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16. Abstract

Three test lanes were constructed at the Louisiana Pavement Research Facility (PRF) to study the performance of Reclaimed Asphalt Pavement (RAP) as a stress relieving layer between the cement treated base and asphalt concrete layers in lieu of crushed stone. The first test lane consisted of a RAP base over ten inches of cement treated subgrade with five percent cement. The second test lane consisted of a RAP base over six inches of soil cement treated subgrade with ten percent cement. The third test lane (control section) consisted of a stone base over six inches of soil cement treated subgrade with ten percent cement.

A four inch perforated drain pipe system was also constructed in the embankment. This interim report documents the construction of the three test lanes, including the drainage system. Properties of the drainage system, base materials, and HMA used for this construction are included along with a detailed instrumentation plan. All sections were constructed utilizing current Louisiana Department of Transportation and Development (DOTD) standard specifications and special provisions.

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EVALUATION

OF

STONE/RAP INTERLAYERS

UNDER ACCELERATED LOADING,

CONSTRUCTION REPORT

Interim Report

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LTRC Report No. 352
Research Project No. 2000-1P

LOUISIANA TRANSPORTATION RESEARCH CENTER,
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
In Cooperation With
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

March 2001

ABSTRACT

Three test lanes were constructed at the Louisiana Pavement Research Facility (PRF) to study the performance of Reclaimed Asphalt Pavement (RAP) as a stress relieving layer between the cement treated base and asphalt concrete layers in lieu of crushed stone. The first test lane consisted of a RAP base over ten inches of cement treated subgrade with five percent cement. The second test lane consisted of a RAP base over six inches of cement stabilized subgrade with ten percent cement. The third test lane (control section) consisted of a stone base over six inches of cement stabilized subgrade with ten percent cement.

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INTRODUCTION

In the first experiment under accelerated loading on evaluation of Louisiana's conventional and alternative base courses, it was realized that pavement performance could be enhanced significantly if a layer of stone was placed over the cement stabilized subgrade and below the flexible HMAC layer. The concept is referred to as "inverted pavement design." The increase in performance could be attributed to strengthening the area between the soil cement and the flexible layer and also providing a medium for moisture discharge. Although, it could not be effectively evaluated in an accelerated test, the stone interlayer should result in reduction of the reflective soil cement shrinkage cracking.

LADOTD is in possession of large quantities of Reclaimed Asphaltic Pavement (RAP) produced from various rehabilitation jobs throughout the state. It is estimated that the Department has over 258,000 cubic yards of RAP in stockpile with an annual accumulation of 468,000 cubic yards from implementation of the overlay program. This is equivalent to 50% of the total produced RAP. The other 50% is given as a cost reduction incentive to the contractors to be used in hot mix asphalt. At a cost of $15.00 per cubic yard, total utilization of this material in construction of inverted pavements would save the state over $7 million annually in addition to improving the life expectancy of roadway pavements.

This study was proposed to answer several concerns regarding cost savings as well as pavement performance. The potential of improved pavement life using the RAP base materials in lieu of the stone base needs to be investigated.

The performance of the RAP base materials in the inverted pavement design will be compared to that of the stone in the inverted pavement design. Additionally, a thicker treated subgrade section with reduced cement (5%) will be compared to the thinner stabilized subgrade with standard cement (8%), both having the inverted RAP base materials.

This interim report documents the construction of the three test lanes to be tested as experiment number three at the Pavement Research Facility (PRF).

OBJECTIVE

The objective of this research is to evaluate the performance and determine the effectiveness of the RAP material as a base course layer in lieu of stone when used as a stress relieving layer.

SCOPE

The scope of this project is to evaluate the pavement performance until failure under accelerated loading of the three test lanes constructed at the PRF.

METHODOLOGY

Site layout and experiment design

Figures 1 and 2 illustrate the layout design and cross section respectively of each of the three test lanes constructed for this study. Lane 3-1 was designed for a 3½ inch RAP base over 10 inches of cement treated subgrade with five percent cement content. Lane 3-2 was designed for a 3½ inch RAP base over 6 inches of cement stabilized subgrade with ten percent cement content. Lane 3-3 was designed for a 3½ inch stone base over 6 inches of cement stabilized subgrade with ten percent cement content. In addition a select soil was used for grade adjustments within the selected test lanes.

A 2 inch asphalt concrete binder course and 1½ inch asphalt concrete wearing course was placed on top of each test lane. Also included in the design was a perforated drain pipe system located at the edge of each test lane. Each lane was constructed on an existing five foot type A-4 soil embankment.

The asphalt concrete mix designs were Type 8 with PAC-40 asphalt cement for both the binder course and wearing course layers. Louisiana Type 8 mixtures are designed for high speed, high volume pavements which require the use of modified asphalt.

The contract was awarded to F.G. Sullivan, Jr. Contracting (Sullivan) of Baton Rouge, Louisiana, for $198,190. Construction of the three test lanes began on July 23, 1999 and was completed October 1, 1999.

Normal construction practices were followed so the project would represent actual highway practices as closely as possible in accordance with the *Louisiana Standard Specifications for Roads and Bridges, 1992*. The contract specifications and special provisions are found in appendix A: Contract Specifications.

