Appendix A

Summary and Evaluation

of

Rubblized Pavement Test Results

at the

Federal Aviation Administration National Airport Test Facility

October 2006

Part of the Final Report for
AAPTP Project 04-01
Development of Guidelines for Rubblization
November 15, 2007

TABLE OF CONTENTS

Sections

Sections

Sections

Sections

Appendices

A.1 In-Situ CBR Test Results CC-2

A.2 PSPA Test Results

A.3 Traffic History

A.4 Profile Plots

A.5 Post-Traffic Subgrade CBR Test Results

SECTION 1.0

INTRODUCTION

SECTION 1.0 INTRODUCTION

Task 7 of AAPTP Project 04-01 requires a separate report on the results of Federal Aviation Administration (FAA) testing of rubblized concrete pavement test items at the FAA's National Airport Pavement Test Facility (NAPTF) in Atlantic City, NJ. The primary purpose of this report is to summarize the NAPTF results in order to provide support for development of material characterization and thickness design requirements for airport pavements incorporating rubblized concrete. This report, included as Appendix A of the project report, summarizes:

- Test item construction;
- Full scale test results; and
- Materials and heavy falling weight deflectometer (HWD) testing conducted by the FAA.

The FAA's NAPTF is located at the FAA William J. Hughes Technical Center, Atlantic City International Airport, New Jersey. The primary purpose of the NAPTF is to generate full-scale pavement response and performance data for development and verification of airport pavement design criteria. NAPTF construction was a joint venture between the FAA and the Boeing Company and became operational on April 12, 1999. The facility consists of a 900 ft. long by 60 ft. wide test pavement area, embedded pavement instrumentation and data acquisition system, and a test vehicle for loading the test pavement with up to twelve aircraft tires at wheel loads of up to 75,000 lbs.

Pavement test items can be constructed on low, medium, and high strength subgrades, with nominal California Bearing Ratio (CBR) of 3-4%, 6-8%, and 25+%, respectively. The rubblized concrete test items were constructed on the medium strength subgrade soils.

This report is organized to provide information and results on:

- Construction of the rubblized test items;
- Full scale loading history;
- Rut depth progression measurements;
- HWD test data and back-calculations;
- Post trafficking test results; and
- Performance predictions.

SECTION 2.0

CONSTRUCTION CYCLE 2 PAVEMENTS

SECTION 2.0 CONSTRUCTION CYCLE 2 PAVEMENTS

The rubblized test items incorporated the Construction Cycle 2 (CC-2) concrete construction test items after the concrete pavements were loaded to failure. CC-2 consisted of three concrete pavement test items constructed on the medium strength subgrade. All three items had 12-inch Portland cement concrete (PCC) slabs which were constructed on:

- grade and designated as MRG;
- 10-inch P-154 subbase and designated as MRC; and
- 6-inch P-154 on 6-inch econcrete (P-306) stabilized base and designated as MRS.

The subgrade CBR for the three items generally ranged between 7% to 8%. The concrete mix design was developed to yield a target flexural strength of 750 psi or less. With the high quality local aggregate and cements, the flexural strength could only be met with 500 lbs. of cementitious material, 50% of which consisted of Type C flyash.

CC-2 construction was completed in April 2004, at which time full scale loading began. Full scale loading continued with 6-wheel (3D), 55,000 lbs. loading on the north side of the test items and 4-wheel (2D), 55,000 lbs. loading on the south side. Loading continued until December 2004, when the measured Structural Condition Index (SCI) was essentially zero. Varying numbers of full scale load repetitions were applied to the north (2D) and south (3D) traffic lanes on each test item. Detailed crack maps, loading history, and materials characterization data for CC-2 construction and trafficking can be found in (1).

SECTION 3.0

RUBBLIZATION CONSTRUCTION

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3.1 RUBBLIZATION

In January 2005, all of the 12-inch concrete slabs in the north CC-2 traffic lane, including transition slabs, were rubblized with an RMI RB-500 resonant breaker operating at 44 Hz from Hayhoe and Garg (2). The rubblized pavements were compacted with a steel wheel vibratory roller in June 2005. The south CC-2 traffic lane was not rubblized and both the north and south lanes were overlaid with 5-inches of P-401 hot mix asphalt (HMA) placed in two, 2.5-inch lifts. This allowed for observation of the comparative performance of the asphalt overlaid rubblized and non-rubblized concrete pavements during later trafficking. In this report, asphalt on rubblized concrete sections are referred to as ARC, while asphalt on non-rubblized concrete sections are referred to as APC. Figure 1, “RMI Resonant Breaker” and Figure 2, “Steel Wheel Vibratory Roller” depict the rubblizing and compaction equipment, respectively, that were used for the construction. A schematic of rubblized and non-rubblized test items is depicted in Figure 3, “Layout of Test Items at the NAPTF”.

