveness) data. This will help TxDOT determine which maintenance treatments are most cost-effective.

Some of the more interesting data items and the ways they were collected are discussed below. In addition to the general data about the date and the time that construction began and ended, the target application rate at which the asphaltic binder was to be applied was recorded from the plan sheets. If this rate was changed at the job site, the new value was recorded. By measuring the quantity of asphaltic binder in the tank before and after application on the lanes, and by using the length and width of treatment, the actual application rate for the asphaltic binder was determined. The target application temperature of the asphaltic binder and the actual temperature of the asphaltic binder in the distributor tank were also recorded. To determine the actual application rate of the aggregate, a one square yard, 3 x 3, (.836 m^2, .914 m x .914 m) plastic mat was placed at the end of the test section. One mat was placed in the inner wheel path, and the other mat was placed between the wheel paths. The aggregate on the mat was then dumped into a bucket and weighed using a spring scale.

The environmental conditions at the time of construction were also recorded. This included the pavement and air temperature at the time of construction, the relative humidity at the time of construction, the temperature of the asphaltic material as it came out of the nozzles, and the temperature of the asphaltic material at the time the aggregate was applied. The pavement and asphalt temperatures were collected using a non-contact infrared temperature sensor. The air temperature and relative humidity were collected using a handheld relative humidity/temperature meter. A variety of time spans, including the time between the application of the asphaltic material and the application of the aggregate and the time between application of the aggregate and initial rolling, were recorded using a stopwatch. A wrist watch was used to determine the time between final rolling and brooming, between final rolling and opening section to reduced speed traffic, and between final rolling and opening the section to full speed traffic.

This data (and the other data that were collected but not described above) were all expected to have some impact on the performance of the treatment. For example, if there were a long delay between applying the asphaltic material and applying the aggregate, the asphaltic material would cool. This would probably reduce embedment and may reduce the bonding strength of the asphaltic material to the aggregate and the road surface. By collecting this information, it is possible to identify why a section did not have the same performance as otherwise similarly applied treatments.

For micro-surfacing test sections, much of the data collected was the same. However, application rates were determined based on the calibration factors developed during calibration of the slurry truck. During calibration of the slurry truck, a gate is set at a certain height under which the aggregate passes as it is moved on the rock belt. A higher setting means more material is able to pass under the gate. For this project the gate was calibrated at 3", 4", and 5" (.0762, .1016, .1270 m) by weighing the aggregate that came under the gate on the rock belt for a certain number of clicks (usually 50) of the rock belt counter. The pounds of dry rock per count of the rock belt counter were then determined at the various settings. A straight line was then drawn through the three points to determine the pounds of rock for any setting. The pounds of emulsion per count of the rock belt were also determined. The pounds of mineral filler, for this project Type I, non-entrained portland cement, was calibrated from the fines feeder counter. From the mix design, which set the percent emulsion by weight of dry rock, and the rock belt counter calibration, the appropriate gate setting was determined. The following calibration factors were determined:

Slurry Aggregate Gate Setting = 3 7/8" (9.84 cm),
Pounds of Dry Rock Per Count = 30.94 (14.0 Kg),
Pounds of Emulsion Per Count = 3.867 (1.75 Kg), and
Pounds of Mineral Filler Per Count = 0.624 (.28 Kg).

CHAPTER 3. RESULTS AND FUTURE WORK

PRELIMINARY RESULTS

Although it is far too early to determine the effectiveness of each of the treatments, some early results regarding the application process can be shown. The actual application rates can be compared to the target rates for the treatments. The results of the percent difference between proposed application and actual application are shown in Figures B-1 through B-4 in Appendix B. For the application of the asphaltic chip seals, the rates matched quite closely except for the asphalt rubber. Some reasons for the variation in application rates by the asphalt rubber contractor were that, in such a short stretch, they could not get everything properly calibrated; constantly changing application rates made calibration difficult; and the difficulties in working for a few hours one day and then not working again for three to four days.

A statistical test for the equality of variance was conducted to determine whether the percent of target application rate for the asphalt rubber binder was statistically significantly different than the results for the other applications. There was a statistically significant difference between the asphalt rubber percent of target application rate and the percent of target application rates for the other treatments. The means and standard deviations are listed below.

Treatment Type	Mean	Standard Deviation
Asphalt Rubber	105.0	11.93
CRS-2P	101.1	4.30
Latex Modified	102.0	2.34
Asphalt Cement	103.3	5.74

Tables 8 and 9 show the rates of application of the asphaltic material in the test and non-test lane. Figures B-5 through B-12 show the corresponding aggregate application rates. However, these aggregate application rates may not be quite as useful as planned. On sites where the application was deficient, additional rock was shoveled onto the section to reduce streaking, balling up onto tires, pickup onto tires, etc.

Figure 13 and Tables 10 and 11 (SI units) show the target and actual application rates for the micro-surfacing treatment and the individual components.

Table 8. Asphalt Application Rates in Test Lane, (gal/sy)/liters/m²

Treatment Type	SITE NUMBER																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Seal Coat, AC-5 Conventional	.31 1.40		.32 1.45	.32 1.45	.36 1.63	.37 1.68	.33 1.49	.27 1.22	.35 1.58				.32 1.45	.32 1.45				.35 1.58	.29 1.31	.31 1.40
Seal Coat, AC-10 Conventional		.24 1.09								.34 1.54	.27 1.22	.26 1.18			.36 1.63	.32 1.45	.33 1.49			
Seal Coat, Polymer Modified	.31 1.40	.38 1.72	.46 2.08	.46 2.08	.36 1.63	.37 1.68	.41 1.86	.26 1.18	.49 2.22	.43 1.95	.32 1.45	.31 1.40	.42 1.90	.41 1.86	.37 1.68	.39 1.76	.40 1.81	.41 1.86	.43 1.95	.39 1.76
Seal Coat, Latex Modified	.30 1.36	.31 1.40	.35 1.58	.37 1.68	.36 1.63	.36 1.63	.36 1.63	.27 1.22	.36 1.63	.34 1.54	.28 1.27		.40 1.81	.42 1.90	.38 1.72	.31 1.40	.32 1.45	.35 1.58	.31 1.40	.31 1.40
Seal Coat, Rubber Modified	.57 2.58	.59 2.67	.59 2.67	.70 3.17	.59 2.67	.64 2.90	.54 2.44	.59 2.67	.64 2.90	.60 2.72	.56 2.54	.56 2.54	.60 2.72	.64 2.90	.62 2.81	.55 2.49	.49 2.22	.61 2.76	.53 2.40	.59 2.67
Micro-Surfacing Lbs/SY (Kg/m²)	23.0 12.5	24.0 13.0	22.9 12.4	26.5 14.4	22.5 12.2	23.1 12.5	17.4 9.4	21.1 11.4	23.5 12.7	28.5 15.5	20.2 11.0	24.8 13.5	21.7 11.8	19.7 10.7	16.2 8.8	25.6 13.9	20.0 10.8	24.2 13.1	22.4 12.1	22.7 12.3

Table 9. Asphalt Application Rates in Non-Test Lane, (gal/sy)/liters/m^2

Treatment Type	SITE NUMBER																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Seal Coat, AC-5 Conventional	.30 1.36		.33 1.49	.33 1.49	.37 1.68	.37 1.68	.38 1.72	.31 1.40	.35 1.58				.31 1.40	.31 1.40				.35 1.58	.39 1.77	.31 1.40
Seal Coat, AC-10 Conventional		.32 1.45								.35 1.58	.32 1.45	.29 1.31			.37 1.68	.34 1.54	.32 1.45			
Seal Coat, Polymer Modified	.31 1.40	.35 1.58	.45 2.04	.46 2.08	.37 1.68	.36 1.63	.40 1.81	.30 1.36	.49 2.22	.43 1.95	.30 1.36	.32 1.45	.41 1.86	.42 1.90	.37 1.68	.41 1.86	.40 1.81	.40 1.81	.51 2.31	.40 1.81
Seal Coat, Latex Modified	.31 1.40	.31 1.40	.35 1.58	.37 1.68	.36 1.63	.38 1.72	.38 1.72	.31 1.40	.35 1.58	.31 1.40	.28 1.27		.41 1.86	.41 1.86	.36 1.63	.33 1.49	.33 1.49	.36 1.63	.39 1.77	.29 1.31
Seal Coat, Rubber Modified	.54 2.44	.56 2.54	.45 2.04	.48 2.17	.59 2.67	.51 2.31	.54 2.44	.63 2.85	.62 2.81	.59 2.67	.51 2.31	.48 2.17	.59 2.67	.48 2.17	.50 2.26	.45 2.04	.53 2.40	.54 2.44	.46 2.08	.50 2.26
Micro-Surfacing Lbs/SY (Kg/m^2)	23.7 12.9	25.8 14.0	12.3 6.7	27.9 15.1	19.9 10.8	21.2 11.5	24.4 13.2	25.7 13.9	23.3 12.6	28.7 15.6	23.6 12.8	20.0 10.8	20.3 11.0	28.5 15.5	17.0 9.2	28.1 15.2	20.3 11.0	25.2 13.7	- -	20.5 11.1