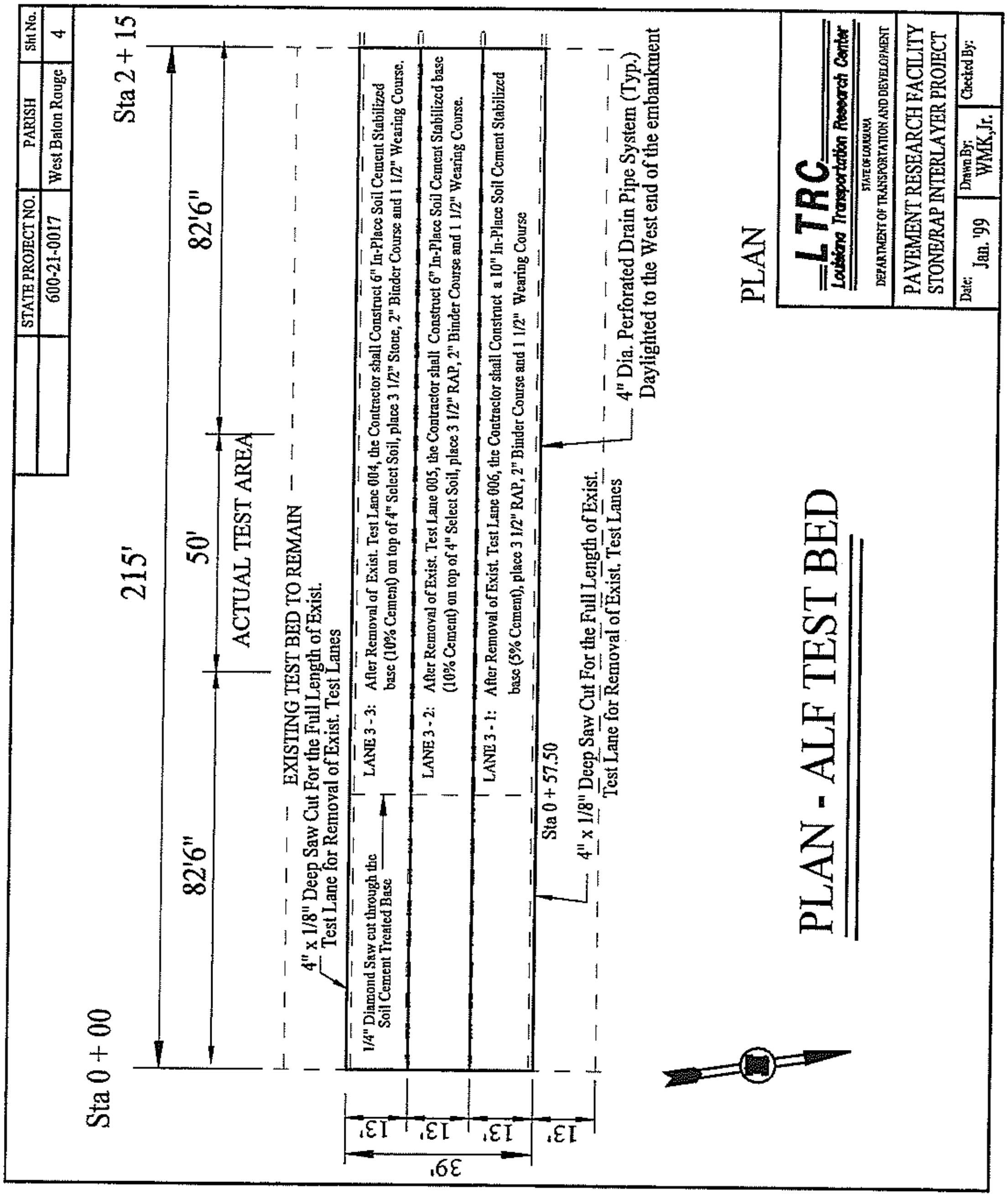


Figure 1

Test bed layout for experiment three test lanes.

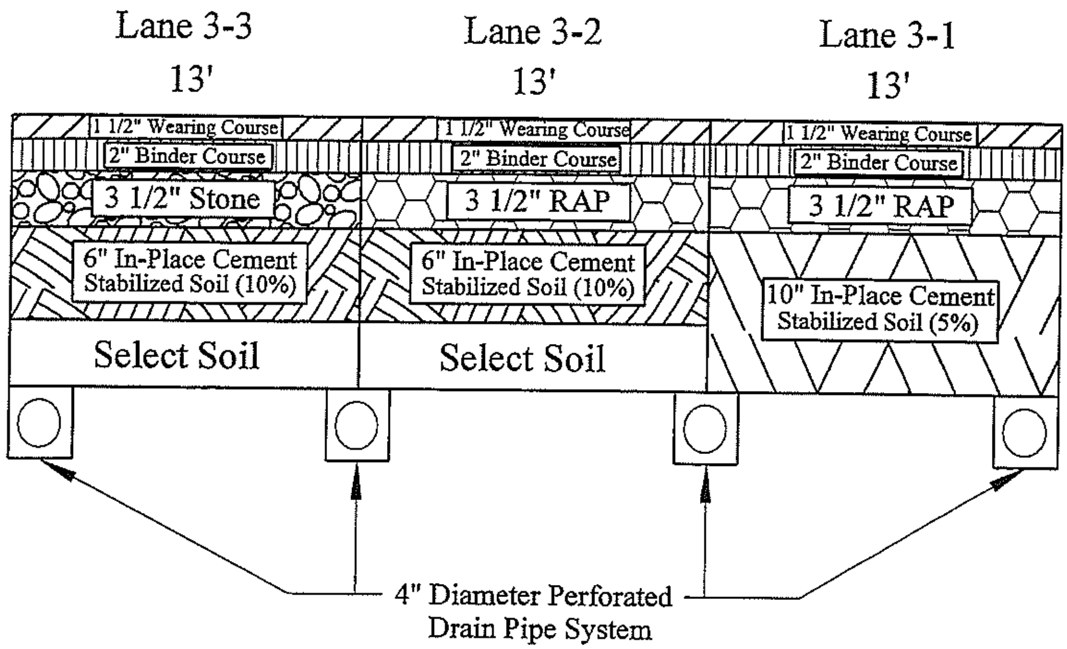


Figure 2
Section Through Test Lanes

Asphalt concrete materials and mix design

Asphalt cement. Eagle Asphalt, Inc. supplied the PAC-40 asphalt cement for the mix at a rate of four percent. A Permatac 99 liquid anti-strip agent was added to all of the asphalt cements at a rate of 0.8 percent by weight as determined by Louisiana TR 322-92, which is a modified ASTM T-283 procedure.