RMI Resonant Breaker

FIGURE 1

Steel Wheel Vibratory Roller

FIGURE 2

Layout of Test Items at the NAPTF

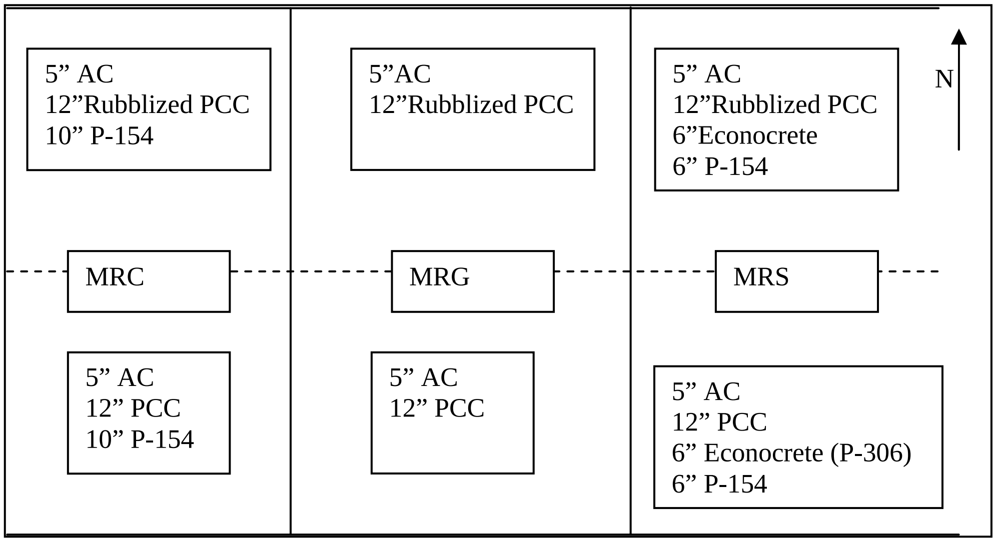


FIGURE 3

3.2 TEST PITS

After the test items were rubblized, 4-ft. by 4-ft. test pits were cut in each test item to observe the rubblized concrete and to access subgrade and base layers for testing. Photos depicting fracture patterns and particle sizes of the rubblized concrete on MRC, MRG, and MRS are depicted in Figure 4, “Rubblized Pieces in MRC”, Figure 5, “Rubblized Pieces in MRG”, and Figure 6, “Rubblized Pieces in MRS”, respectively. Figure 7, “Surface of Rubblized Pavement in MRS” depicts the typical condition of the pavement surface after rubblizing and compaction. The test pits indicated that the top 2 inches to 3 inches of the rubblized concrete was rubblized to particle sizes of 1-inch to dust. The particle sizes in the bottom 9 inches generally ranged from 4 inches to 15 inches with the larger particle sizes in the MRS section.

Rubblized Pieces in MRC

FIGURE 4

Rubblized Pieces in MRG

FIGURE 5

Rubblized Pieces in MRS

FIGURE 6

Surface of Rubblized Pavement in MRS

FIGURE 7

Figures 4-7 provided by Hayhoe and Garg

3.3 PRE-LOADING TESTS

Prior to beginning full scale traffic testing, materials characterization tests consisting of plate load, Portable Seismic Pavement Analyzer (PSPA) and CBR testing were performed. The plate load and CBR tests were performed during CC-2 construction in 2003-2004. These tests were repeated in 2005 after completion of the traffic tests (see Section 7.0). The PSPA tests were conducted after construction of the asphalt overlay and prior to beginning traffic tests. HWD tests were also performed prior to loading, as discussed in Section 6.0.

3.3.1 Plate Load Test Plate load tests were performed on subgrade and subbase (P-154 and P-306) layers for the CC-2 test items in 2004 and summarized in Table 1, "Plate Load Tests – CC-2 Construction".