Table 10. Application Rates for Micro-Surfacing Test Sections

DISTRICT	SITE ID	EMULSION ACTUAL Lb/SY	AGGREGATE ACTUAL Lb/SY	MINERAL FILLER ACTUAL Lb/SY	TOTAL SLURRY ACTUAL Lb/SY
TARGET		0.311	22.0	0.33	25.0
01	1M	0.297	20.2	0.32	23.0
01	1I	0.306	20.8	0.28	23.7
01	2M	0.310	21.1	0.31	24.0
01	2I	0.333	22.6	0.34	25.8
04	3M	0.296	20.1	0.28	22.9
04	3I	0.157	10.7	0.25	12.3
04	4M	0.343	23.3	0.30	26.5
04	4I	0.359	24.5	0.32	27.9
06	5M	0.289	19.7	0.34	22.5
06	5I	0.256	17.4	0.31	19.9
06	6M	0.297	20.2	0.39	23.1
06	6I	0.272	18.5	0.34	21.2
08	7M	0.224	15.2	0.29	17.4
08	7I	0.314	21.3	0.40	24.4
08	8M	0.271	18.5	0.35	21.1
08	8I	0.331	22.5	0.42	25.7
09	9M	0.236	20.6	0.32	23.5
09	9I	0.301	20.5	0.31	23.3
10	10M	0.367	25.0	0.39	28.5
10	10I	0.370	25.2	0.41	28.7
13	11M	0.276	17.6	0.30	20.2
13	11I	0.304	20.7	0.31	23.6
13	12M	0.317	21.7	0.43	24.8
13	12I	0.257	16.6	0.33	20.0
15	13M	0.279	19.0	0.36	21.7
15	13I	0.260	17.7	0.38	20.3
15	14M	0.252	17.2	0.34	19.7
15	14I	0.366	24.9	0.49	28.5
17	15M	0.208	14.2	0.29	16.2
17	15I	0.217	14.8	0.27	17.0
19	16M	0.314	22.6	0.35	25.6
19	16I	0.362	24.6	0.39	28.1
19	17M	0.257	17.5	0.30	20.0
19	17I	0.262	17.8	0.30	20.3
20	18M	0.312	21.2	0.33	24.2
20	18I	0.324	22.1	0.35	25.2
23	19M	0.288	19.6	0.37	22.4
23	19I	0.299	22.0		
23	20M	0.291	19.8	0.41	22.7
23	20I	0.263	17.9	0.36	20.5

Table 11. Application Rates for Micro-Surfacing Test Sections (SI Units)

DISTRICT	SITE ID	EMULSION ACTUAL Kg/m^2	AGGREGATE ACTUAL Kg/m^2	MINERAL FILLER ACTUAL Kg/m^2	TOTAL SLURRY ACTUAL Kg/m^2
TARGET		0.169	11.9	0.18	13.6
01	1M	0.161	11.0	0.17	12.5
01	1I	0.166	11.3	0.15	12.9
01	2M	0.168	11.4	0.17	13.0
01	2I	0.181	12.3	0.18	14.0
04	3M	0.161	10.9	0.15	12.4
04	3I	0.085	5.8	0.14	6.7
04	4M	0.186	12.6	0.16	14.4
04	4I	0.195	13.3	0.18	15.1
06	5M	0.156	10.7	0.18	12.2
06	5I	0.138	9.4	0.17	10.8
06	6M	0.161	10.9	0.21	12.5
06	6I	0.147	10.0	0.18	11.5
08	7M	0.121	8.2	0.16	9.4
08	7I	0.170	11.6	0.22	13.2
08	8M	0.146	10.0	0.19	11.4
08	8I	0.179	12.2	0.23	13.9
09	9M	0.128	11.2	0.17	12.7
09	9I	0.163	11.1	0.17	12.6
10	10M	0.199	13.6	0.21	15.5
10	10I	0.200	13.7	0.22	15.6
13	11M	0.149	9.5	0.16	11.0
13	11I	0.164	11.2	0.17	12.8
13	12M	0.171	11.8	0.23	13.5
13	12I	0.139	9.0	0.18	10.8
15	13M	0.151	10.3	0.20	11.8
15	13I	0.141	9.6	0.21	11.0
15	14M	0.136	9.3	0.18	10.7
15	14I	0.198	13.5	0.27	15.5
17	15M	0.112	7.7	0.16	8.8
17	15I	0.117	8.0	0.15	9.2
19	16M	0.170	12.3	0.19	13.9
19	16I	0.196	13.3	0.21	15.2
19	17M	0.139	9.5	0.16	10.8
19	17I	0.142	9.7	0.16	11.0
20	18M	0.169	11.5	0.18	13.1
20	18I	0.175	12.0	0.19	13.7
23	19M	0.156	10.6	0.20	12.1
23	19I	0.162	11.9		
23	20M	0.157	10.7	0.22	12.3
23	20I	0.142	9.7	0.19	11.1

OUTPUT FILE FORMATS

The data collected were entered into a Quattro Pro[R] spreadsheet for the purpose of properly formatting the data. The data is contained in ASCII files formatted into the SHRP LTPP SPS-3 compatible format. Data could not be entered directly into the SHRP LTPP data base because neither TTI nor TxDOT has access to the SHRP LTPP data base. Therefore, the format used to output data from the SHRP National Information Management System (NIMS) into ASCII files was selected (Ref. 3). The data can then be easily combined with the SPS-3 data for analysis.

The data files follow the data sheets quite closely, and since the data sheets include a longer description of the data item, it is advisable to have both the data sheets and this file format available during analysis.

FUTURE WORK

Since the treatments have been constructed, the next stages will be to monitor the performance of the sections and to begin the analysis of that performance. It has been proposed that a distress survey be performed approximately six months after construction, twelve months after construction, and then on a yearly basis. This data should be recorded in the SHRP compatible format. Additional data collection will include inspecting all of the test sections visually and using the ARAN. Non-destructive deflection testing will be performed one year after construction and then every two years. All of the sections will be monitored until failure.

The data analysis should begin after the two data collection surveys. If these treatments behave similarly to the SHRP H-101 test sections, distress will remain relatively minimal until at least eighteen months after construction. However, due to the condition of some of the test sections prior to construction, the SMERP test sections may exhibit some early distress including bleeding, rutting, and on one or two sections, alligator cracking. Future analysis will determine the effectiveness of each treatment based on the different conditions at each site. The analysis of the cost-effectiveness should begin when adequate data is available.

REFERENCES

1. Smith, R. E., T. J. Freeman, and O. Pendleton, "H-101 Pavement Maintenance Effectiveness", Strategic Highway Research Program, National Research Council, 1993.

2. "Distress Identification Manual for the Long-Term Pavement Performance Project", Strategic Highway Research Program, National Research Council, SHRP-P-338, 1993.

3. "Data Base Structure Reference Manual", Strategic Highway Research Program, National Research Council, 1993.

APPENDIX - A

Data Collection Sheets

Sheet 1 *STATE CODE [__ __]

SMERP DATA *STATE ASSIGNED ID [__ __ __ __]

SEAL COAT APPLICATION DATA FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES

MEASUREMENTS TO BE TAKEN ON BOTH LANES, BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

1. ***DATE WORK BEGAN (MONTH/DAY/YEAR)** [___ ___ / ___ ___ / ___ ___]

   ***DATE WORK WAS COMPLETED (MONTH/DAY/YEAR)** [___ ___ / ___ ___ / ___ ___]

2. ***TIME WORK WAS BEGUN** (Hr/Min) [___ ___/ ___ ___]

   ***TIME OF DAY** (AM = 1, PM = 2) [___]

   ***TIME WORK WAS COMPLETED** (Hr/Min) [___ ___/ ___ ___]

   ***TIME OF DAY** (AM = 1, PM = 2) [___]

3. ***LENGTH OF TEST SECTION SEALED** (Feet) [___ ___ ___ ___]

   ***WIDTH OF TEST SECTION SEALED** (Feet) [___ ___.___]

4. ***TYPE OF SEAL COAT** [___]
   HOT ASPHALT RUBBER.............1 POLYMER MODIFIED 2
   LATEX MODIFIED.................3 CONVENTIONAL SEAL COAT 4
   OTHER (______________________________) 5

5. ***TYPE/GRADE OF BITUMINOUS MATERIAL IN SEAL COAT**
   DESCRIPTION OF ASPHALT CEMENT [______________________________]

   MANUFACTURER NAME [______________________________]

   MANUFACTURER MATERIAL NAMES [______________________________]

