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16. Abstract

The objectives of this project was to conduct vehicle loading tests on the Ohio SHRP Test Pavement (US23) sections under hot weather conditions, collect and analyze pavement response and vehicle dynamic load data, and examine the validity of existing rutting models. To accomplish these objectives, additional sensors (strain gauges and thermocouples) were installed at the SPS-8 sections of the Ohio-SHRP U.S. 23 Test Road. The FHWA Heavy Vehicle Test Truck was used to conduct load tests. The truck was loaded to 19.25 kips for all test series. Each series of test was repeated at least three times or until three different tire prints around the gauges were achieved. Four different sets of tires were used for these tests – two wide base tires and two sets of dual tires (M445 and G286wide base tires and G159 and M275 dual tires). Pavement temperatures and strain responses under truck loading test were collected during July 1996. The processed and cleaned load test data were delivered to ODOT and FHWA in CD-rom as text files. Series of laboratory tests were performed on the cores taken from the test pavements following laboratory test program prepared by FHWA. The laboratory test program included creep and relaxation tests, triangular pulse load tests with rise time varying from 4.5 to 36 milliseconds, with peak load varying from 360 to 2880 lb. For selected specimens, a repeated load tests were performed. Processed and cleaned laboratory test data were also submitted to ODOT and FHWA for further analysis.

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HOT WEATHER LOAD TEST

FHWA/OH-2002/034

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Ohio Department of Transportation
State Job No.: 14711(0)
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Prepared in cooperation with the:

OHIO DEPARTMENT OF TRANSPORTATION

and the

U.S. DEPARTMENT OF TRANSPORTATION,
FEDERAL HIGHWAY ADMINISTRATION

Compiled by:

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1.0 INTRODUCTION

1.1 PROBLEM STATEMENT

During the fall 1997, sections of the Ohio-SHRP U.S. 23 Test Road were replaced. Additionally, two sections on the SPS-8 experiment were instrumented for further testing. The SPS-8 experiment includes four inch thick and seven inch thick Asphalt Concrete (AC) sections. Two hundred feet of the seven inch AC section was modified to an eight inch thick section with uniform materials throughout the depth. The controlled load test was performed on the four inch and eight inch AC sections. These sections were constructed over six inches of dense graded aggregate base.

During construction, several layers of sensors were placed. These included the Dynatest H-shaped gauges and Canadian Strain Gauges. In addition to the strain gauge instrumentation, cables were placed in the base at specific locations for future use. Four inch square holes were created above the location of the buried wires, and strain gauge rosettes were epoxied to the side of the holes. Thermocouples were also placed in the pavement sections at three different depths (top, middle, and bottom) of each section to be tested in this project.

1.2 OBJECTIVES

The objectives of this project were to conduct vehicle loading tests on the Ohio SHRP Test Pavement (US23) sections under hot weather conditions, collect and analyze pavement response and vehicle dynamic load data, and examine the validity of existing rutting models. To accomplish these objectives, the following tasks were performed:

Task 1 Installation of Additional Sensors as part of the preparation for this Project

Task 2 Controlled Load Test

Task 3 Laboratory Tests

Task 4 Data Analysis

Task 5 Reporting

Task 6 Work Plan

2.0 PROJECT SUMMARY

2.1 TASK 1: INSTALLATION OF ADDITIONAL SENSORS AS PART OF THE PREPARATION OF THIS PROJECT

During the fall 1997, sections of the Ohio-SHRP U.S. 23 Test Road were replaced. Additionally, two sections on the SPS-8 experiment were instrumented for further testing.

During construction, several layers of sensors were placed. These included the Dynatest H-shaped gauges and Canadian Strain Gauges. Strain gauges were placed as shown in Figures 1 and 2. In addition to the strain gauge instrumentation, cables were placed in the base at specific locations for future use. Four inch square holes were created above the location of the buried wires, and strain gauge rosettes were epoxied to the side of the holes as shown in Figures 3 and 4. Thermocouples were also placed in the pavement sections at three different depths (top, middle, and bottom) of each section to be tested in this project.

2.2 TASK 2: CONTROLLED LOAD TEST

The FHWA Heavy Vehicle Test Truck was used to conduct the load tests. The truck was loaded to 19.25 kips for all test series. Each series of tests was repeated at least three times or until three different tire prints around the gauges were achieved. Four different sets of tires were used for these tests – two wide base tires and two sets of dual tires. The FHWA supplied the M445 wide base tires and both the G159 and M275 dual tires and Ohio University supplied the G286 wide base tires. Tire changes were conducted on-site as necessary. Table 1 summarizes the test runs and Table 2 outlines the sequence of events during the truck load testing.