Mix Design. Typical Louisiana Marshall mix designs were required by the contract. LADOTD specifications allow the substitution of wearing course mixes for the binder course. The job mix design used for both the binder and wearing course in this project is detailed in Table 1. The ¾ inch nominal size mix design for both the binder and wearing course using the normally specified Louisiana asphalt cements was submitted by the contractor in August 1999.

Table 1
Job Mix Design

HMAC Mix Designs				
Aggregate		Type 8 Binder, %	Type 8 Wearing, %	Specific Gravity
Source	Type			
Vulcan Reed	No 67 LS	43.2	43.2	2.700
Vulcan Reed	No 78	17.3	17.3	2.697
Vulcan Reed	No 11	21.1	21.1	2.701
Quick Sand	c sand	14.4	14.4	2.654
Asphalt Liquid				
Binder	Type			
AntiStrip	Perm 99	0.8	0.8	
Eagle	PAC40	4.0	4.0	1.03
TOTAL % AC		4.0	4.0	

Gradation Required			
Sieve, mm	Sieve, in	Type 8 Binder	Type 8 Wearing
25.00	1	100	100
19.00	¾	91-100	91-100
12.50	½	78-89	78-89
9.50	⅜	62-74	62-74
4.75	No. 4	33-45	33-45
2.00	No. 10	20-31	20-31
0.43	No. 40	7-15	7-15
0.18	No. 80	1-9	1-9
0.075	No. 200	2.0-5.5	2.0-5.5

The No. 67 and No. 78 coarse aggregates and the No. 11 gradations were siliceous limestone supplied by Vulcan Materials Company, of Gilbertsville, Kentucky. The coarse, siliceous sand was supplied by Quick Sand and Gravel of Watson, Louisiana.

Construction

Embankment. Construction of the new test lanes began by removing three existing test lanes. An ALTEC RW18 vemeer type joint cutter was used to cut a joint along the edges of the test lanes to be removed. The contractor used a Roadtech RX-60 roto-milling machine to recycle the existing asphalt pavement. This RAP material was stockpiled on the remaining lanes just adjacent to the work area to be used for the newly constructed test lanes.

A Hitachi EX200-LC track hoe was then used to excavate the remaining material in the existing test lanes. The material was loaded in dump trucks and placed in the back of the DOTD property and graded smooth by the contractor.

The three existing test lanes were removed to the top of the existing embankment. A Case 850C dozer and Natalis 65-B motor grader was used to obtain a smooth level embankment surface. A Hyster C727A roller was used to compact the embankment surface. Nuclear Density values were obtained using a Troxler Nuclear device and are reported in Table 2.

Table 2
Nuclear Density Values
Existing Embankment

Lane No.	Station	Dry Weight Density	Wet Weight Density	Moisture Content, %	Density, % Proctor
3-1	0-75	112.7	129.3	14.7	103.9
	0-92.5	110.4	127.2	15.2	101.7
	1-57.5	109.5	126.5	15.6	100.9
Average Proctor					102.2
3-2	0-50	113.4	130.2	14.8	104.5
	0-92.5	107.9	126.0	16.9	99.4
	1-07.5	107.2	124.7	16.4	98.8
Average Proctor					100.9
3-3	0-75	110.7	126.6	14.3	102.1
	0-92.5	111.9	127.7	14.2	103.1
	1-57.5	107.0	124.2	16.0	98.6
Average Proctor					101.3
Average Proctor (All Lanes)					101.5

Perforated drain pipe system installation. The contractor began installing the 4 inch perforated drain pipe system by removing a 9 inch deep by 9 inch wide trench in the existing embankment with a Case 580 backhoe/front end loader as shown in figure 3. An approved geotextile fabric was placed along the sides and bottom to line the trench. The trench was then partially back-filled with an approved pea gravel as shown in figure 4. The 4 inch schedule 35 perforated PVC pipe was then placed and the remainder of the trench was back-filled with the

Table 3
Pea Gravel Gradation for Drainage System

Contractor		F.G. Sullivan		
Plant		AP 2		
Date		7/28/99		
Material		Pea Gravel		
Sieve Size	Weight,	% Passing	% Coarse	% Passing
1½"	0	0.00	0.00	100.00
1"	0	0.00	0.00	100.00
¾"	0	0.00	0.00	100.00
½"	0	0.00	0.00	100.00
⅜"	40.2	2.10	2.10	97.90
No. 4	1487.4	77.65	79.75	20.25
No. 8	347.7	18.15	99.90	2.10
No. 10	0	0.00	97.90	2.10
No. 16	27.8	1.45	99.35	0.65
No. 30	0	0.00	99.35	0.65
No. 40	0	0.00	99.35	0.65
No. 50	0	0.00	99.35	0.65
No. 80	0	0.00	99.35	0.65
No. 200	7.9	0.41	99.77	0.23
Pan	1.9			
Dec	2.6			
Total	1915.5	+ 4 Mat.	1527.6 lbs.	
Initial	1912.9	Cr. Mat.	0.0	
a/wash	1910.3	% Cr.	0.0	

same pea gravel. The fabric was draped over the top of the trench and secured using U-shaped spikes. Table 3 shows the gradation of the pea gravel. Prior to the construction of the subgrade, the PRF personnel began placing the pressure cell instrumentation on top of the embankment. The instrumentation plan and installation is discussed in detail in the Instrumentation section of this report.