Plate Load Tests – CC-2 Construction

TEST ITEM	LAYER TESTED	*k* (psi / in.) NORTH LANES	*k* (psi / in.) SOUTH LANES
MRC	Subgrade Top	132	130
	P-154 Top	159	149
MRG	Subgrade Top	149	133
MRS	Top of Econocrete	532	479

TABLE 1

As shown, MRG subgrade offered stiffer support than MRC. The impact of the stiffer subgrade on the relative performance of the test items will be discussed later.

3.3.2 CBR Tests CBR tests were performed on various lifts during the reconstruction of CC-2 subgrade after the original CC-1 test cycle in 2003. The lift by lift tabulation of CBR test results is included in Appendix A.1. As shown in the Appendix, the top layer of MRC subgrade had a lower average CBR then the top layer of MRG subgrade. This was believed to be the result of water "drain down" from the P-154 subbase layer.

3.3.3 PSPA Tests PSPA tests were performed on the 5-inch HMA overlay on rubblized and non-rubblized test items. PSPA test results are summarized in Appendix A.2. As shown, for the asphalt overlay on the rubblized items, PSPA indicated that the average modulus of the HMA layer was 645,000 psi, with a coefficient of variation of 6%. During the traffic testing, asphalt temperatures were measured and found to vary between 66°F and 85°F, with an average of 78°F.

SECTION 4.0

LOADING HISTORY

SECTION 4.0 LOADING HISTORY

Upon completion of construction, i.e., placement of the 5-inch asphalt overlay, traffic testing began in July 2005, on the ARC and APC sections. The purpose of the traffic testing was to load the test item pavements to failure to obtain data to support development of thickness design procedures for rubblized pavement. As discussed in the main body of the report and FAA Engineering Brief (EB) 66, asphalt overlaid rubblized pavement is treated as a flexible pavement for design. Therefore, FAA's definition of failure for flexible pavement, i.e., 1-inch upheaval in the subgrade (shear failure), would govern.

Trafficking began on July 7, 2005, with a four wheel, dual tandem (2D) configuration applied to both north (rubblized items) and south (non-rubblized items) traffic lanes. The same 2D spacing as used for previous traffic tests at the NAPTF was used for the rubblization traffic tests. This 2D wheel geometry consisted of 54-inch dual spacing and 57-inch tandem spacing. The wheel loads were initially set at 55,000 lbs. based on preliminary layered elastic computations of structural life, which was expected to vary between the test items. The standard NAPTF 66 repetitions per cycle wander pattern was used on both the north and south traffic lanes.

After a total of 5,082 load repetitions, very little rutting (approximately ¼-inch) was observed in the test items, with very little difference in measured rutting between the ARC and APC sections observed. That is, the performance of both the ARC and APC test items was essentially the same. Therefore, the FAA decided to increase the wheel loads for the rubblized (north) test item trafficking to 65,000 lbs. and add another dual wheel loading model, resulting in tridem (3D) loading for those test items, i.e., six, 65,000 lbs. wheel loads. The wheel loads on the south (non-rubblized) sections were also increased to 65,000 lbs. while retaining the dual tandem (2D) geometry for trafficking those items. The schedule used for trafficking is summarized in Table 2, “Trafficking Schedule for Rubblized Test Items” from Hayhoe and Garg (2). A more complete trafficking schedule is contained in Appendix A.3.

Trafficking Schedule for Rubblized Test Items

Dates (from-to)	Repetitions (from-to)	Test Items Trafficked	Load on North Lane*	Load on South Lane*
07/07/05 07/25/05	1 5,082	MRG-N, MRC-N, MRS-N MRG-S, MRC-S, MRS-S	4-Wheel, 55,000 lbs.	4-Wheel, 55,000 lbs.
07/26/05 08/12/05	5,083 11,814	MRG-N, MRC-N, MRS-N MRG-S, MRC-S, MRS-S	6-Wheel, 65,000 lbs.	4-Wheel, 65,000 lbs.
08/15/05 08/18/05	11,814 14,256	MRG-N, MRC-NW, MRS-N MRG-S, MRC-S, MRS-S	6-Wheel, 65,000 lbs.	4-Wheel, 65,000 lbs.
08/19/05 08/24/05	14,257 16,302	MRG-N, MRS-N MRG-S, MRC-S, MRS-S	6-Wheel, 65,000 lbs.	4-Wheel, 65,000 lbs.
09/13/05 10/06/05	16,303 25,608	MRG-N, MRS-N MRG-S, MRS-S	6-Wheel, 65,000 lbs.	4-Wheel, 65,000 lbs.