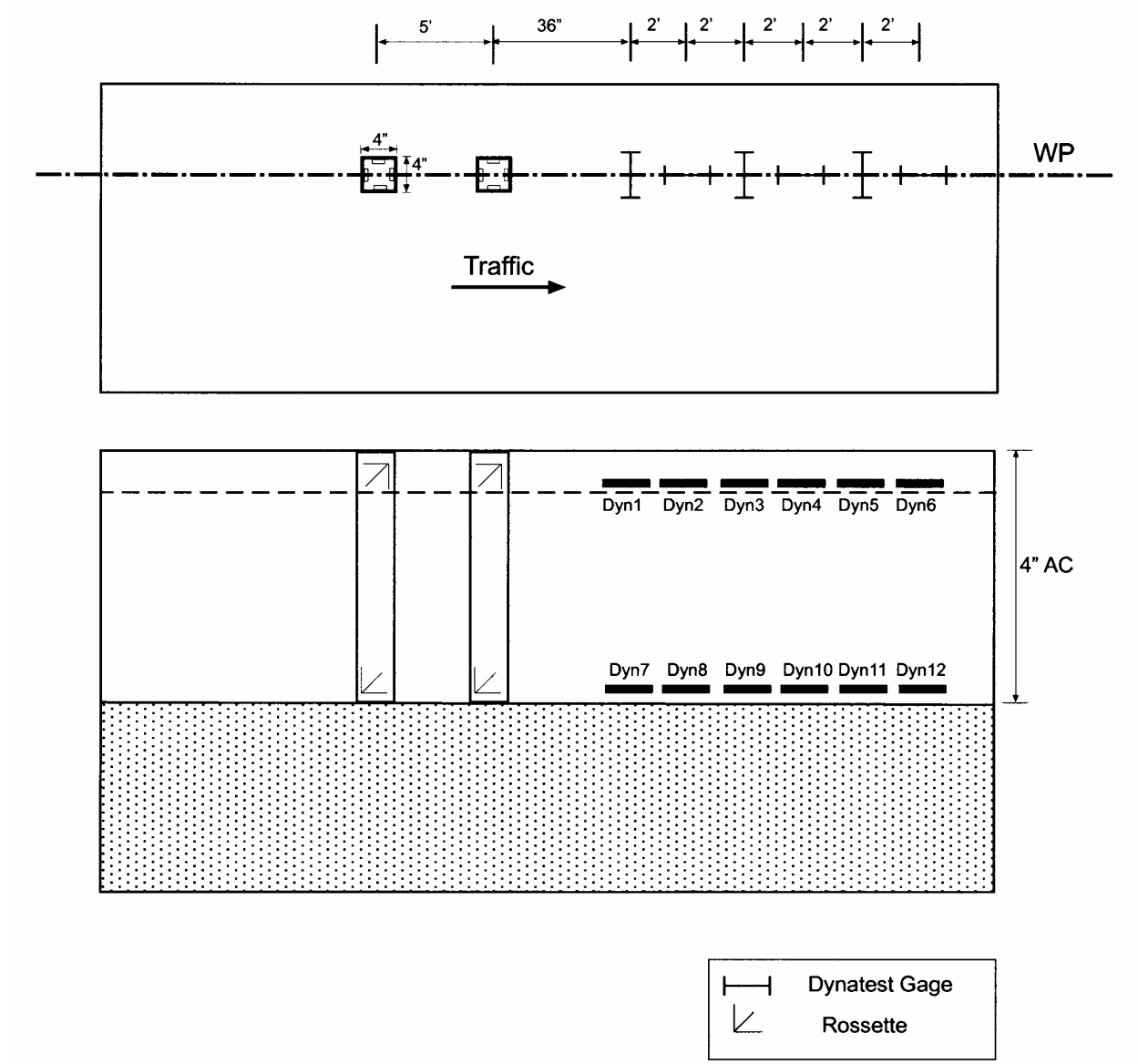

Figure 2.1 Instrumentation of 4 inch AC Section

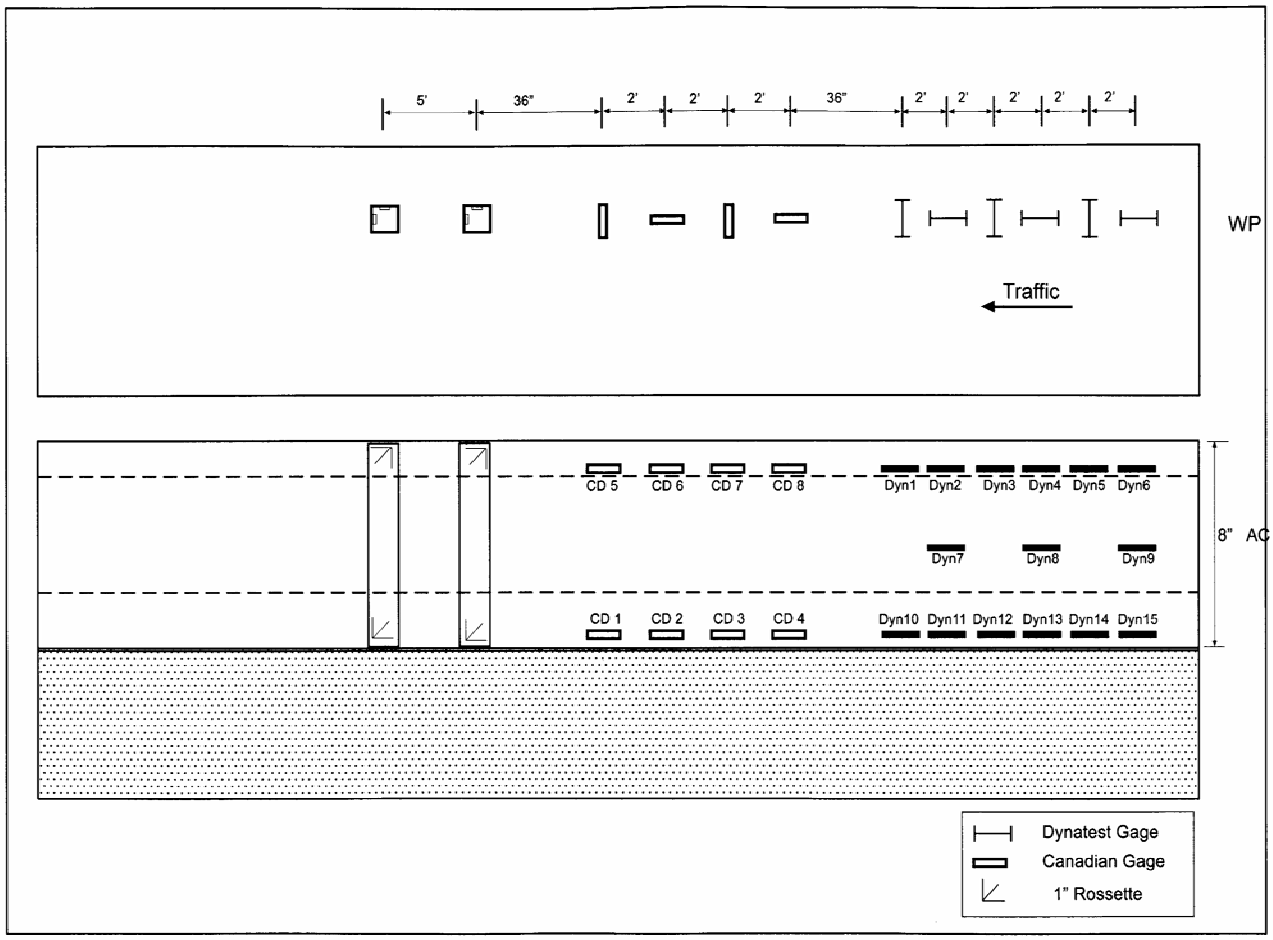

Figure 2.2 Instrumentation of 8 inch AC Section

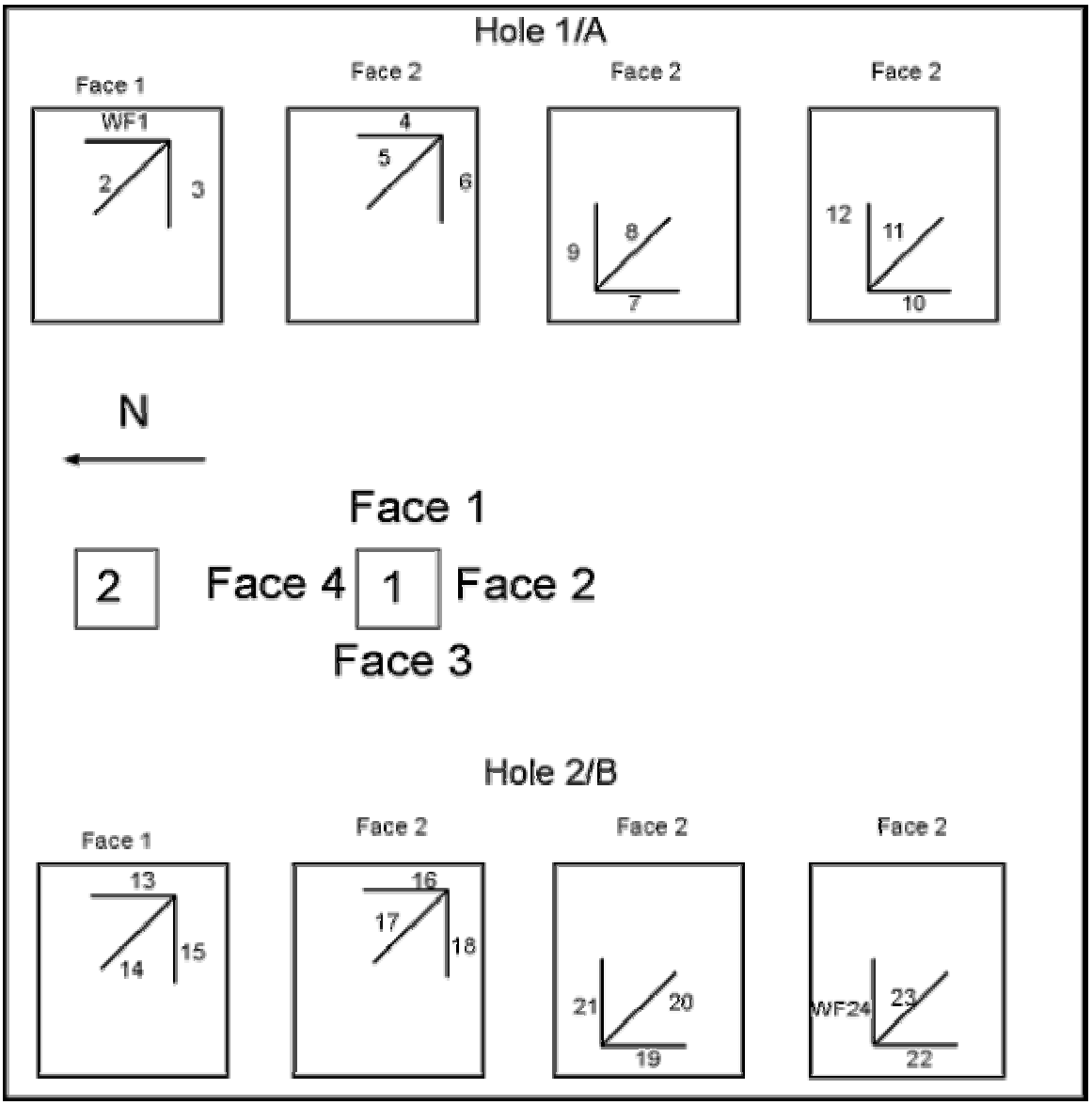

Figure 2.3 Strain Gauge Rosettes Installed in Square Holes of 4 inch AC Section

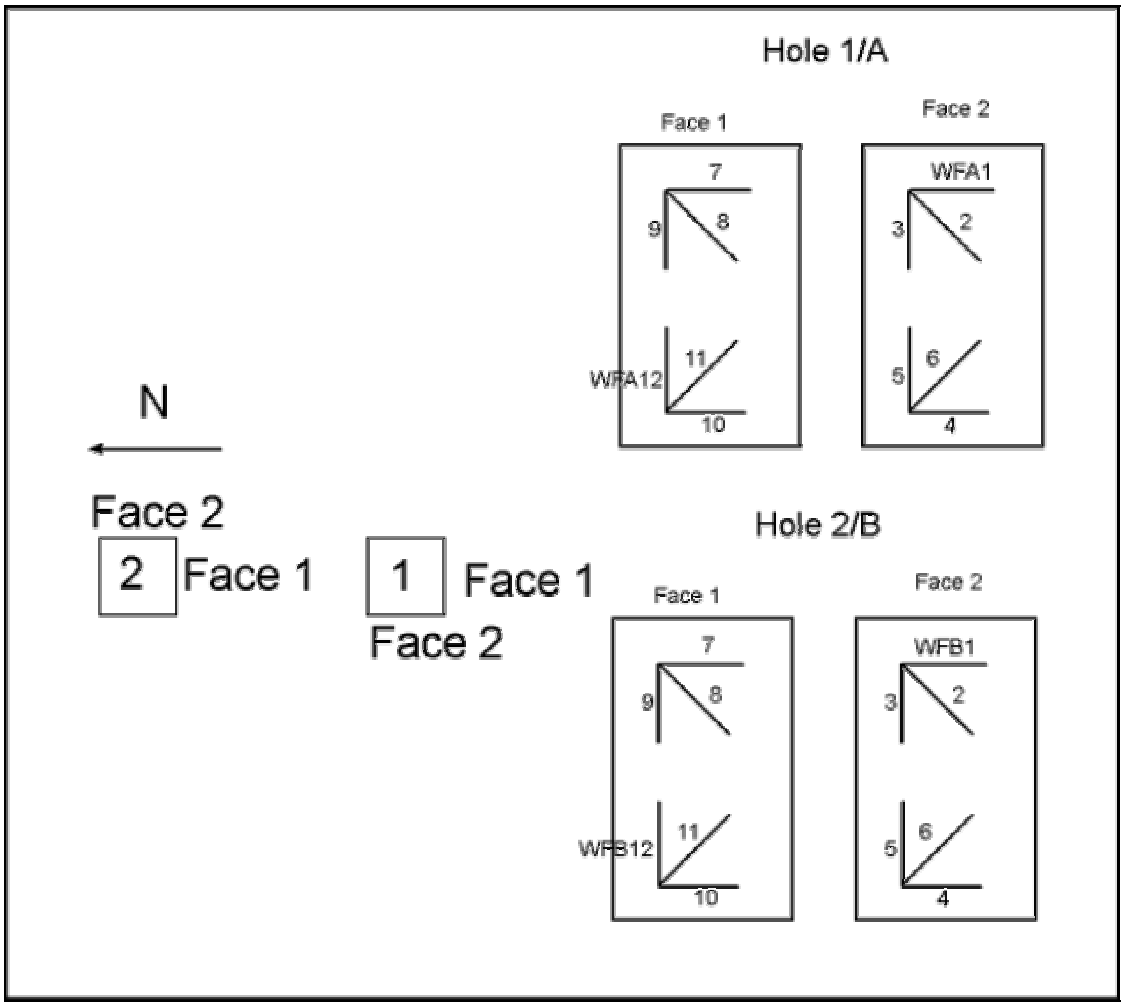

Figure 2.4 Strain Gauge Rosettes Installed in Square Holes of 8 inch AC Section

Table 2.1 Truck Load Test Run Summary

Wide-Base (G286 & MXDA)				**Duals** (G159 & MXZA2)		
Test Series	Speed (mph)	Tire Pressure (psi)		Test Series	Speed (mph)	Tire Pressure (psi)
1	5	70		10	5	70
2	25	70		11	25	70
3	55	70		12	55	70
4	5	100		13	5	100
5	25	100		14	25	100
6	55	100		15	55	100
7	5	120		16	5	120
8	25	120		17	25	120
9	55	120		18	55	120

Table 2.2 Actual Truck Load Testing Time Line

Task	Sun.	Mon.	Tue.	Wed.	Thu.	Fri.
Travel/Arrival	X					
Change tires - G159(11") to G286		X				
Prelim. Profile and Dynamic Tests		X				
Truck strain gage cal., Test G286			X			
and collect Prof. and Dyn. data			X			
Change tires-G286 to G159(295mm)				X		
Test G159(295mm) w/ prof. and dyn.				X		
Change tires-G159(295mm) to MXDA					X	
Test MXDA w/ prof. and dyn.					X	
Change tires-MXDA to MXZA2					X	
Test MXZA2 w/ prof. and dyn.					X	
Change tires-MXZA2 to G159(11")						X
Drive IH Truck to Athens						X
Departure/Travel						X

Strain Gauge response data were collected using two Optim Electronic Megadac Systems. Temperature data from the thermocouple were collected using a portable temperature reader. In addition, weather condition data were monitored using the on-site weather station available for the test road.

Data was collected on July 21st, 22nd and 23rd 1998. The data acquisition systems collected dynamic data at a minimum rate of 1200 samples per second per sensor. Megadac number 1 collected data from sensors in the four inch section. The Megadac files were named SPS8A4 for all runs collected on the 21st, SPS8B4 for all runs collected on the 22nd, and SPS8C4 for all runs collected on the 23rd. Each run was identified by a run number starting with 001. A typical file name would be SPS8B4.008. This file would contain data collected from all the sensors for that run. Sensors were labeled according to the location and type of each sensor, as shown in Figure 1. Dynatest gauges were labeled Dyn1 through Dyn12. The rosette strain gauges epoxied in the square holes were labeled WF1 through WF24 as shown in Figure 3.