Subbase construction. Construction of the new test lanes continued with the placing and compacting of a 10 inch lift of A-4 soil material in each test lane. A Case 850C dozer was used to spread the soil at the proper depth prior to compacting. A Bomag BW172 vibratory sheep-foot roller was used to compact the A-4 soil material. Final grade was achieved using a Natalis motor grader. A Hyster C530A pneumatic roller was used to achieve a smooth surface of the A-4 soil prior to placing the cement.

A total of 24.08 tons of Type I Portland cement was spread at the required rates over each test lane. Lane 3-1 received 122.2 pounds per linear foot for a total of 13.14 tons, and lanes 3-2 and 3-3 each received 50.91 pounds per linear foot for a total of 5.47 tons in each lane.

Figure 3
Perforated drain pipe system installation. Digging Trench.

Figure 4
Perforated drain pipe system installation. Installing Fabric and Backfill.

A Caterpillar SS 250 stabilizer was used to process the soil cement at the proper depths. Lane 3-1 was mixed at a depth of 10 inches and lanes 3-2 and 3-3 were mixed at a depth of six inches. Compaction was accomplished using the Bomag sheeps-foot roller followed by a Hyster steel roller.

Final grade was accomplished using a motor grader followed by the steel roller, and an MC-30 cutback asphalt prime coat was sprayed to seal the treated embankment at a rate of 0.10 gallons per square yard. Table 4 shows the nuclear density and moisture content results for the stabilized subbase using a Troxler Nuclear Density gauge.

Base. The crushed stone was back-dumped on lane 3-3 and spread with a Case 850C dozer to a depth of 3½ inches. Grading was accomplished using a Caterpillar motor grader, and compaction was achieved using a vibratory steel roller. Water was used to aid in the compaction effort and to achieve proper moisture content. The compaction effort was carefully monitored so that the same effort would be used to compact the RAP material. A rolling pattern was obtained by checking the density of the stone after each roll. It was determined that maximum density would be achieved after three passes of the steel roller (no vibration). The optimum density for the stone was 138.0 pounds per cubic feet at 7.1 percent moisture content as measured by the DOTD district laboratory, (lab report number 61-147667).

The RAP material was placed in dump trucks with a track hoe and then back-dumped on lanes 3-1 and 3-2. A Case 850C dozer was used to spread the RAP material to a 3½ inch depth. Due to the physical properties of the RAP material, compaction curves were not developed, therefore, a compaction effort similar to the stone was used. Nuclear density readings were obtained for the sole purpose of verifying the optimum compaction effort. The same optimum density and

Table 4
Nuclear Density Values
Cement Treated Subbase

Lane No.	Station	Dry Weight Density	Wet Weight Density	Moisture Content, %	Density, % Proctor
3-1	0+70	110.7	100.2	10.4	97.2
	0+92	110.3	-	12.2	95.3
	1+60	123.3	109.1	13.0	105.8
Average Proctor					99.4
3-2	0+52	106.3	95.9	10.8	93.1
	0+70	108.7	99.3	9.5	96.3
	1+12.5	110.4	99.1	11.4	96.1
Average Proctor					95.2
3-3	0+70	111.7	100.6	11.1	95.8
	0+92	117.2	103.1	13.7	98.2
	1+57.5	124.3	106.3	16.9	101.3
Average Proctor					98.4
Average Proctor (All Lanes)					97.6

moisture content of the stone was also used for the RAP material as input data for the nuclear density device, which is not a true representation of the RAP material. It was determined from the readings obtained that the same rolling pattern (three passes of the steel roller, no vibration) used for stone should be used for the RAP material.

The nuclear density and moisture content results of both the completed stone and RAP layers are reported in table 5. Once the subbase was accepted, the contractor sprayed an asphaltic cement prime coat. An MC-250 cutback asphalt was used to prime both the stone base and RAP base with a measured 0.25 gallons per square yard. The total material used was approximately 250 gallons covering 1000 square yards.

Table 5
Nuclear Density Values
Stone/RAP Base

Lane No.	Material	Station	Dry Weight Density	Wet Weight Density	Moisture Content, %	*Density, % Proctor
* 3-1	RAP	0+54	124.9	114.3	9.3	N/A
		1+07.5	116.7	107.8	8.3	N/A
		1+62	121.9	115.0	6.0	N/A
Average Proctor						N/A
* 3-2	RAP	0+54	114.8	104.4	10.0	N/A
		1+07.5	119.4	111.5	7.1	N/A
		1+62	117.8	107.6	9.5	N/A
Average Proctor						N/A
3-3	STONE	0+54	140.1	133.0	5.3	96.4
		1+07.5	144.1	137.7	4.6	99.8
		1+62	138.8	131.9	5.2	95.6
Average Proctor						97.3

* Proctor curves were not developed at the time of construction for the RAP material. The % Proctor measurements were recorded to determine rolling pattern, but not reported. These values can be found in the project file.

HMAC plant production

Plant mix summary. A summary of the plant Marshall results are shown in table 6 labeled Marshall Properties. All plant volumetrics were within specifications and the asphalt mix maintained 4 percent voids.

HMAC Lay down

Tack coat. An SS-1 asphalt emulsion as manufactured by Asphalt Products Unlimited was supplied which allowed a 50 percent dilution rate. Two hundred seventy-three gallons of emulsion material was placed between the binder and wearing course HMAC layers.