* Cold, unloaded tire pressures: 220 psi at 55,000 lbs. and 360 psi at 65,000 lbs.

TABLE 2

SECTION 5.0

RUT DEPTH PROGRESSION

SECTION 5.0 RUT DEPTH PROGRESSION

During the trafficking of the test items, rut depths were measured at periodic intervals (see Appendix A.3.) with a 16 ft. straight-edge and from profile measurements. Rut depth and profile measurements were made at two longitudinal locations at third point intervals on each of the north (ARC) and south (APC) test items. The locations were designated as NW and NE for the ARC (north) test items and SW and SE for the APC (south) test items. The rut depth measurements for each of the rubblized and non-rubblized test items for MRC, MRG, and MRS are depicted in Figure 8, “Straightedge Rut Depth Measurements in MRC”, Figure 9, “Straightedge Rut Depth Measurements in MRG”, and Figure 10, “Straightedge Rut Depth Measurements in MRS”, respectively. Due to upheavals at the longitudinal joints, rut depths were computed from profile measurements on rubblized test items after approximately 10,000, 13,000, and 15,000 passes for MRC, MRG, and MRS items, respectively.

These figures depict the comparative performance of the rubblized (NW, NE) and non-rubblized (SW, SE) for each test item. As shown, the performance of the rubblized and non-rubblized test items were equivalent for the 55,000 lbs. 2D loading. However, the performance of the rubblized and non-rubblized test items diverged after the 65,000 lbs. 3D loading was applied to the ARC items and 65,000 lbs. 2D loading was applied to the APC items.