6. ***WAS APPLICATION RATE OF BITUMINOUS MATERIAL ADJUSTED AT JOBSITE TO CORRECT FOR SURFACE CONDITION** (YES = 1, NO = 2) [___]

7. ***TARGET APPLICATION RATE FOR BITUMINOUS MATERIAL** (Gallons/Sq. Yd) [.___ ___ ___]

8. ***ACTUAL APPLICATION RATE FOR BITUMINOUS MATERIAL MEASURED FROM DISTRIBUTOR READINGS** (Gallons/Sq. Yd) [.___ ___ ___]

9. ***ACTUAL APPLICATION RATE FOR BITUMINOUS MATERIAL MEASURED FROM DISTRIBUTOR TANK MEASUREMENTS** (Gallons/Sq. Yd) [.___ ___ ___]

Sheet 2 *STATE CODE [__ __]

SMERP DATA *STATE ASSIGNED ID [__ __ __ __]

SEAL COAT APPLICATION DATA FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES

MEASUREMENTS TO BE TAKEN ON BOTH LANES, BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

10. ***TARGET APPLICATION TEMPERATURE OF BITUMINOUS MATERIAL** (°F) [___ ___ ___]

11. ***ACTUAL APPLICATION TEMPERATURE OF BITUMINOUS MATERIAL** (°F) [___ ___ ___]

12. ***TYPE OF AGGREGATE USED IN SEAL COAT**
    TxDOT Type [___]
    TxDOT Grade [___]

    GEOLOGIC DESCRIPTION AGGREGATE [________________________________]

    AGGREGATE SOURCE [________________________________]

13. ***TARGET APPLICATION RATE FOR AGGREGATE** (Pounds/Sq. Yard) [___ ___.___]

14. ***ACTUAL APPLICATION RATE FOR AGGREGATE IN WHEEL PATHS** (Pounds/Sq. Yard) [___ ___.___]

15. ***ACTUAL APPLICATION RATE FOR AGGREGATE BETWEEN WHEEL PATHS** (Pounds/Sq. Yard) [___ ___.___]

16. ***INITIAL EXISTING PAVEMENT SURFACE PREPARATION** (SWEEPING REQUIRED) [___]
    NONE....................1 COLD MILL..................3
    SWEEP CLEAN ONLY.......2 SHOT BLAST.................4
    OTHER (SPECIFY) ________________________________5

17. ***PAVEMENT CONDITIONS AT TIME SEAL COAT APPLIED**
    PAVEMENT TEMPERATURE (°F) (60 °F Required) [___ ___ ___]

    CONDITION OF SURFACE BEFORE SEALING [___]
    CLEAN ....1 MOSTLY CLEAN..........2
    SOMEWHAT DIRTY....3 DIRTY.................4

    SURFACE MOISTURE CONDITION [___]
    DRY .... 1 MOSTLY DRY............2
    SOMEWHAT MOIST.....3 WET...................4

18. ***AMBIENT CONDITIONS AT TIME SEAL COAT APPLIED**
    AIR TEMPERATURE (°F) (60 °F Required) [___ ___ ___]

    RELATIVE HUMIDITY (Percent) [___ ___ ___]

Sheet 3 *STATE CODE [__ __]

SMERP DATA *STATE ASSIGNED ID [__ __ __ __]

SEAL COAT APPLICATION DATA FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES

MEASUREMENTS TO BE TAKEN ON BOTH LANES, BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

19. ***SURFACE CONDITION** [___]
    BADLY OXIDIZED ....1 NORMAL 3
    SLIGHTLY OXIDIZED.........2 SLIGHTLY FLUSHED.............4
    FLUSHED...................5 FLUSHED ONLY IN WHEEL PATHS..6
    OTHER (SPECIFY) ______________________________ 7

20. ***AVERAGE CRACK SEVERITY LEVEL** (SEE DISTRESS IDENTIFICATION MANUAL)
    LOW = 1, MODERATE = 2, HIGH = 3 [___]

21. ***PRIMARY TYPE OF CRACKS** (SEE TABLE A.22 FOR TYPE CODES) [___ ___]
    SEE DISTRESS IDENTIFICATION MANUAL FOR DESCRIPTION

22. ***ESTIMATED PERCENT OF CRACKS SEALED PRIOR TO SEAL COAT** [___ ___ ___]

23. ***AGGREGATE CONDITION PRIOR TO USE** (CLEAN OR ONLY SLIGHTLY DIRTY REQUIRED)
    CLEAN = 1 ONLY SLIGHTLY DIRTY = 2 SOMEWHAT DIRTY = 3 DIRTY = 4 [___]

    VERY DRY...........1 DRY........... 2 ONLY SLIGHTLY DAMP..3
    SOMEWHAT DAMP..... 4 SLIGHTLY WET.. 5 WET................ 6 [___]

24. ***ESTIMATED TIME BETWEEN APPLICATION OF BITUMINOUS MATERIAL AND SPREADING OF AGGREGATE MATERIAL** (SECONDS) [___ ___ ___]

25. ***ESTIMATED TIME BETWEEN APPLICATION OF AGGREGATE MATERIAL AND INITIAL ROLLING** (SECONDS) [___ ___ ___]

26. ***NUMBER OF PASSES PER ROLLER** [___]

27. ***ESTIMATED NUMBER OF COVERAGES PER ROLLER** [___]

28. ***ESTIMATED TIME BETWEEN FINAL ROLLING AND BROOMING SECTION** (HOURS) [___ ___.___]

29. ***ESTIMATED TIME BETWEEN FINAL ROLLING AND OPENING SECTION TO REDUCED SPEED TRAFFIC** (HOURS) [___ ___.___]

30. ***MAXIMUM REDUCED SPEED ALLOWED** (MPH) [___ ___]

31. ***ESTIMATED TIME BETWEEN FINAL ROLLING AND OPENING SECTION TO FULL SPEED TRAFFIC** (HOURS) [___ ___.___]

Sheet 4	*STATE CODE [__ __]
SMERP DATA	*STATE ASSIGNED ID [__ __ __ __]

EQUIPMENT USED IN SEAL COAT APPLICATION

MEASUREMENTS TO BE TAKEN ON BOTH LANES BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

32. ***ROLLER DATA**

ROLLER BRAND AND NUMBER	ROLLER DESCRIPTION	GROSS WT. (TONS)	TIRE PRES (PSI)	WIDTH (INCHES)	SPEED (MPH)
____________	Pneumatic-tired	__ __.__	__ __ __.	__ __.	__.__
____________	Pneumatic-tired	__ __.__	__ __ __.	__ __.	__.__
____________	Pneumatic-tired	__ __.__	__ __ __.	__ __.	__.__
____________	Pneumatic-tired	__ __.__	__ __ __.	__ __.	__.__

33. ***ROLLING INFORMATION** (YES = 1, USUALLY = 2, SOMETIMES = 3, NEVER = 4)

ROLLER SPEED EXCEEDS 5 MPH [__]

FINAL ROLLER COVERAGES IN DIRECTION OF TRAFFIC [__]

34. ***DISTRIBUTOR**

BRAND ____________

MODEL ____________

YEAR [__ __ __ __]

NOZZLE ANGLE (Degrees) [__ __]

SPRAY BAR HEIGHT (Inches) [__ __.__]

NOZZLE SPACING (Inches) [__ __.__]

NOZZLE BRAND ____________

MODEL ____________

35. ***DISTRIBUTOR DETAILS** (YES = 1, USUALLY = 2, SOMETIMES = 3, NO = 4)

CLEANED BEFORE USE [__]
EQUIPPED WITH A BITUMETER THAT REGISTERS IN FT/MIN OR GAL/SY [__]
BITUMETER VISIBLE TO OPERATOR [__]
BITUMETER USED BY OPERATOR [__]
EQUIPPED WITH A TACHOMETER ON THE PUMP [__]
TACHOMETER VISIBLE TO THE OPERATOR [__]
TACHOMETER USED BY OPERATOR [__]
EQUIPPED WITH HEATERS THAT CAN BE USED TO BRING THE ASPHALTIC MATERIAL TO SPRAY APPLICATION TEMPERATURE [__]
THERMOMETER VISIBLE TO OPERATOR [__]
THERMOMETER WELL FREE OF CONTACT WITH THE HEATING TUBE? [__]
EQUIPPED WITH A FULL CIRCULATORY SYSTEM INCLUDING THE SPRAY BAR [__]

Sheet 5 *STATE CODE [__ __]

SMERP DATA *STATE ASSIGNED ID [__ __ __ __]

EQUIPMENT USED IN SEAL COAT APPLICATION (CONTINUED)

MEASUREMENTS TO BE TAKEN ON BOTH LANES BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

36. ***DOUBLE OR TRIPLE LAP** (DOUBLE = 1, TRIPLE = 2) [___]