Table 6
Marshall Properties

TEST DESCRIPTION	*ASPHALT MIX DESCRIPTION		AGGREGATE GRADATION	
	Type 8 Binder P40	Type 8 Wearing P40	Sieve Size, in.	% Passing
Theo. Specific Gravity	2.529	2.529	1"	100
Specific Gravity	2.429	2.429	¾"	97
% Theo. Gravity	96.0	96.0	½"	82
% AC By Weight	4.0	4.0	⅜"	68
% AC By Volume	9.4	9.4	No. 4	44
% Voids Total Mix	4.0	4.0	No. 10	30
%VFA	71	71	No. 40	14
%VMA	13.4	13.4	No. 80	7
Density, Kg/m^3	2429	2429	No. 200	5
Stability, Kn	2323	2323		
Flow	12	12		
Corrected Stability, Kn	2408	2408		

* The mix was the same for both the binder and wearing course.

Equipment. Sullivan Contractor's double barrel counter flow Astec plant used four of the five cold feed bins into the outer shell of the drum for mixing. The mixture was stored in the silo while volumetric tests and gradations were evaluated. The laboratory at the plant site was fully equipped with a Marshall hammer and stabilometer, Troxler asphalt content oven, and all necessary scales and ovens to perform required tests, including gradation analysis, AC content, and specific gravity of the mixture. This plant, located on the north side of Highway 190 at the foot of the "Old" Mississippi River Bridge in Baton Rouge, is less than ten miles from the PRF site. At the PRF site, a Barber Green track paver was used to place the HMAC. The paver accepted trucks directly into its receiving hopper as insufficient distance was available in incorporate a Material Transfer Vehicle (MTV) as is required on all paving projects in Louisiana.

Compaction, setting the rolling pattern. In accordance with the specifications, the contractor was responsible for determining the rolling pattern for both the binder course and wearing course. After placement of the HMAC, an Ingersoll-Rand DD90 vibratory steel roller followed by a Bomag BW-12 rubber wheeled roller was used for compaction. The following rolling pattern was set by the contractor: four vibratory passes, one static steel pass, and three rubber roller passes.

Post construction testing. Two cores from each lane were obtained and sent the LADOTD district laboratory for analysis. Table 7 reports the measured densities and thicknesses obtained from the cores as reported by the district laboratory. An additional six cores per lane were obtained and measured by PRF personnel and are reported in Table 8. Also, elevations were taken at the centerline of each lane, every 10 feet and are also reported in Table 8 for comparison purposes.

Evaluation plan

A series of cores and beams were taken to further evaluate the in-place asphalt pavement at various locations outside the actual area to be loaded. The evaluation of these cores will be completed and reported by the LTRC materials characterization group. Dynaflect and Falling Weight Deflectometer (FWD) data were collected by the LTRC pavements research group after placement of each lift. The evaluation of all data will be reported in the final report.

Instrumentation and data acquisition system

The purpose of the instrumentation and data acquisition system is to measure actual stress and strains within the pavement structure as it relates to load response.

Each test lane was instrumented at various layer interfaces with strain measuring and pressure gauge devices. These measuring devices are connected to a data acquisition system.

Figure 5 shows the instrumentation plan layout with a description of each type of gauge used to collect the various types of data. Figures 6, 7, and 8 show the cross section locations of the gauges used in each test lane respectively.

Strain gauges. The TML model KM-100-HAS is an H-bar type strain gauge as shown in figure 9 and is used to measure horizontal strains at the various interfaces in the HMAC. This model is a full bridge, 350 ohm, strain gauge with a capacity of $\pm 5{,}000 \times 10^{-6}$. This gauge can also be wired for quarter bridge operation and for relative temperature measurement.

Table 7
Density and thickness of HMAC cores

Lane No.	Layer	Sample #	Specific Gravity	Density, #/Ft^3	Density, % of Theo.	Thickness, * in.
3-1	Binder	3	2.368	147.8	97.5 %	2.74
		4B	2.361	147.3	97.2 %	2.25
	Wearing	3A	2.338	145.9	96.3 %	2.03
		4A	2.315	144.5	95.3 %	2.00
3-2	Binder	2	2.327	145.2	95.8 %	1.99
		7B	2.367	147.7	97.5 %	1.92
	Wearing	2A	2.292	143.0	94.4 %	1.54
		7A	2.293	143.1	94.4 %	1.51
3-3	Binder	1	2.371	148.0	97.7 %	1.73
		8B	2.374	148.1	97.8 %	1.95
	Wearing	1A	2.360	147.3	97.2 %	1.92
		8A	2.341	146.1	96.4 %	1.66

* Average binder thickness = 2.1 in., and the average wearing thickness = 1.78 in.

Table 8
Average thickness by elevation vs HMAC cores

Type	Lane 3-1					Lane 3-2					Lane 3-3 (Control)				
	Elevations, in.		Core Thickness, in.			Elevations, in.		Core Thickness, in.			Elevations, in.		Core Thickness, in.		
	*Ave	*Std	Ave	Std	# of Cores	*Ave	*Std	Ave	Std	# of Cores	*Ave	*Std	Ave	Std	# of Cores
Wearing Course	1.29	.27	1.90	.16	8	1.67	.43	1.36	.14	8	1.48	.49	1.75	.20	8
Binder Course	2.02	.24	1.93	.22	8	1.62	.32	2.15	.39	8	1.95	.27	2.11	.32	8
Total	3.31	.46	3.84	.28		3.29	.57	3.51	.43		3.43	.65	3.86	.47	

* Each average elevation was based on six measurements evenly spaced along the test section.