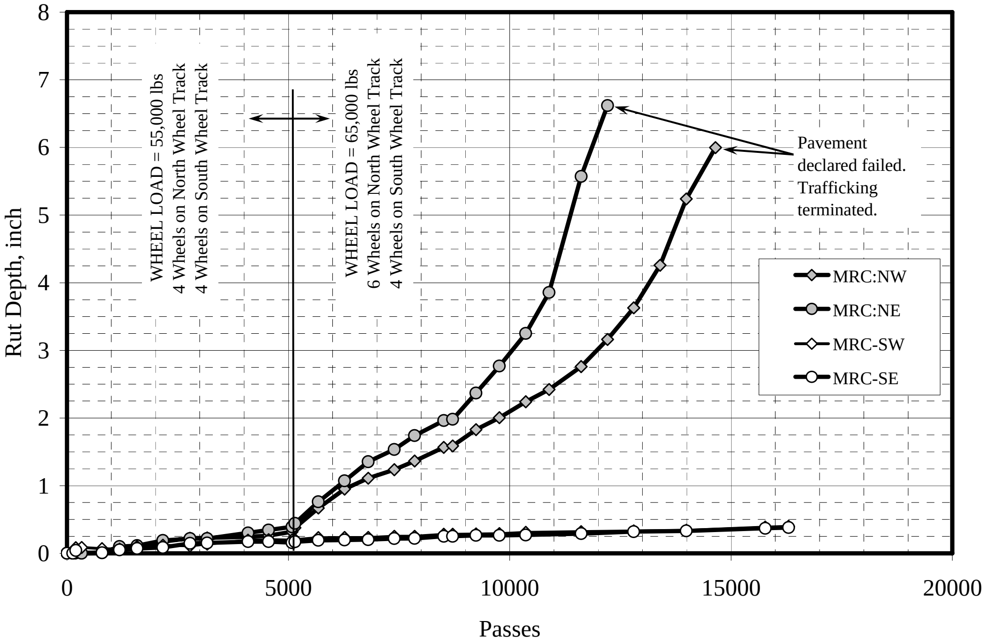


FIGURE 8

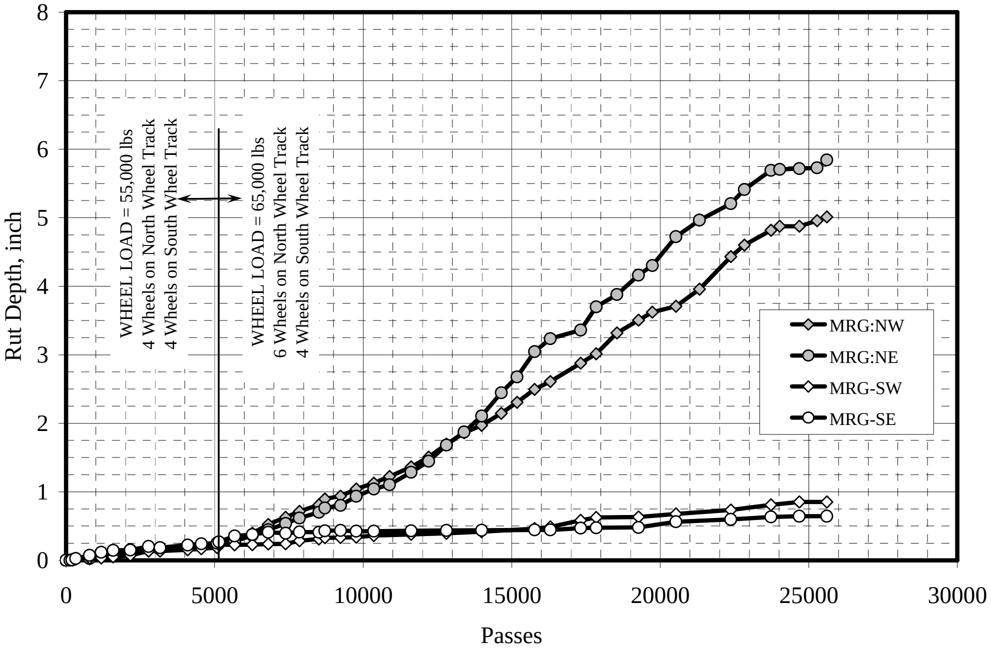


FIGURE 9

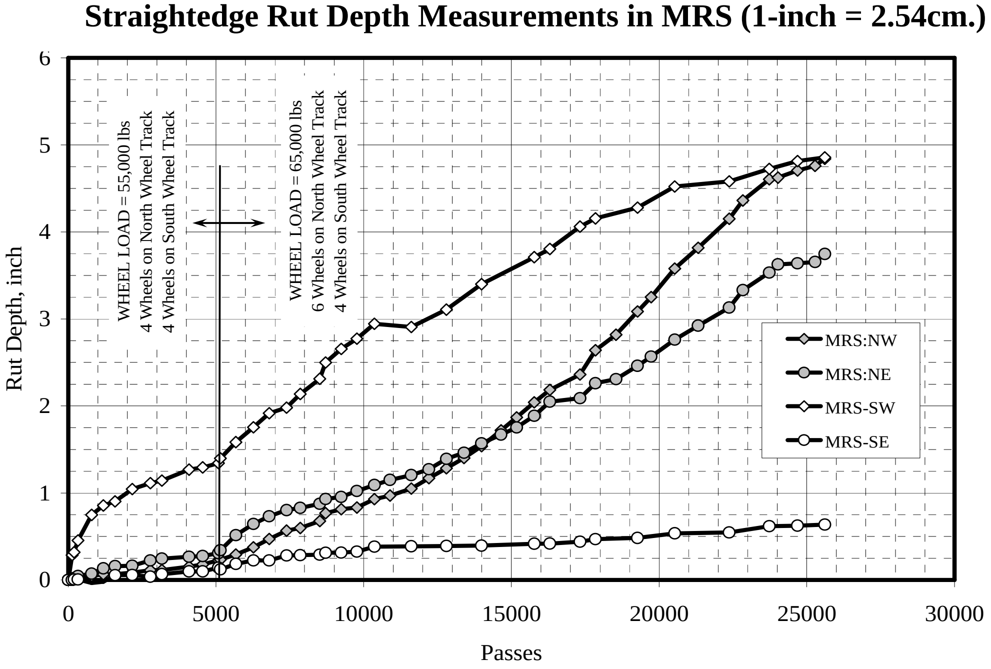


FIGURE 10

A comparison of the relative performance of the three rubblized (ARC) test items is shown in Figure 11, “Comparative Performance of Rubblized Test Items”. As shown, rut accumulation was highest for the MRC rubblized test item, followed by the MRG and MRS items, respectively. As discussed later, the relatively poor performance of the thicker MRC test item as compared to the thinner MRG test item is believed to be due to differences in subgrade strength. (see Section 3.0 and Section 7.0).

Profile plots across the width of the test items can be found in Appendix A.4. The plots also show the progressive accumulation of rutting with increasing load repetitions.