Megadac 2 collected data from sensors in the eight inch section. The Megadac files were named SPS8A8 for all runs collected on the 21st, SPS8B8 for all runs collected on the 22nd, and SPS8C8 for all runs collected on the 23rd. Each run was identified by a run number starting with 001. A typical file name would be SPS8B8.006. This file would contain data collected from all

sensors for that run. Sensor labels are as shown in Figure 2. Dynatest gauges were labeled Dyn1 through Dyn15 and the Canadian Strain Gauges were labeled CD1 through CD16. The rosette strain gauges epoxied in Hole A were labeled WFA1 through WFA12, and rosette strain gauges epoxied in Hole B were labeled WFB1 through WFB12, as shown in Figure 4. The processed and cleaned load test data were delivered to ODOT and FHWA in CD-Rom as text files.

2.3 TASK 3: LABORATORY TESTS

Laboratory tests were performed on the cores taken from the test pavement and followed the laboratory test program dated June 7, 2000 outlined by FHWA research personnel and revised April 10, 2001, also by FHWA. According to the FHWA laboratory test program, creep and relaxation tests were to be run at 40, 65, 90, and 115°F. Triangular pulse load tests were to be run at 70, 90 and 110°F. The laboratory test program included creep and relaxation tests, triangular pulse load tests with rise time varying from 4.5 to 36 milliseconds, with peak load varying from 360 to 2880 lb. For selected specimens, a repeated load tests were performed at 70°F only

Creep test, relaxation test, triangular pulse load test, and repeated cyclic load test were performed on 27 specimens following modified test plan (Phase I). All tested specimens together with 13 unused core specimens were saved for further testing. Phase I tests were performed in compression mode without confinement (uniaxial test). Following describes detailed test set-up/procedure and summary of test results.

In the FHWA requested laboratory test program (dated June 7, 2000 and revised April 10, 2001), the resilient modulus tests were not included.

2.3.1 Laboratory Test Procedures