37. ***APPLICATION OF ASPHALT** (YES = 1, USUALLY = 2, SOMETIMES = 3, NO = 4, NA = 5)
    - WAS UNIFORM SPRAY APPLIED [___]
    - WAS ATOMIZATION NOTICED [___]
    - WERE ANY LOCATIONS MISSED OR DEFICIENT IN ASPHALT [___]
    - WAS A HANDSPRAYER USED TO TOUCH UP MISSED SPOTS [___]
    - WAS BUILDING PAPER USED AT THE BEGINNING OF THE TREATMENT [___]
    - WAS BUILDING PAPER USED AT THE END OF THE TREATMENT [___]
    - WAS STREAKING OF THE ASPHALT NOTICED [___]
    - WERE END NOZZLES USED TO ALLOW FOR AN OVERLAP OF EMULSIFIED ASPHALT BINDER TO THE ADJACENT LANE [___]

38. ***AGGREGATE SPREADER**
    - BRAND ____________________
    - MODEL ____________________

39. ***IS A SELF-PROPELLED MECHANICAL SPREADER USED ?** (YES = 1, NO = 2) [___]

40. ***SPREADING OF AGGREGATE** (YES = 1, USUALLY = 2, SOMETIMES = 3, NO = 4, NA = 5)
    - IS AGGREGATE SPREAD UNIFORMLY [___]
    - IS STREAKING OF THE AGGREGATE NOTICED [___]

41. ***IS A MOTORIZED POWER BROOM USED TO REMOVE LOOSE MATERIAL FROM THE SURFACE AFTER ROLLING IS COMPLETE?** (YES = 1, NO = 2) [___]

42. ***NUMBER OF PASSES WITH BROOM** [___ ___]

43. ***ESTIMATED PERCENT OF LOOSE MATERIAL REMOVED DURING BROOMING** [___]
    - NONE (<1%)...............1
    - VERY LITTLE (1 - 3%).....2
    - SOME (3 - 5%)............3
    - SUBSTANTIAL (>5%)........4

44. ***ESTIMATED PERCENT OF LOOSE MATERIAL REMAINING AFTER BROOMING** [___]
    - NONE (<1%)...............1
    - VERY LITTLE (1 - 3%).....2
    - SOME (3 - 5%)............3
    - SUBSTANTIAL (>5%)........4

45. **FIELD NOTES AVAILABLE** (YES = 1, NO = 2) [___]
    FIELD NOTE LOCATION [____]

Sheet 6 *STATE CODE [__ __]

SMERP DATA *STATE ASSIGNED ID [__ __ __ __]

MICROSURFACING APPLICATION DATA FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES

MEASUREMENTS TO BE TAKEN ON BOTH LANES, BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

1. ***DATE WORK BEGAN (MONTH/DAY/YEAR)** [___ ___ / ___ ___ / ___ ___]

   ***DATE WORK WAS COMPLETED (MONTH/DAY/YEAR)** [___ ___ / ___ ___ / ___ ___]

2. ***TIME WORK WAS BEGUN** (Hr/Min) [___ ___/ ___ ___]

   TIME OF DAY (AM = 1, PM = 2) [___]

   ***TIME WORK WAS COMPLETED** (Hr/Min) [___ ___/ ___ ___]

   TIME OF DAY (AM = 1, PM = 2) [___]

3. ***LENGTH OF TEST SECTION SEALED** (Feet) [___ ___ ___ ___]

   ***WIDTH OF TEST SECTION SEALED** (Feet) [___ ___.___]

4. ***TYPE OF SEAL COAT** [__6]
   MICROSURFACING..............6 OTHER.............. 7 (____________________)

5. ***TYPE/GRADE OF BITUMINOUS MATERIAL IN SLURRY SEAL**
   (SEE TABLE A.16 FOR TYPE CODE) [___ ___]
   DESCRIPTION OF "OTHER CEMENT" [____]

   MANUFACTURER NAME [____]

   MANUFACTURER MATERIAL NAMES [____]

6. ***TYPE OF AGGREGATE USED IN SLURRY SEAL**
   (SEE TABLE A.9 FOR TYPE CODE) [___ ___]
   DESCRIPTION OF "OTHER AGGREGATE" [____]

   AGGREGATE SOURCE [____]

7. ***TYPE OF MINERAL FILLER USED IN SLURRY SEAL**
   CEMENT........ 1 HYDRATED LIME .... 2 OTHER .... 3 [___]
   DESCRIPTION OF "OTHER" [____]

   MINERAL FILLER BRAND AND TYPE [____]

8. ***TYPE OF SPECIAL ADDITIVE** [____]

Sheet 7 *STATE CODE [__ __]

SMERP DATA *STATE ASSIGNED ID [__ __ __ __]

MICROSURFACING APPLICATION DATA FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES

MEASUREMENTS TO BE TAKEN ON BOTH LANES, BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

9. ***REVOLUTION COUNT OF SLURRY SEAL MACHINE BEFORE APPLICATION** [___ ___ ___ ___]

10. ***REVOLUTION COUNT OF SLURRY SEAL MACHINE AFTER APPLICATION** [___ ___ ___ ___]

11. ***TARGET APPLICATION RATE FOR BITUMINOUS MATERIAL** (Gallons/Sq. Yd) [.___ ___ ___]

12. ***ACTUAL APPLICATION RATE FOR BITUMINOUS MATERIAL MEASURED FROM DISTRIBUTOR READINGS** (Gallons/Sq. Yd) [.___ ___ ___]

13. **PUMP CAPACITY/RATING** [___ ___.___]

14. ***TARGET APPLICATION RATE FOR AGGREGATE** (Pounds/Sq. Yard) [___ ___.___]

15. ***ACTUAL APPLICATION RATE FOR AGGREGATE FROM DISTRIBUTOR READINGS** (Pounds/Sq. Yard) [___ ___.___]

16. ***GATE OPENING** (INCHES) [___ ___.___]

17. ***TARGET APPLICATION RATE FOR MINERAL FILLER** (Pounds/Sq. Yard) [___.___ ___]

18. ***ACTUAL APPLICATION RATE FOR MINERAL FILLER FROM DISTRIBUTOR READINGS** (Pounds/Sq. Yard) [___.___ ___]

19. ***MINERAL FILLER SETTING** [___ ___.___ ___]

20. ***TARGET APPLICATION RATE FOR SLURRY MIXTURE** (Pounds/Sq. Yard) [___ ___.___]

21. ***ACTUAL APPLICATION RATE FOR SLURRY MIXTURE FROM DISTRIBUTOR READINGS** (Pounds/Sq. Yard) [___ ___.___]

22. ***AMOUNT OF WATER ADDED** (Gallons per Gallon of Emulsion) [___.___ ___]

23. ***AMOUNT OF SPECIAL ADDITIVE USED** (Gallons per Gallon of Emulsion) [___.___ ___]

Sheet 8 *STATE CODE [__ __]

SMERP DATA *STATE ASSIGNED ID [__ __ __ __]

MICROSURFACING APPLICATION DATA FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES

MEASUREMENTS TO BE TAKEN ON BOTH LANES, BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

24. ***ACTUAL TEMPERATURE OF BITUMINOUS MATERIAL PRIOR TO APPLICATION** (°F) [___ ___ ___]

25. ***ACTUAL APPLICATION TEMPERATURE OF SLURRY MATERIAL** (°F) [___ ___ ___]

26. ***INITIAL EXISTING PAVEMENT SURFACE PREPARATION** (SWEEPING REQUIRED) [___]
    NONE....................1 COLD MILL.................3
    SWEEP CLEAN ONLY.......2 SHOT BLAST................4
    OTHER (SPECIFY) ______________________________5

27. ***PAVEMENT CONDITIONS AT TIME SEAL COAT APPLIED**
    PAVEMENT TEMPERATURE (°F) (60 °F Required) [___ ___ ___]

    CONDITION OF SURFACE BEFORE MICROSURFACING [___]
    CLEAN ....1 MOSTLY CLEAN..........2
    SOMEWHAT DIRTY....3 DIRTY.................4
    OILY SPOTS PRESENT.........5

    SURFACE MOISTURE CONDITION [___]
    DRY .... 1 MOSTLY DRY............2
    SOMEWHAT MOIST.....3 WET...................4

28. ***AMBIENT CONDITIONS AT TIME OF MICROSURFACING APPLIED**
    AIR TEMPERATURE (°F) (60 °F Required) [___ ___ ___]

    RELATIVE HUMIDITY (Percent) [___ ___ ___]

    TEMPERATURE FORECAST TO BE >32 °F IN NEXT 24 HOURS [___]
    YES.......... 1 NO.......... 2 UNKNOWN.......... 3

    FORECAST MINIMUM TEMPERATURE DURING 24 HOURS AFTER MICROSURFACING °F [___ ___]