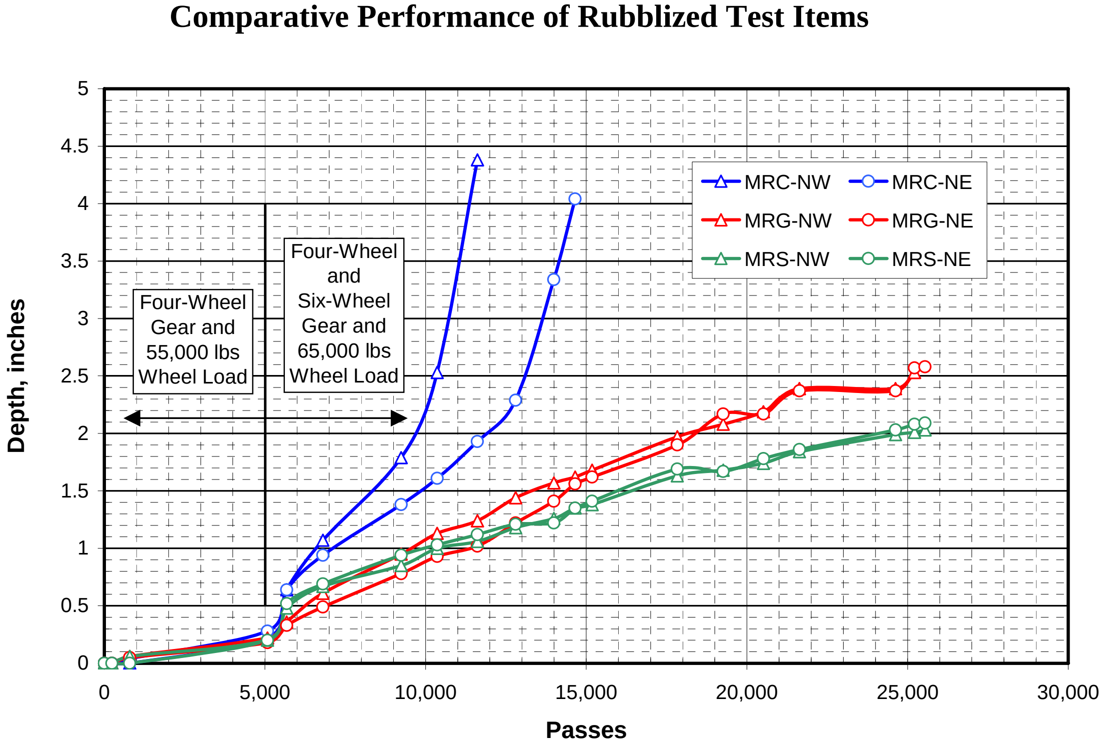


FIGURE 11

In reviewing Figures 8 through 11 and Appendix A.4 one may be concerned with the rather large rut depths depicted in the figures. To understand this, one must first understand the FAA and military definition of failure for flexible pavements, which is shear failure in the subgrade, assumed to occur with a 1-inch upheaval in subgrade from loading. This was also the definition used for the multi-wheel heavy gear load (MWHGL) and prior tests conducted by the military in the 1940s, 1950s, and 1960s, which are the basis for the current FAA and military flexible design criteria. Therefore, it is often necessary to incur large surface ruts to ensure invoking the subgrade shear failure criteria.

SECTION 6.0

HWD TESTING

SECTION 6.0 HWD TESTING

6.1 HWD EQUIPMENT AND TEST METHOD

Prior to trafficking and at periodic intervals during trafficking HWD tests were performed with the FAA's KUAB HWD, which is depicted in Figure 12, "FAA's KUAB HWD". Tests were performed with the equipment's 12-inch diameter segmented load plate at nominal force amplitudes of 12,000 lbs., 24,000 lbs., and 36,000 lbs., and pavement responses measured at 12-inch offsets from the center of the load plate out to 72 inches. The load response data at each test location represent the deflection basin, which can be used with either closed–form or layered elastic back-calculation procedures to compute the elastic moduli of pavement and subgrade layers. For this study, the elastic modulus of the rubblized layer (E_r) was of primary interest, since E_r would be an input to a mechanistic design procedure, such as FAA's LEDFAA layered elastic design program.