1. Creep and relaxation tests were performed as described in the Phase I plan. For measurement of vertical deformation, a set of two 4.5 inch gauge length extensometers was mounted at the opposite sides at the middle height of the specimen, as shown in Figure 5. Some of the creep tests at high temperature and high stress levels could not be performed because of specimen failure. Creep tests were conducted with 180 seconds of loading immediately followed by 180 seconds of recovery. Relaxation behaviors were measured for duration of 300 seconds. All samples were stored for future tension tests.

2. Triangular pulse load tests were performed in load-control mode following the procedures described below.
   a) Each pulse shape was defined by specifying the initial base load and peak load, time to reach the peak load and base load, and times to reach the base load (file-playback command in MTS software was used for this task).
   b) For each pulse type (A1, A2) and each temperature, using a laboratory prepared asphalt specimen, the MTS test system was tuned to produce the desired triangular shape of load pulse (peak load and rise time). For deformation measurements, a set of two 4.5 inch gauge length extensometers was mounted at the middle height of the specimen.
   c) The best possible MTS tuning parameter values (PDIF) were recorded for each pulse type and temperature.
   d) The trimmed core specimens were tested following the desired test sequence. For each pulse type, MTS PDIF (tuning parameters in MTS system) was set to the values determined in step b.
   e) Nearly every time, the first pulse load applied to the specimen produced a much lower peak load than the desired load level due to large plastic deformation that existed at the beginning of bituminous materials testing. Usually, repeating the test without changing any MTS tuning parameters produced a pulse closer to the desired pulse shape.
   f) Occasionally, PDIF values needed re-adjustment. The repeated tests were labeled as A1b, A1c, and so on.
   g) At the very short rise time (4.5 milliseconds), there were vibratory noise in the displacement measurement. The noise was cleaned using the Fourier transform in MS Excel and the cleaned data were compared with the original data to check the reasonableness of the data cleaning.