    FORECAST RAIN IN NEXT 24 HOURS [___]
    YES.......... 1 NO.......... 2 UNKNOWN.......... 3

    PERCENT CHANCE IF YES [___ ___]

    AMOUNT OF RAIN DURING 24 HOURS AFTER MICROSURFACING (in.) [___ ___.___]

Sheet 9 *STATE CODE [__ __]

SMERP DATA *STATE ASSIGNED ID [__ __ __ __]

MICROSURFACING APPLICATION DATA FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES

MEASUREMENTS TO BE TAKEN ON BOTH LANES, BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

29. ***SURFACE CONDITION** [___]
    BADLY OXIDIZED ....1 NORMAL 3
    SLIGHTLY OXIDIZED.........2 SLIGHTLY FLUSHED.............4
    FLUSHED...................5 FLUSHED ONLY IN WHEEL PATHS..6
    OTHER (SPECIFY) ________________________________ 7

30. ***AVERAGE CRACK SEVERITY LEVEL** (SEE DISTRESS IDENTIFICATION MANUAL)
    LOW = 1, MODERATE = 2, HIGH = 3 [___]

31. ***PRIMARY TYPE OF CRACKS** (SEE TABLE A.22 FOR TYPE CODES) [___ ___]
    SEE DISTRESS IDENTIFICATION MANUAL FOR DESCRIPTION

32. ***ESTIMATED PERCENT OF CRACKS SEALED** [___ ___ ___]

33. ***AGGREGATE CONDITION PRIOR TO USE** (CLEAN OR ONLY SLIGHTLY DIRTY REQUIRED)
    CLEAN = 1 ONLY SLIGHTLY DIRTY = 2 SOMEWHAT DIRTY = 3 DIRTY = 4 [___]

34. ***AGGREGATE MOISTURE CONTENT**
    VERY DRY...........1 DRY........... 2 ONLY SLIGHTLY DAMP..3
    SOMEWHAT DAMP..... 4 SLIGHTLY WET.. 5 WET................ 6 [___]

35. ***ESTIMATED TIME BETWEEN APPLICATION AND OPENING SECTION TO REDUCED SPEED TRAFFIC** (HOURS) [___ ___.___]

36. ***MAXIMUM REDUCED SPEED ALLOWED** (MPH) [___ ___]

37. ***ESTIMATED TIME BETWEEN APPLICATION AND OPENING SECTION TO FULL SPEED TRAFFIC** (HOURS) [___ ___.___]

Sheet 10 *STATE CODE [__ __]

SMERP DATA *STATE ASSIGNED ID [__ __ __ __]

EQUIPMENT USED IN SLURRY SEAL APPLICATION

MEASUREMENTS TO BE TAKEN ON BOTH LANES, BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

38. ***SLURRY MIXING MACHINE**
    BRAND ____________________________
    MODEL ____________________________
    YEAR [___ ___ ___ ___]

39. ***SLURRY MIXING MACHINE DETAILS** (YES = 1, USUALLY = 2 SOMETIMES = 3, NO = 4)
    CONTINUOUS FLOW MIXING [___]
    ACCURATELY APPORTIONED MIX COMPONENTS [___]
    DISCHARGED THOROUGHLY MIXED PRODUCT CONTINUOUSLY [___]
    AGGREGATE PREWET IMMEDIATELY PRIOR TO MIXING WITH EMULSION [___]
    INGREDIENTS THOROUGHLY BLENDED IN THE MIXING CHAMBER [___]
    METERING DEVICE INTRODUCES PREDETERMINED PROPORTION OF MINERAL FILLER INTO THE MIXER [___]
    MINERAL FILLER FED AT SAME TIME AND LOCATION AS THE AGGREGATE [___]
    FINES FEEDER PROVIDED FOR MINERAL FILLER [___]
    FOG SPRAY (WATER) USED PRIOR TO SLURRY SEAL [___]
    EQUIPPED WITH A MECHANICAL TYPE SQUEEGEE DISTRIBUTOR [___]
    FLEXIBLE REAR STRIKEOFF USED [___]
    FLEXIBLE REAR STRIKEOFF KEPT IN CONTACT WITH PAVEMENT SURFACE [___]
    WORKING STEERING DEVICE ON SPREADER BOX [___]

Sheet 11 *STATE CODE [__ __]

SMERP DATA *STATE ASSIGNED ID [__ __ __ __]

WORKMANSHIP IN SLURRY SEAL APPLICATION

MEASUREMENTS TO BE TAKEN ON BOTH LANES, BUT ENTERED ONLY FOR THE LANE CONTAINING THE SMERP TEST SECTION

40. ***WORKMANSHIP** (YES = 1, USUALLY = 2 SOMETIMES = 3, NO = 4)

SPREADER BOX KEPT CLEAN AND FREE OF BUILDUP [___]
WAS SPREADER BOX OVERLOADED [___]
WAS SPREADER BOX EVENLY FILLED AT ALL TIMES [___]
WAS ANY LUMPING, BALLING, OR UNMIXED AGGREGATE NOTICED [___]
WAS SEGREGATION OF THE EMULSION AND AGGREGATE FINES FROM THE COARSE AGGREGATE NOTICED [___]
SLURRY REMAINED WELL MIXED IN SPREADER BOX [___]
WAS BREAKING OF EMULSION OBSERVED IN THE SPREADER BOX [___]

FINISHED SURFACE
- UNIFORM TEXTURE [_]
- EXCESSIVE SCRATCH MARKS OR TEARS [_]
- OTHER SURFACE IRREGULARITIES [_]
- ADHERES FULLY TO THE UNDERLYING PAVEMENT [_]
- READY FOR TRAFFIC WITHIN ONE HOUR [_]
- SURFACE ALTERED BY TRAFFIC [_]

JOINTS/SEAMS
- JOINTS NEAT APPEARING AND UNIFORM [_]
- EXCESSIVE BUILDUP [_]
- UNCOVERED AREAS [_]
- UNSIGHTLY APPEARANCE [_]
- LONGITUDINAL JOINTS PLACED ON LANE LINES
- EXCESSIVE OVERLAP (GREATER THAN 2 INCHES) [_]
- MORE THAN 1/2 INCH GAP BETWEEN THE PAVEMENT SURFACE [_] AND A TEN FOOT STRAIGHT EDGE PLACED ACROSS THE LONGITUDINAL JOINT [_]
- MORE THAN 1/4 GAP INCH FOR A TRANSVERSE JOINT [_]

EDGES
- UNIFORM AND NEAT APPEARING [_]
- MORE THAN VARIATION FROM STRAIGHT EDGE OR CURVE OVER 100 FEET [_]

41. ***SETTING OF SPREADER BOX WIDTH** (Inches) [__ __ __.]

42. ***TYPE OF DRAG USED** (NONE = 1, BURLAP = 2, STEEL = 4, DOUBLE STRIKEOFF = 4, OTHER = 5) [___]

OTHER (SPECIFY) ______________________________

43. **FIELD NOTES AVAILABLE** (YES = 1, NO = 2) [___]

FIELD NOTE LOCATION [______________________________]