Pressure cells. The Geokon model 3500 earth pressure cell is designed to measure total pressure in earth fills and embankments as well as in other structures. The pressure cell has a range of up to 100 psi. It has a 350 ohm resistance strain gauge type with a 10 volt DC maximum excitation. The pressure cell consists of two, 9 inch diameter, stainless steel plates welded contiguously around their periphery and separated by a narrow cavity filled with an anti-freeze or mercury solution. A high pressure stainless steel tube connects to the plates with a pressure transducer placed in the cavity. External pressures acting on the cell are balanced by an equal pressure induced in the internal fluid. This pressure is converted by the pressure transducer into an electrical signal, which is transmitted by a four conductor shielded cable to a readout location. The entire device weighs approximately five pounds. Figure 10 is a photograph of the gauge.

Data acquisition system. The data acquisition system used is the Megadac 3415A, and data is collected at a rate between 100 and 500 samples per second. It has up to 512 channels and 64 megabytes of internal non-volatile onboard memory. The signal conditioning provides for quarter, half and full bridge operation, programmable gain up to 4000, eight pole Butterworth filtering, auto balance, auto zero, and voltage calibration. All of these functions are computer controlled.

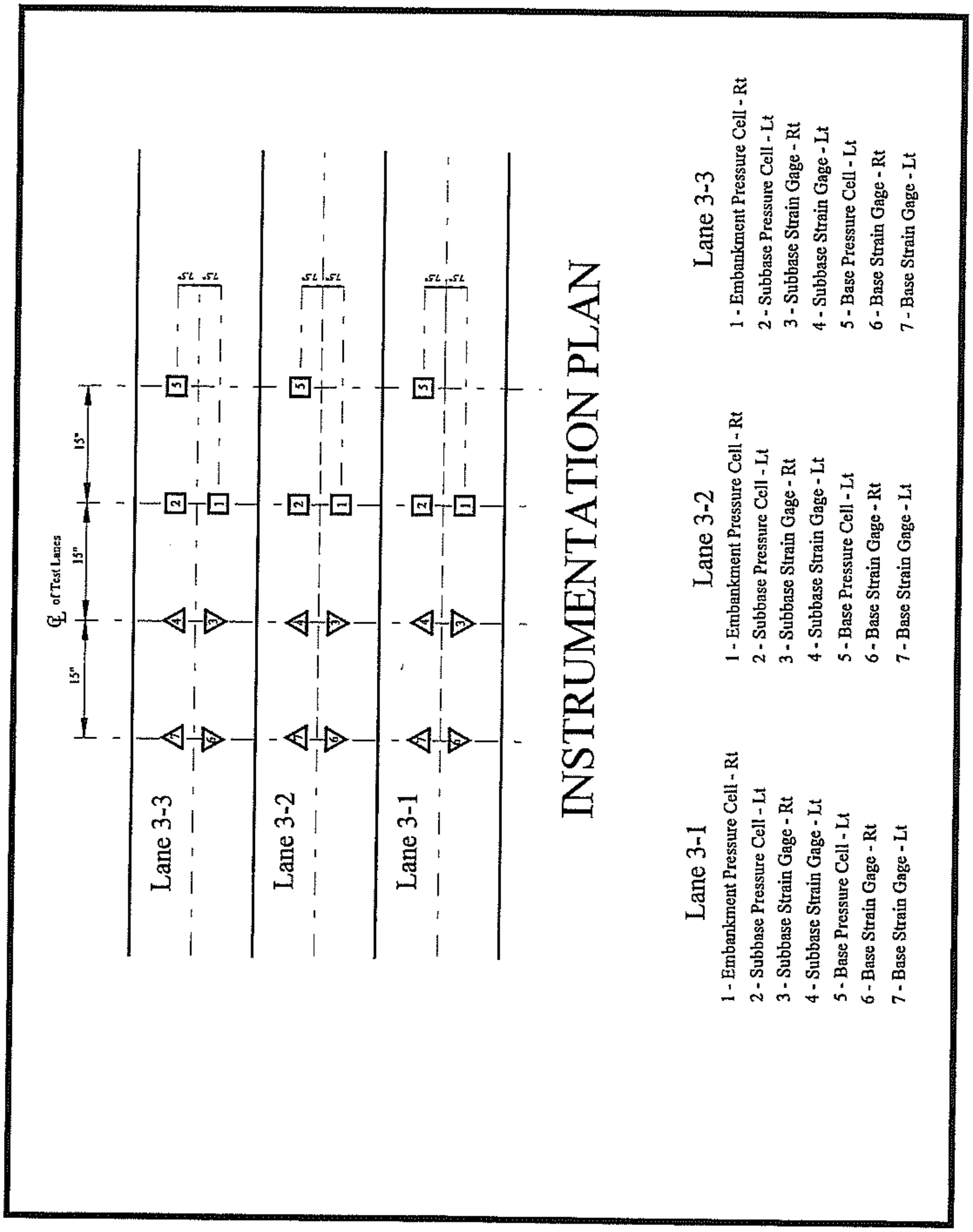


Figure 5.
Instrumentation plan layout

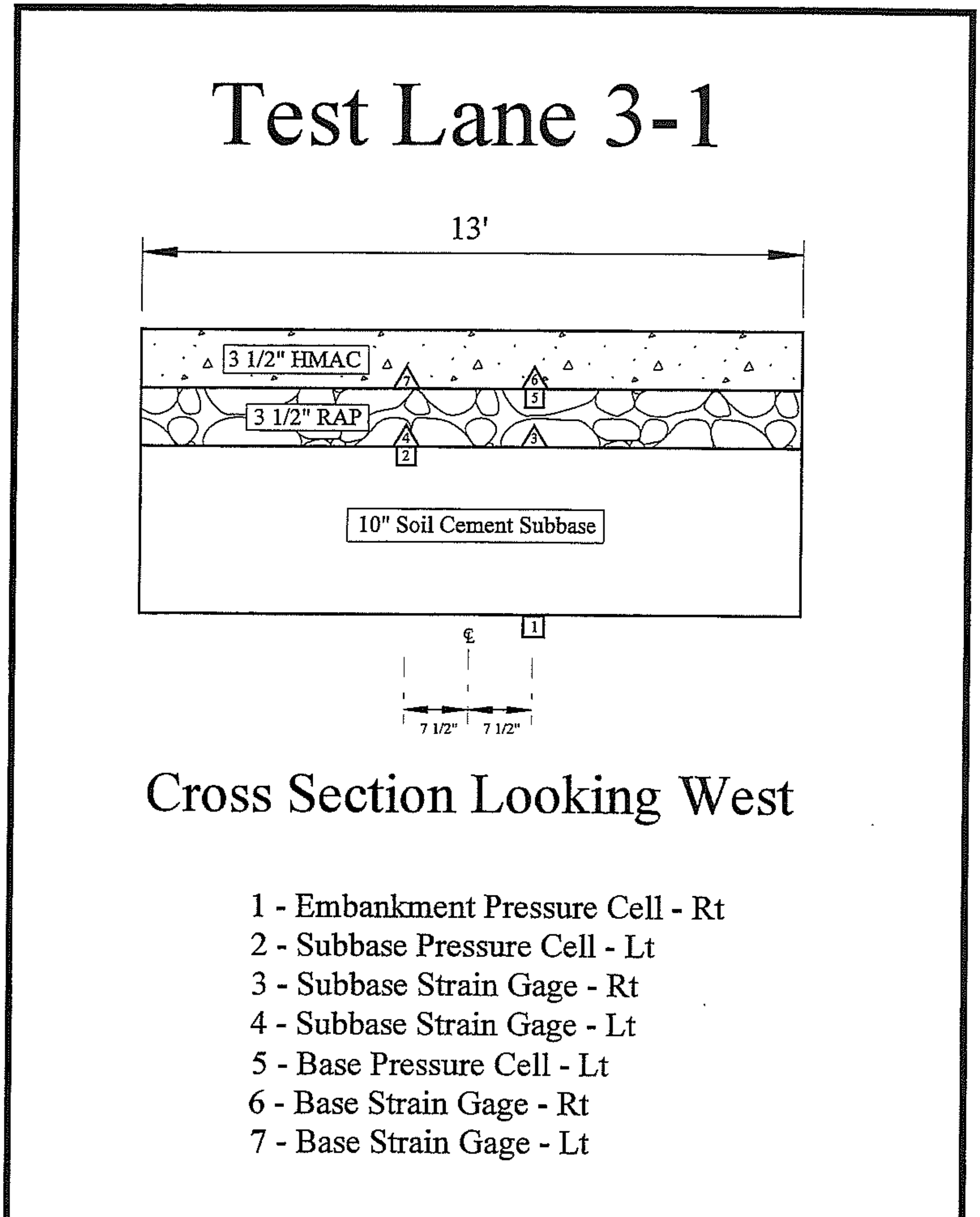
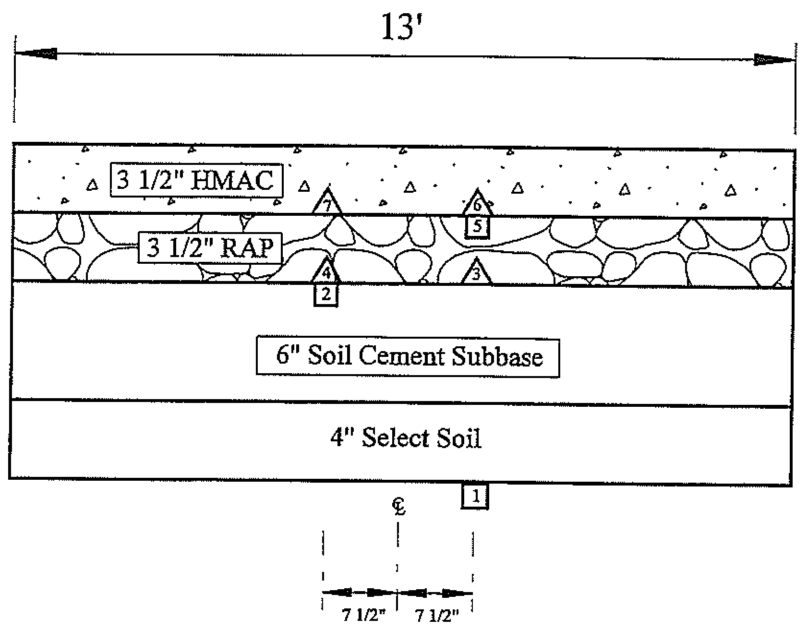


Figure 6.
Instrumentation cross section, lane 3-1.

Test Lane 3-2



Cross Section Looking West

1 - Embankment Pressure Cell - Rt
2 - Subbase Pressure Cell - Lt
3 - Subbase Strain Gage - Rt
4 - Subbase Strain Gage - Lt
5 - Base Pressure Cell - Lt
6 - Base Strain Gage - Rt
7 - Base Strain Gage - Lt

Figure 7.
Instrumentation cross section, lane 3-2.