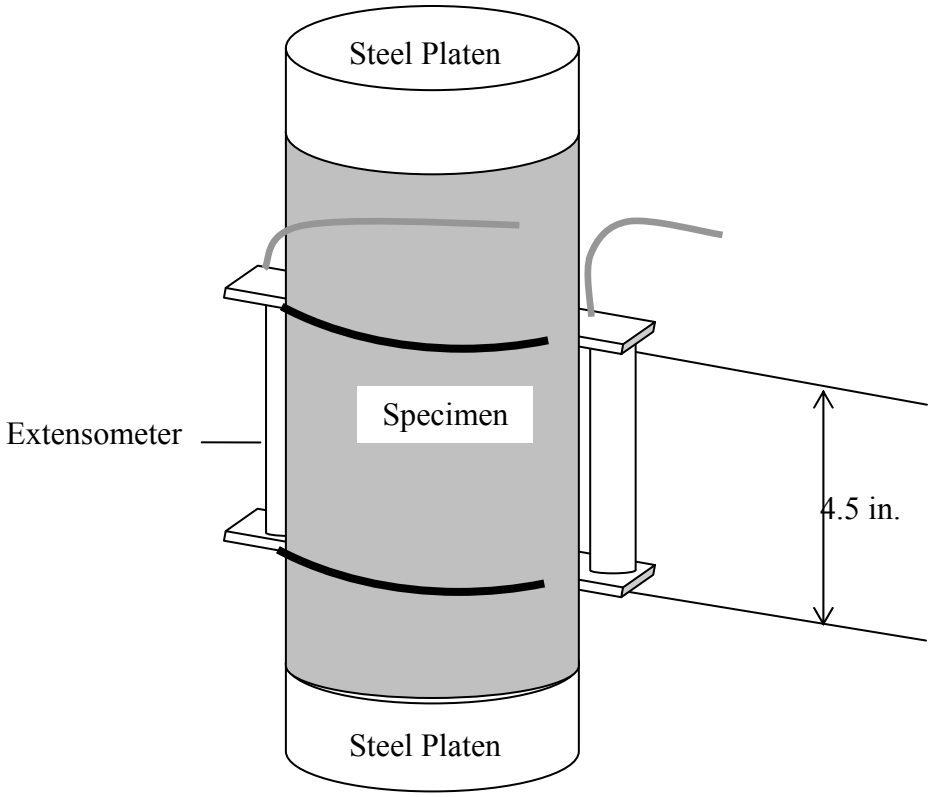

Figure 2.5 Extensometer Set-up

2.3.2 Test Results per Modified Laboratory Test Plan (Phase I)

All test data are stored in the accompanied CD. As shown in Figure 6, the CD contains 6 directories for the different types of tests performed; creep, relaxation, pulse tests at 70, 90, and 110°F and cyclic tests at 70°F. The contents of these 6 directories are also shown in Figure 6.