APPENDIX - B

Comparisons of Actual Application Rates

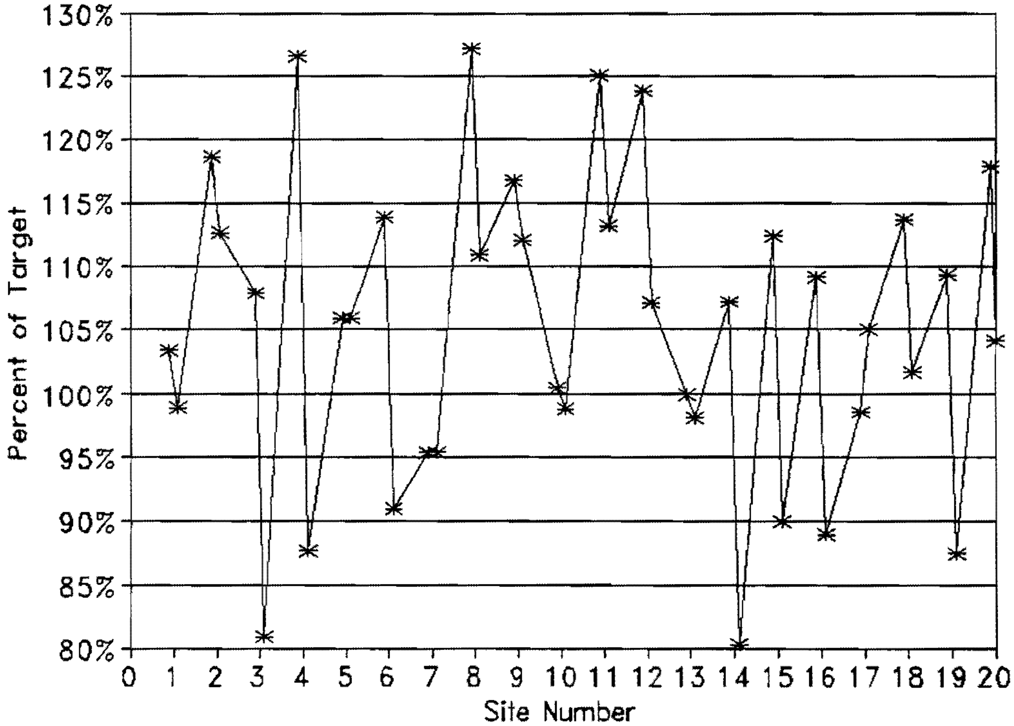

Figure B-1. Asphalt Application Rate - Asphalt Rubber Test Section

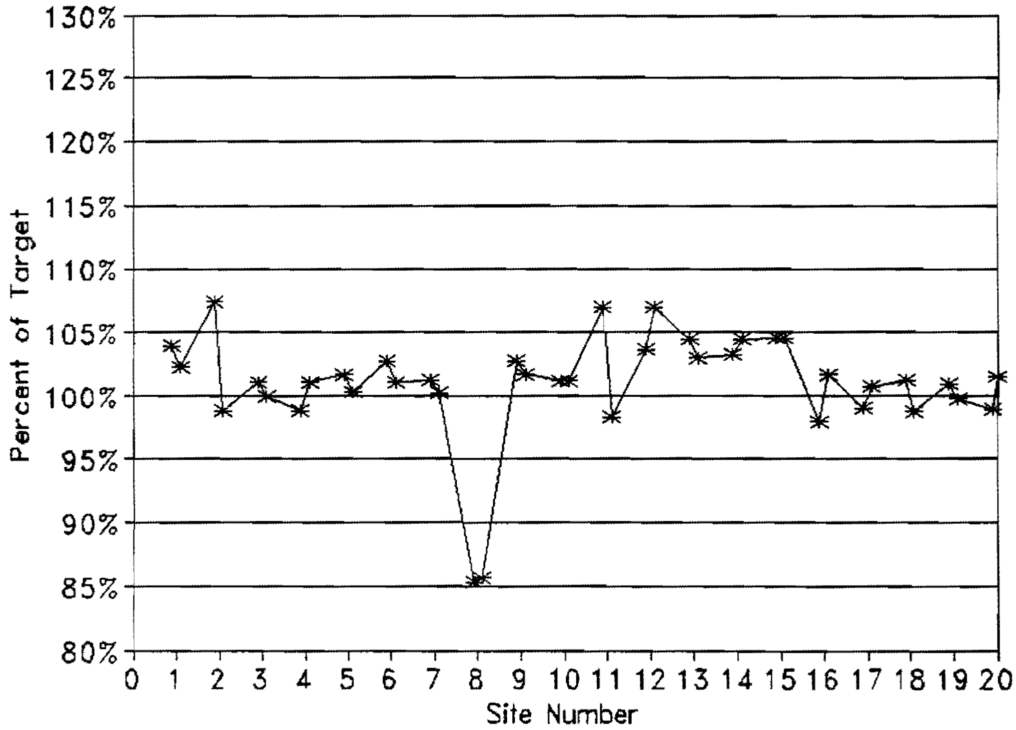

Figure B-2. Asphalt Application Rate - CRS-2P Test Section

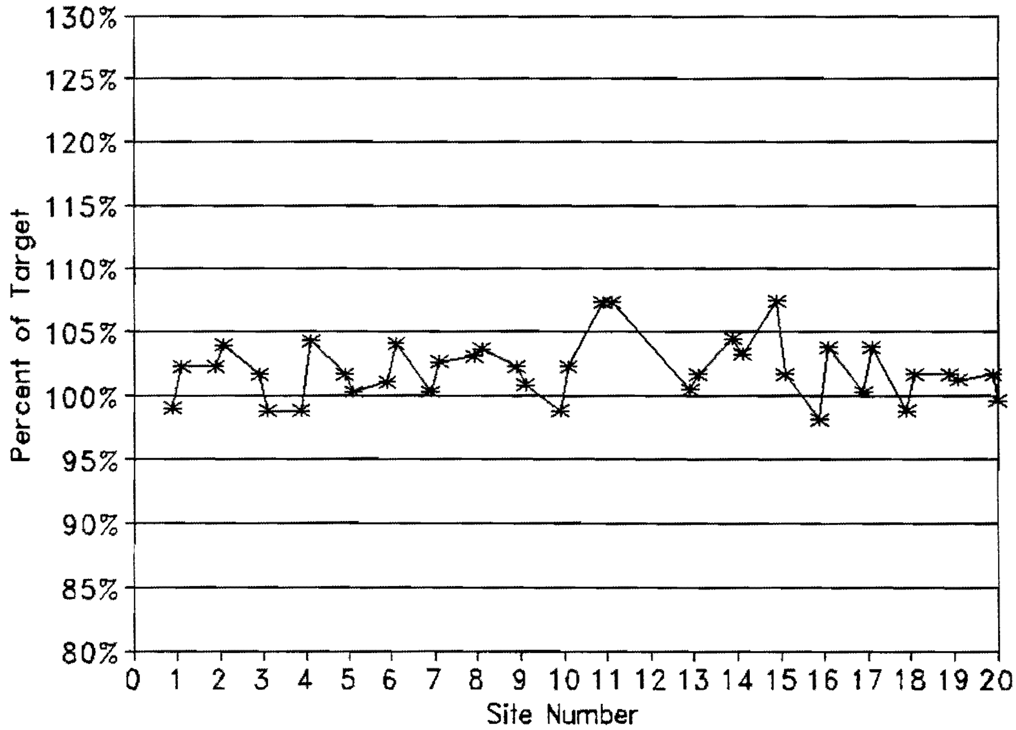

Figure B-3. Asphalt Application Rate - Latex Modified Asphalt Cement Test Section