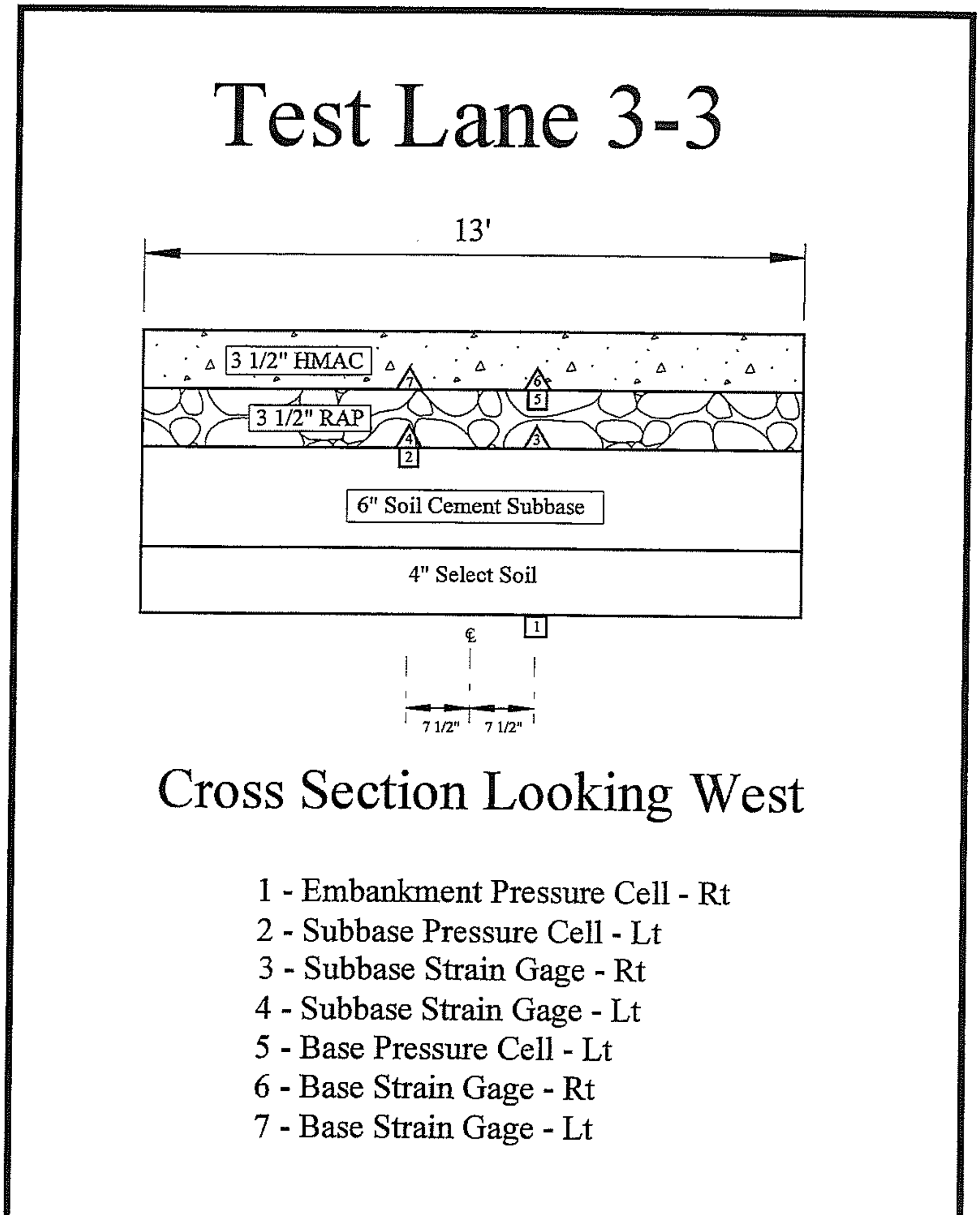


Figure 8.
Instrumentation cross section, lane 3-3.

Figure 9.
TML H-Bar (KM-100-HAS) gauge.

Figure 10.
Geokon pressure cell.

The software which controls the Megadac is Optim's TCS95. TCS is used like a workbook, where all information about the test's definition is stored in a unique TCS test file. Within the test's definition, there are worksheets describing the requirements such as recording rates, sensor definitions and channel assignments to perform a data acquisition application.

Weather data acquisition. A Campbell Scientific Weather Station is located at the northeast corner of the test bed to acquire weather data. The weather station is equipped with a CR10 data logger measurement and control module and utilizes PC208 operating software to collect the data. The weather station updates itself every 10 seconds, records the data every hour, and has the following capabilities to record: (1) temperature measurements from CS model HMP35C probes, (2) relative humidity measurements (maximum and minimums) from CS model HMP35C probes, (3) wind direction and speeds using Young's model 5103-5/5305-5, (4) solar watts per meter squared, (5) barometric pressure measurements (maximum, minimum, and average) using a model PTA427 probe, and (6) rain fall and intensity every hour using a CS model TE525 tipping bucket rain gauge.

The system is currently using eight temperature thermocouples to measure temperature at various levels in the pavement, however, it has the capability of using 30 temperature thermocouples.

LIST OF ACRONYMS

ALF - Accelerated Loading Facility
DOT - Department of Transportation
Gb - Specific Gravity of Asphalt
Gmm - Maximum Specific Gravity, asphalt mixture
Gmb - Bulk Specific Gravity, asphalt mixture
Gsb agg - Bulk Specific Gravity, aggregates
Gse - Effective specific gravity, aggregate
GSI - Gyratory Shear Index
GTM - Gyratory Testing Machine
HMAC - Hot Mix Asphaltic Concrete
LADOTD - Louisiana Department of Transportation and Development
LTRC - Louisiana Transportation Research Facility
LVDT - Linear Variable Differential Transformers
MTV - Materials Transfer Vehicle
Pabsorb - Asphlat absorpbed
Pbe - Effective asphalt content
PRF - Pavement Research Facility
STD - Standard Deviation
VFA - Voids filled with Asphalt
VMA - Voids in Mineral Aggregate

Appendix "A"

4" Perforated Drain Pipe System Specifications