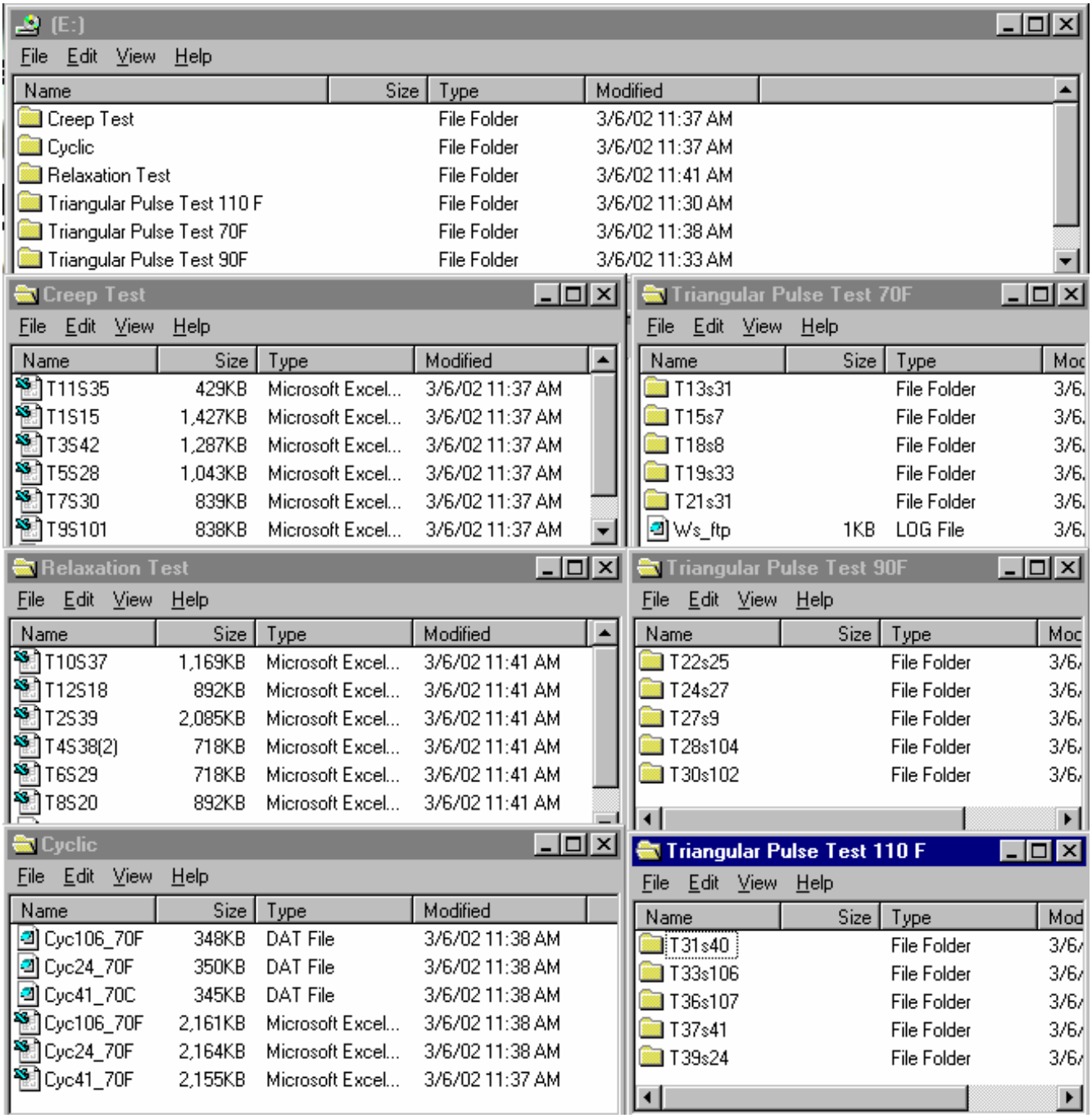

Figure 2.6 Directory of the data CD

2.3.3 Subtask 3.1. Creep and Relaxation Tests (Compression test only)

Six data files are stored in the 'Creep Test' directory and another six data files are stored in the 'Relaxation Test' directory. In the file name, for example, "T1S15", "T1" represents Test #1 (called as Specimen # on the original FHWA laboratory test plan) and "S15" represents the specimen ID assigned by the field engineer who drilled the cores. The last worksheet in the Excel file, usually named as "SX-1", contains raw data [Time (sec), Actuator Displacement (in.), Load Cell (lb), and Extensometer (in.)] and calculated stress and strain using Load Cell and Extensometer values. Creep and relaxation plots are also included in the Excel files. Table 3 summarizes the creep/relaxation tests performed. All creep and relaxation curves are saved in the respective Excel files.

Table 2.3 Summary of Uniaxial Creep/Relaxation Test

Test Number	Sample ID	Temperature °F	Creep/Relax	Test Sequence
1	15	40	Creep	10, 20, 40, 80, 160 psi
2	39	40	Relax	50, 100, 200 με
3	42	40	Creep	10, 20, 40, 80, 160 psi
4	38	65	Relax	50, 100, 200, 400 με
5	28	65	Creep	10, 20, 40, 80, 160 psi
6	29	65	Relax	50, 100, 200, 400 με
7	30	90	Creep	10, 20, 40, 80 psi
8	20	90	Relax	50, 100, 200, 400, 800 με
9	101	90	Creep	10, 20, 40, 80 psi
10	37	115	Relax	50, 100, 200, 400, 800 με
11	35	115	Creep	10, 20 psi
12	12	115	Relax	50, 100, 200, 400, 800 με

2.3.4 Subtask 3.2 Triangular Pulse Load Test, Compression Only, No Confining Pressure

Five specimens were used for each of three test temperatures; 70, 90, and 110°F. Results of each pulse load applied to a specimen were saved as a separate Excel file. The last worksheet of each Excel file contains the raw data [Time (sec), Load Cell (lb), and Extensometer [C] (in.)] and calculated stress, and if needed, filtered strain [clean data], unfiltered strain [original], and filtered Extensometer values [real] obtained by the Fast Fourier (FF) Transform. The Excel file also includes the triangular form of stress and strain response versus time plot. If the FF

transform is used, the extensometer deformation plot on frequency domain, the plot of stress and filtered strain on time domain, and the plot of filtered and unfiltered strains versus time are included. Results of the 70, 90, and 110°F test results are summarized in Tables 4-6 and their plots are saved in respective Excel files. The tables include actual load, stress, stress-rate and strain-rate at the straight portions of loading/unloading curves.

Table 2.4 Triangular Pulse Load Test at 70°F, Compression Only, No Confining Pressure

Test Number	File Name & Sequence of Testing		Intended Peak Load, lb	Intended Rise Time, ms	Actual Peak Stress, psi	Actual Peak Load, lb.	Loading		Unloading	
							Stress Rate, psi/ms	Strain Rate, με/ms	Stress Rate, psi/ms	Strain Rate, με/ms
18	T18S8C_1	A1	360	4.5	34.8	438	8.0	8.8	7.0	9.7
	T18S8C_1b	A1	360	4.5	51.2	643	9.2	13.7	10.4	9.2
	T18S8C_2	B1	720	4.5	49.3	619	9.2	15.0	11.3	13.2
	T18S8C_3	C1	1440	4.5	78.9	992	12.9	22.5	13.8	19.4
	T18S8C_4	D1	2880	4.5	102.3	1286	16.0	32.1	17.9	21.7
	T18S8C_4b	D1	2880	4.5	112.0	1407	16.7	33.3	18.5	21.8
19	T19S33C_1	A2	360	9	23.9	300	2.7	6.2	2.1	2.8
	T19S33C_0	A2	360	9	40.2	505	5.9	12.9	6.1	10.0
	T19S33C_2	B2	720	9	51.7	649	7.5	13.9	4.1	7.1
	T19S33C_3	C2	1440	9	105.2	1322	11.7	25.9	11.4	15.7
	T19S33C_4	D2	2880	9	208.8	2623	21.7	50.0	22.7	35.3
21	T21S13C_1	A4	360	36	22.4	282	0.8	1.7	0.6	0.9
	T21S13C_2	B4	720	36	52.8	663	2.3	6.5	1.6	2.6
	T21S13C_3	C4	1440	36	121.8	1530	4.1	11.6	3.2	5.0
	T21S13C_4	D4	2880	36	220.5	2771	6.8	22.7	5.8	9.7
13	T13S31_A1	A1	360	4.5	25.7	323.2	0.8	2.4	0.8	1.3
	T13S31_A2	A2	360	9	19.1	239.6	2.0	4.0	1.5	3.5
	T13S31_A3	A3	360	18	24.4	306.5	1.3	3.8	1.0	2.0
	T13S31_A4	A4	360	36	24.6	308.8	0.8	2.4	0.7	1.4
	T13S31_B1	B1	720	4.5	59.5	747.1	12.0	22.2	14.0	20.9
	T13S31_B2	B2	720	9	47.4	595.0	5.1	9.8	4.5	10.2
	T13S31_B3	B3	720	18	56.8	713.5	3.3	8.2	2.9	4.8
	T13S31_B4	B4	720	36	57.2	718.2	1.8	5.4	1.6	2.9
	T13S31_C1	C1	1440	4.5	111.0	1394.2	17.9	36.2	18.2	24.4
	T13S31_C2	C2	1440	9	109.2	1372.0	12.2	26.9	11.0	13.0
	T13S31_C3	C3	1440	18	109.9	1380.5	5.6	14.0	5.2	8.0
	T13S31_C4	C4	1440	36	109.6	1377.4	3.2	9.8	3.0	4.9
15	T15S7_B1	B1	720	4.5	5.5	68.9				
	T15S7_B1(b)	B1	720	4.5	48.6	610.6	10.3	16.1	12.7	15.7
	T15S7_B2	B2	720	9	57.5	722.2	6.9	11.7	5.4	6.9
	T15S7_B3	B3	720	18	59.1	742.8	3.4	7.7	3.3	4.3
	T15S7_B4	B4	720	36	59.7	749.6	1.8	5.1	1.7	2.4
	T15S7_C1	C1	1440	4.5	126.2	1585.5	21.2	33.8	20.9	21.4
	T15S7_C2	C2	1440	9	121.5	1527.2	14.3	21.6	13.1	14.0
	T15S7_C3	C3	1440	18	120.1	1509.2	6.1	11.9	6.1	7.5
	T15S7_C4	C4	1440	36	115.8	1455.2	3.5	8.2	3.2	4.3
	T15S7_D1	D1	2880	4.5	154.5	1941.8	23.1	36.6	22.8	26.9
	T15S7_D1(b)	D1	2880	4.5	161.1	2024.7	22.0	36.8	20.9	29.0
	T15S7_D2	D2	2880	9	225.2	2829.3	24.5	42.0	26.0	29.6
	T15S7_D3	D3	2880	18	225.0	2826.8	12.2	24.6	11.0	13.8
	T15S7_D4	D3	2880	18	226.4	2845.5	12.5	27.5	11.0	17.4
	T15S7_D4	D4	2880	36	222.1	2791.0	7.0	17.4	6.1	15.0