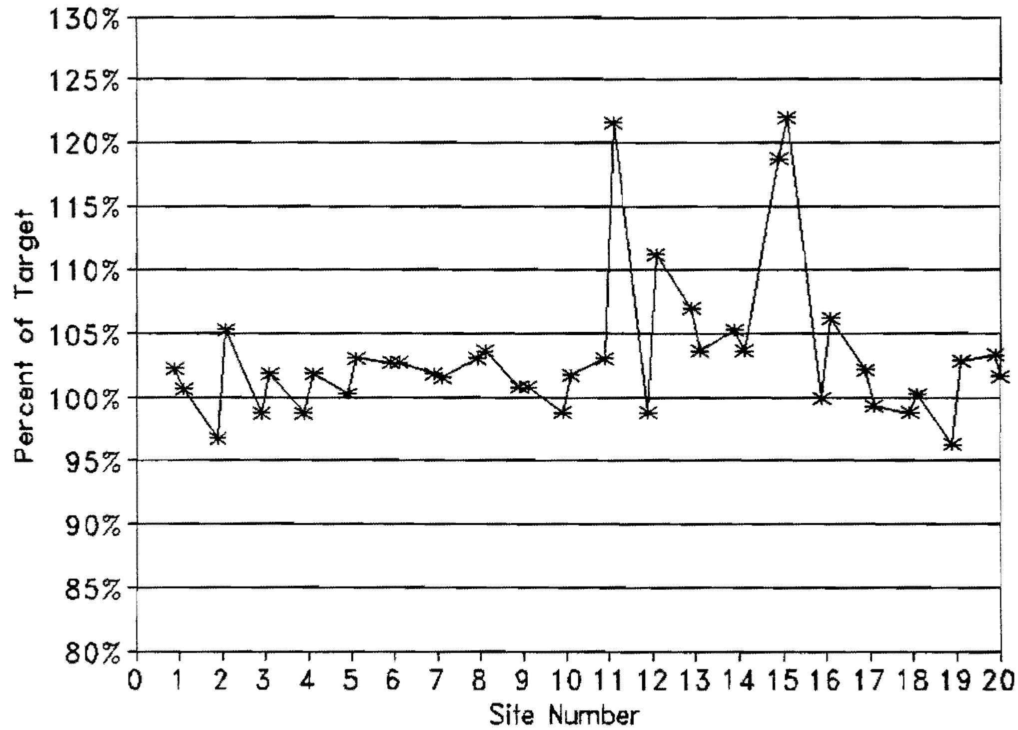

Figure B-4. Asphalt Application Rate - Asphalt Cement Test Section

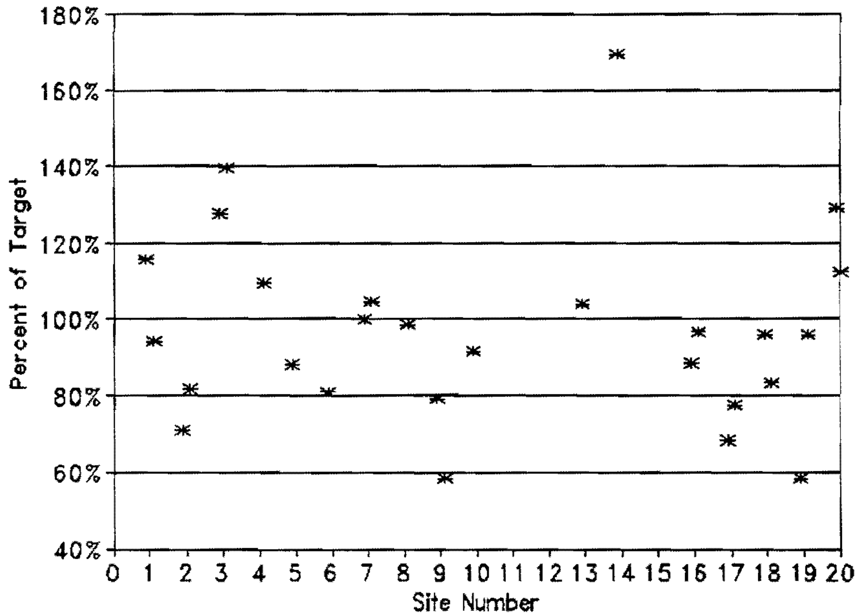

Figure B-5. Aggregate Application Rate in Wheel Path - Asphalt Rubber Test Section

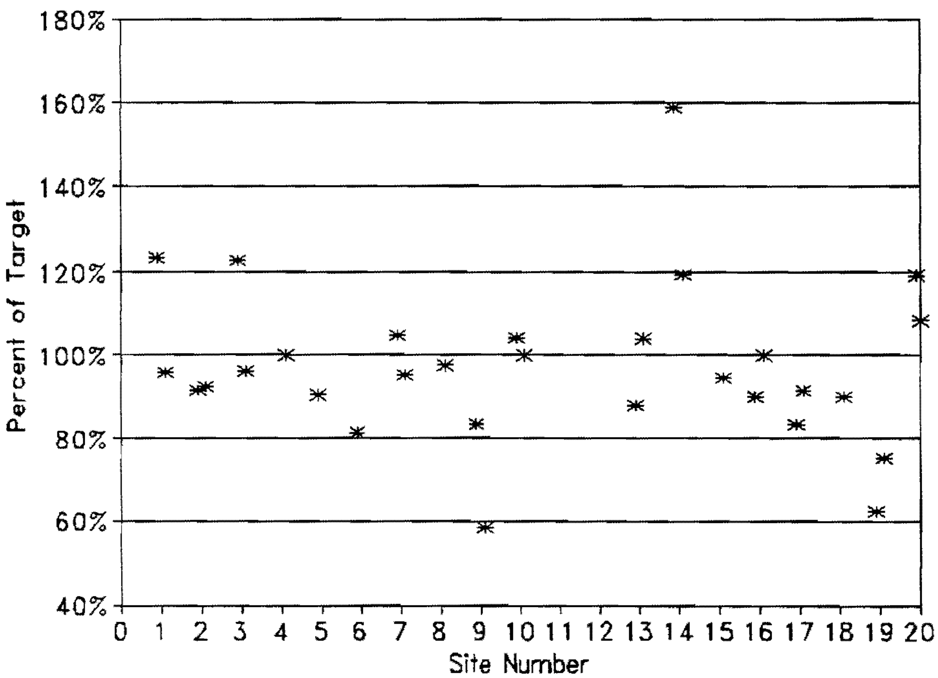

Figure B-6. Aggregate Application Rate Between Wheel Paths - Asphalt Rubber Test Section

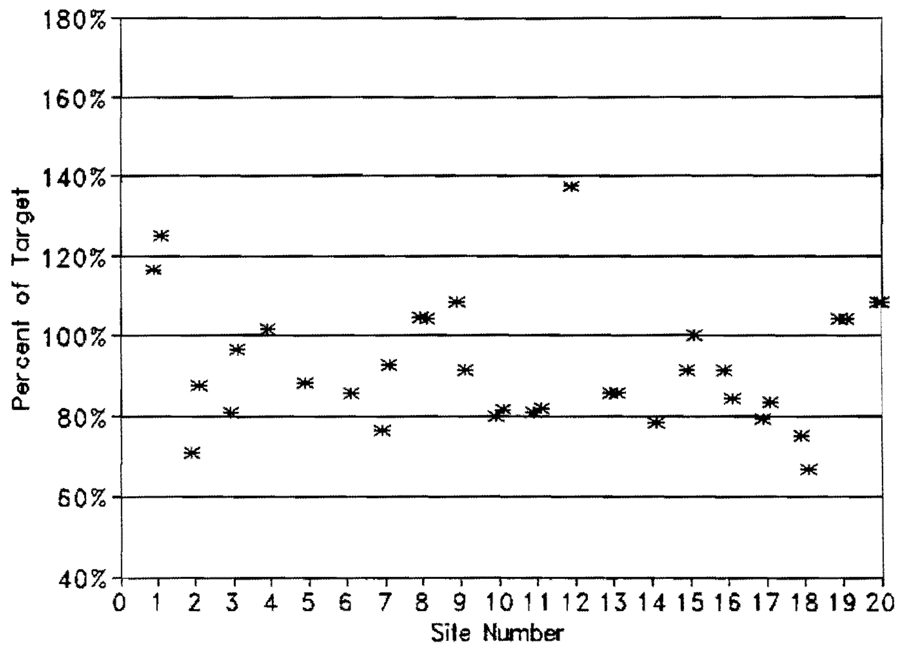

Figure B-7. Aggregate Application Rate in Wheel Path - CRS-2P Test Section

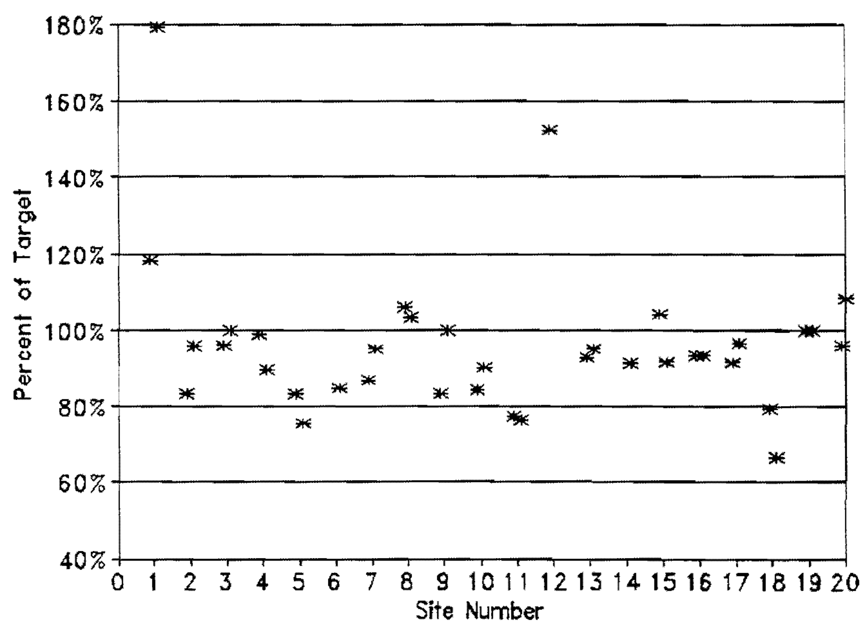

Figure B-8. Aggregate Application Rate Between Wheel Paths - CRS-2P Test Section

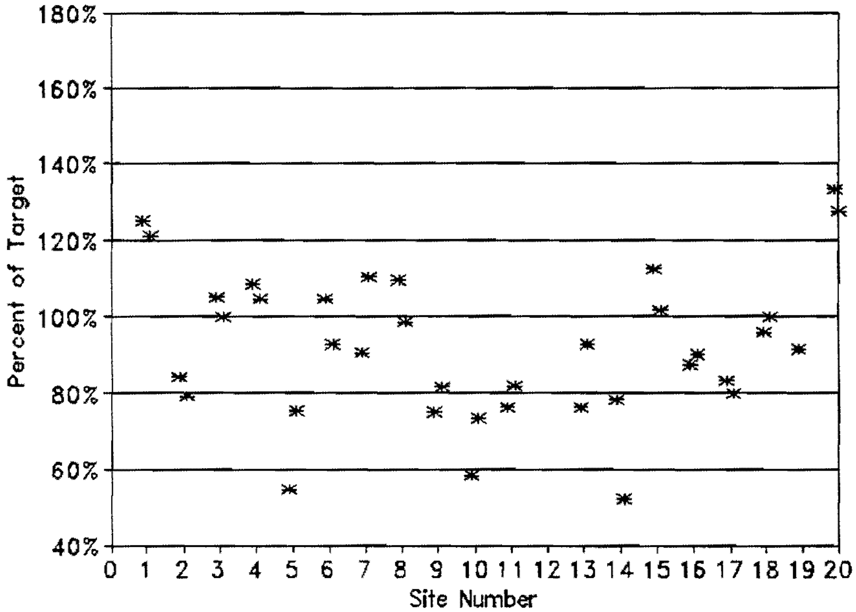

Figure B-9. Aggregate Application Rate in Wheel Path - Latex Modified Test Section