Table 2.5 Triangular Pulse Load Test at 90°F, Compression Only, No Confining Pressure

Test Number	File Name & Sequence of Testing		Intended Peak Load, lb	Intended Rise Time, ms	Actual Peak Stress, psi	Actual Peak Load, lb	Loading		Unloading	
							Stress Rate, psi/ms	Strain Rate, με/ms	Stress Rate, psi/ms	Strain Rate, με/ms
22	T22S25_A1	A1	360	4.5	14.3	179.6	2.35	5.00	2.08	4.29
	T22S25_A1b	A1b	360	4.5	47.5	597.5	9.09	24.44	11.63	18.33
	T22S25_A1c	A1c	360	4.5	59.4	746.2	13.73	32.24	16.28	22.90
	T22S25_A1d	A1d	360	4.5	27.2	341.8	15.79	13.08	18.00	11.93
	T22S25_A2	A2	360	9	19.8	249.2	2.05	6.96	1.47	3.72
	T22S25_A2b	A2b	360	9	31.7	398.7	3.89	10.77	3.43	9.79
	T22S25_A3	A3	360	18	24.2	304.2	1.58	5.45	1.30	2.86
	T22S25_A3b	A3b	360	18	28.0	352.0	1.88	6.17	1.67	6.03
	T22S25_A4	A4	360	36	27.6	346.6	0.65	2.62	0.75	2.15
	T22S25_B1	B1	720	4.5	50.0	628.8	10.31	21.90	12.00	25.56
	T22S25_B1b	B1b	720	4.5	52.7	661.9	11.11	24.21	12.50	31.36
	T22S25_B1c	B1c	720	4.5	56.9	715.2	11.76	27.68	13.95	23.48
	T22S25_B2	B2	720	9	63.1	792.6	9.59	25.00	11.29	19.79
	T22S25_B3	B3	720	18	61.3	769.7	4.67	14.63	3.68	15.79
	T22S25_B4	B4	720	36	62.9	790.2	1.71	8.33	1.75	6.67
	T22S25_C1	C1	1440	4.5	79.2	994.7	15.52	35.54	16.36	26.18
	T22S25_C1b	C1b	1440	4.5	75.9	953.5	15.09	34.23	15.38	26.18
	T22S25_C2	C2	1440	9	118.3	1486.1	16.47	40.91	14.74	26.47
	T22S25_C3	C3	1440	18	106.5	1337.9	7.06	26.32	5.15	18.87
	T22S25_C4	C4	1440	36	112.4	1412.0	3.00	14.89	3.16	14.14
	T22S25_D2	D2	2880	9	175.8	2209.7	16.00	53.75	21.05	35.83
24	T24S27_B1	B1	720	4.5	26.6	333.9	4.48	11.00	6.98	11.00
	T24S27_B1b	B1b	720	4.5	49.5	622.6	10.71	23.62	14.29	29.78
	T24S27_B1c	B1c	720	4.5	53.8	675.6	10.71	26.61	14.29	27.07
	T24S27_B2	B2	720	9	57.4	721.4	8.24	20.00	11.11	16.67
	T24S27_B3	B3	720	18	60.3	758.3	5.00	14.29	3.85	5.97
	T24S27_B4	B4	720	36	61.9	778.0	1.67	7.87	1.67	3.61
	T24S27_C1	C1	1440	4.5	79.0	992.8	15.25	34.09	17.31	22.32
	T24S27_C2	C2	1440	9	121.5	1526.3	16.87	42.86	17.95	25.86
	T24S27_C3	C3	1440	18	110.2	1384.8	7.74	27.78	6.32	7.83
	T24S27_C4	C4	1440	36	114.2	1434.6	3.05	14.49	3.35	5.74
	T24S27_D1	D1	2880	4.5	135.4	1701.3	18.18	48.19	20.78	28.74
	T24S27_D2	D2	2880	9	190.2	2390.2	18.35	58.76	21.98	38.04
	T24S27_D3	D3	2880	18	220.2	2767.2	15.34	54.95	15.63	18.52
	T24S27_D4	D4	2880	36	227.5	2858.9	6.25	28.57	6.94	15.56
27	T27S9_A1	A1	360	4.5	22.6	283.7	4.17	10.61	5.43	9.43
	T27S9_A1b	A1b	360	4.5	24.0	301.5	4.29	9.58	6.38	11.31
	T27S9_A1c	A1c	360	4.5	32.6	409.7	6.73	14.50	10.61	15.54
	T27S9_B1	B1	720	4.5	54.1	680.4	10.34	24.46	15.00	22.83
	T27S9_C1	C1	1440	4.5	66.3	833.5	16.28	33.40	14.89	36.51
	T27S9_D1	D1	2880	4.5	114.5	1438.7	16.67	50.00	18.67	27.63

Table 2.5 Triangular Pulse Load Test at 90°F, Compression Only, No Confining Pressure

Test Number	File Name & Sequence of Testing		Intended Peak Load, lb	Intended Rise Time, ms	Actual Peak Stress, psi	Actual Peak Load, lb	Loading		Unloading	
							Stress Rate, psi/ms	Strain Rate, με/ms	Stress Rate, psi/ms	Strain Rate, με/ms
28	T28S104_A2b	A2b	360	9	28.2	354.6	3.37	10.17	2.94	4.86
	T28S104_B2	B2	720	9	56.5	710.6	8.11	22.47	9.84	16.00
	T28S104_C2	C2	1440	9	112.1	1408.9	17.65	48.39	14.46	20.83
	T28S104_D2	D2	2880	9	177.6	2231.4	16.67	58.00	7.94	33.33
	T28S104_D2b	D2b	2880	9	185.9	2335.0	17.24	65.00	22.22	35.21
30	T30S102_A4	A4	360	36	24.5	308.4	0.81	3.68	0.75	1.46
	T30S102_A4b	A4b	360	36	26.4	332.0	0.94	4.32	0.71	1.61
	T30S102_B4	B4	720	36	60.1	754.9	1.75	8.89	1.63	2.36
	T30S102_C4	C4	1440	36	110.5	1388.9	3.08	15.69	3.04	5.83
	T30S102_D4	D4	2880	36	221.9	2788.9	6.25	34.04	6.33	9.09

Table 2.6 Triangular Pulse Load Test at 110°F, Compression Only, No Confining Pressure

Test Number	File Name & Sequence of Testing		Intended Peak Load, lb	Intended Rise Time, ms	Actual Peak Stress, psi	Actual Peak Load, lb	Loading		Unloading	
							Stress Rate, psi/ms	Strain Rate, με/ms	Stress Rate, psi/ms	Strain Rate, με/ms
31	T31S40_A1	A1	360	4.5	17.3	100.4	4.17	19.54	2.99	11.39
	T31S40_A1b	A1b	360	4.5	40.0	242.0	8.49	53.39	9.78	35.71
	T31S40_A2	A2	360	9	25.3	206.6	3.00	8.11	2.03	9.00
	T31S40_A3	A3	360	18	29.0	281.1	1.75	15.91	1.75	7.35
	T31S40_A4	A4	360	36	28.31	329.1	.79	9.09	.71	3.68
	T31S40_B1	B1	720	4.5	57.26	334.3	12.50	72.73	12.73	45.00
	T31S40_B2	B2	720	9	52.2	377.6	8.00	48.75	6.59	30.00
	T31S40_B3	B3	720	18	56.7	525.6	4.00	13.61	3.49	13.88
	T31S40_B4	B4	720	36	56.4	653.6	1.58	17.78	1.58	8.06
	T31S40_C1	C1	1440	4.5	109.3	706.2	14.29	95.68	16.90	59.09
	T31S40_C2	C2	1440	9	107.5	831.9	13.33	90.91	13.33	40.77
	T31S40_C3	C3	1440	18	108.7	976.5	6.59	58.09	5.11	17.61
	T31S40_C4	C4	1440	36	108.9	1147.4	1.62	30.19	2.73	12.37
33	T33S106_B1	B1	720	4.5	51.03	299.5	10.00	56.56	13.33	38.46
	T33S106_B2	B2	720	9	57.7	378.8	9.72	51.72	10.14	31.08
	T33S106_B3	B3	720	18	59.6	508.1	4.32	33.33	3.59	10.95
	T33S106_B4	B4	720	36	58.0	637.5	1.67	18.39	1.56	6.58
	T33S106_C1	C1	1440	4.5	114.4	663.6	18.92	73.68	17.72	48.28
	T33S106_C2	C2	1440	9	115.8	785.3	14.74	88.50	15.56	40.27
	T33S106_C3	C3	1440	18	107.6	937.9	7.50	57.14	4.74	14.48
	T33S106_C4	C4	1440	36	110.0	1136.0	2.96	30.77	2.89	8.77
	T33S106_D2	D2	2880	9	180.8	1197.7	15.38	102.82	21.05	58.33
	T33S106_D2b	D2b	2880	9	177.01	1179.7	15.90	102.10	19.61	61.90
	T33S106_D3	D3	2880	18	219.7	1758.9	14.29	110.00	21.74	50.55
	T33S106_D4	D4	2880	36	219.3	2174.3	6.25	65.22	6.58	27.78
36	T36S107_A1	A1	360	4.5	28.1	164.8	5.17	34.40	6.38	22.37
	T36S107_B1	B1	720	4.5	42.8	289.7	8.93	54.24	11.63	28.12
	T36S107_B1b	B1b	720	4.5	46.6	268.3	10.87	53.70	11.11	31.52
	T36S107_C1	C1	1440	4.5	85.0	511.7	11.39	76.87	15.00	41.67
37	T37S41_A2	A2	360	9	22.4	151.9	2.17	13.85	1.69	4.17
	T37S41_B2	B2	720	9	45.9	287.2	6.49	36.36	6.41	19.05
	T37S41_B2b	B2b	720	9	60.9	366.1	7.78	62.66	11.29	32.61
	T37S41_C2	C2	1440	9	95.0	655.1	10.87	66.67	11.49	26.09
	T37S41_C2b	C2b	1440	9	107.2	723.5	12.63	75.00	16.00	37.89
	T37S41_D2	D2	2880	9	152.4	1012.8	12.41	92.59	18.00	51.85
	T37S41_D2b	D2b	2880	9	155.2	1024.9	13.04	94.07	19.57	54.55
39	T39S24_A4	A4	360	36	25.4	332.2	0.77	10.00	0.68	2.78
	T39S24_A4b	A4b	360	36	26.8	320.8	0.79	8.70	0.71	3.16
	T39S24_B4	B4	720	36	53.0	664.4	1.48	18.18	1.43	5.97
	T39S24_C4	C4	1440	36	104.3	1228.3	2.93	35.16	2.79	12.37
	T39S24_D4	D4	2880	36	211.7	2200.6	6.10	61.22	6.25	25.00

2.3.5 Subtask 3.3: Repeated Cyclic Tests at 70°F, Compression Only, No Confining Pressure

Three specimens tested for pulse load tests were used for repeated cyclic tests. Fifty cycles of pulse shape C3 (1440 lb peak load and 18 millisecond rise time) were applied. Plots of the test results (load and displacement versus time) were saved in respective Excel files together with the raw data.

2.4 TASK 4: DATA ANALYSIS

During the project it was decided that Ohio University collects load test and laboratory data and FHWA analyzes the data and verifies the rutting model. The processed and cleaned data from the controlled load tests and laboratory tests were submitted to FHWA for analysis. Copies of the data on CD were also submitted to ODOT.

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