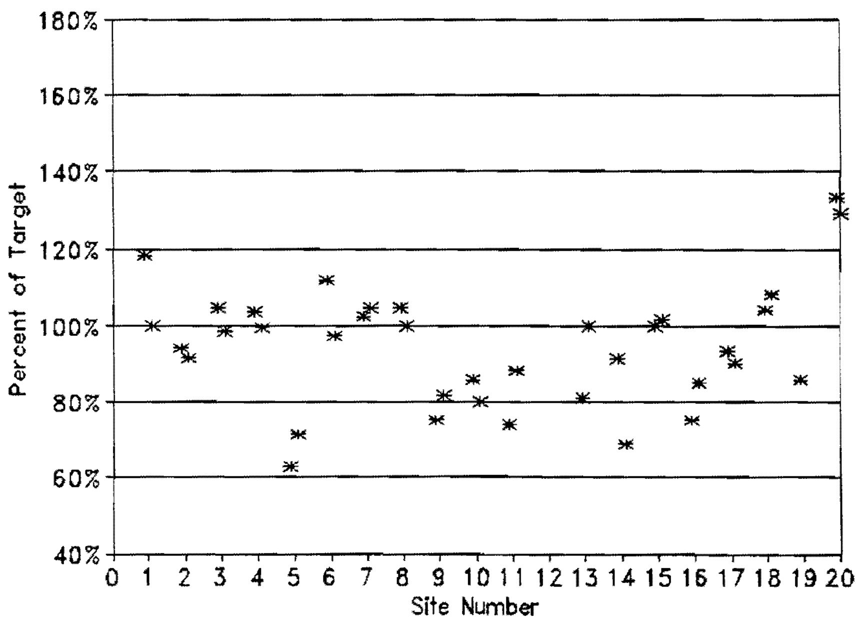

Figure B-10. Aggregate Application Rate Between Wheel Paths - Latex Modified Test Section

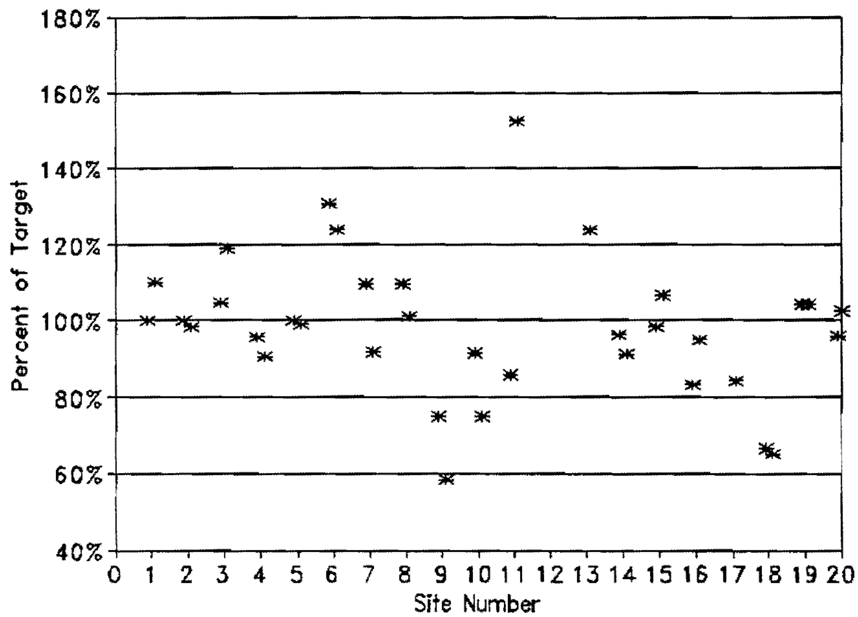

Figure B-11. Aggregate Application Rate in Wheel Path - Straight AC Test Section

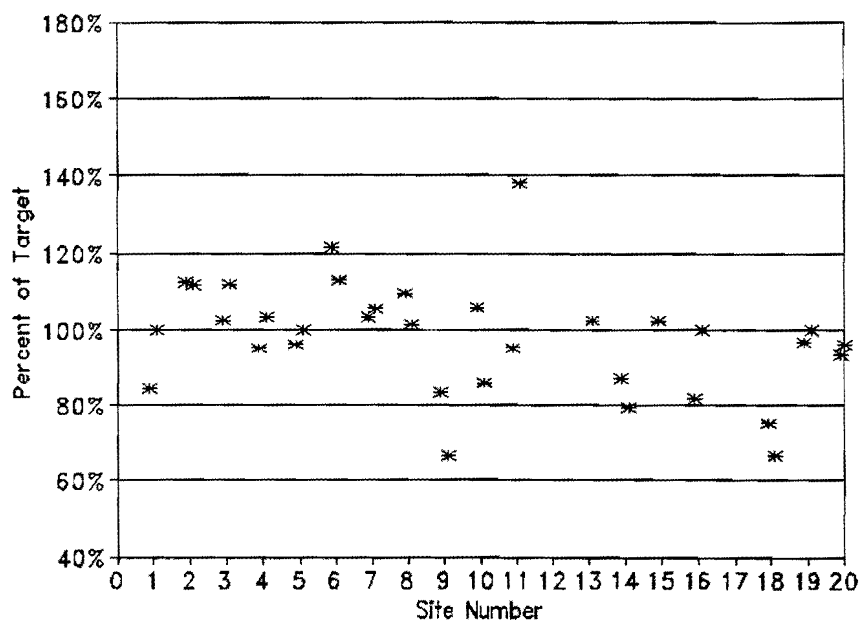

Figure B-12. Aggregate Application Rate Between Wheel Paths - Straight AC Test Section

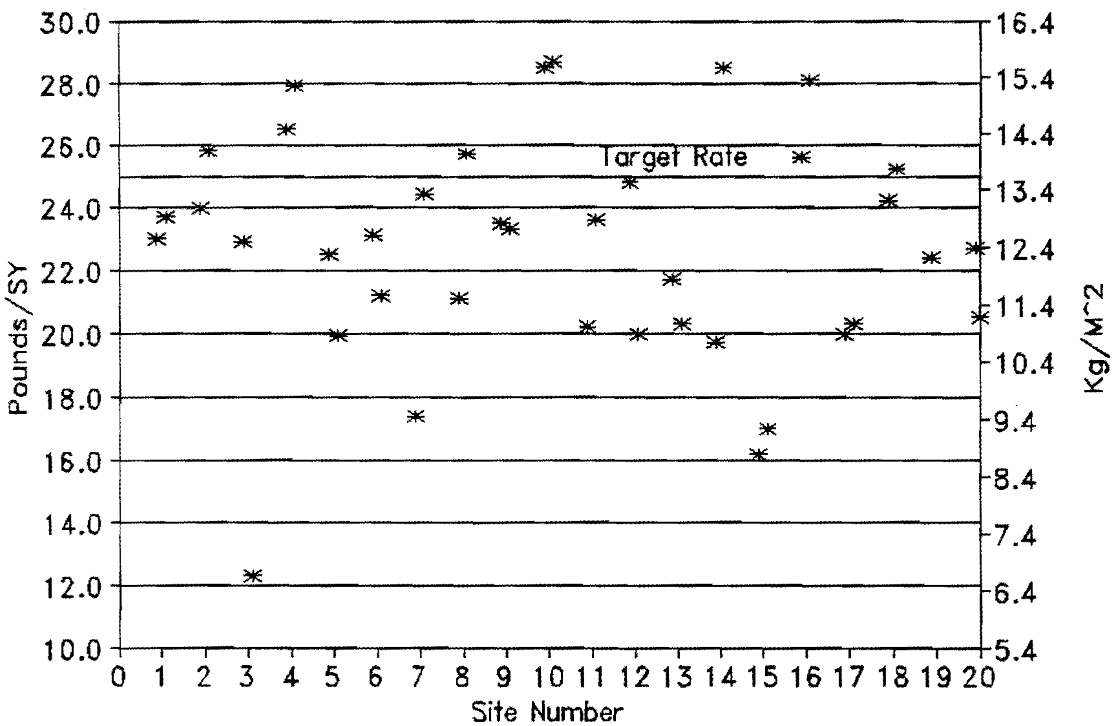

Figure B-13. Application Rate - Micro-Surfacing Test Section