FAA's KUAB HWD

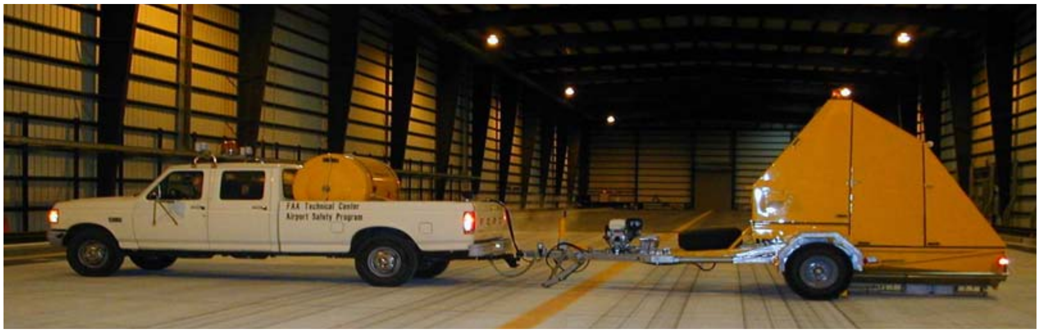


FIGURE 12

HWD tests were performed on both rubblized (ARC) and non-rubblized (APC) pavements. The tests on the APC test items were used primarily to back-calculate the pre-rubblized modulus of the PCC slab. On both the north (ARC) and south (APC) sides, HWD tests were performed at several offsets from centerline. Initial, pre-traffic HWD tests were performed at 5-ft, 12.25-ft., 15-ft., and 25-ft. offset north and south of the centerline demarcation between the ARC and APC pavements. During trafficking, HWD tests were consistently performed at the 5-ft. and 15-ft. offsets on each side of the centerline.

In the HWD data files, a minus (-) offset represents tests on rubblized pavements on the north side rubblized pavements, while a positive offset represents tests on non-rubblized pavements on the south side. During trafficking, the -5-ft. offsets had to be moved outward towards centerline (e.g. -3-ft.) to avoid the more severely rutted areas in the HMA surface that occurred from the loading.

It should also be noted that the original PCC slabs that were rubblized were constructed in a 15-ft. square joint pattern with dowelled transverse and longitudinal joints. Therefore, the 15-ft. offset HWD data on the APC and ARC sections were performed over a dowelled longitudinal joint. As discussed later, this could have had some influence on the HWD test data.

6.2 BACK-CALCULATION METHODS

Procedure for back-calculating of pavement and subgrade moduli from HWD deflection basin data are described in numerous sources including FAA Advisory Circular 150/5370-11A (3). For the ARC pavements, layered elastic back-calculation methods were used, and both layered elastic and closed-form solutions used for APC pavements.

Briefly, the closed-form method for rigid and APC pavements involves computing the normalized area (AREA) under the deflection basin to calculate the radius relative stiffness (ℓ). From ℓ, the elastic modulus of the concrete slab and modulus of subgrade reaction (*k)* can be readily computed. The layered elastic back-calculation method involves using layered elastic computations to compute pavement responses from the HWD load, i.e., the computed deflection basin, for varying combinations of pavement and subgrade moduli. The computed deflection basin is then compared to the measured deflection basin. When the two basins closely match, a set of pavement and subgrade moduli can be considered as a “solution” (actually one of many). Both the military’s WESDEF and the FAA’s BACKFAA programs were used for the layered elastic back-calculations. The computed moduli can then be used as inputs to a forward computational process to compute pavement responses and thicknesses.

In performing the layered elastic back-calculations, the depth to any underlying stiff, or apparently stiff, layer needs to be identified.

For the medium strength subgrade layers, the native subgrade was removed and replaced (with a clay CH) material to a depth of 10-ft. during construction of the NAPTF. Therefore, for the layered elastic back-calculations, a stiff layer ("hard bottom") was placed at 10-ft. below the surface based on the presence of the stiff native sandy soils.

It should be noted that for the MRC and the MRS test items, the back-calculated subgrade modulus is actually a "composite" modulus that includes the influence of both the granular P-154 subbase and the subgrade. The actual subgrade modulus for these test items, then, would be lower than the reported composite modulus.

In addition to the back-calculation of layer moduli, the HWD sensor data can be plotted to detect various properties of a pavement. For example, the center plate sensor (D_O) indicates the overall stiffness of the pavement/subgrade structure, while the outermost sensor (in the case of the FAA's HWD, D7) will indicate subgrade stiffness. A useful characteristic that indicates overall system stiffness is the Impulse Stiffness Modulus (ISM), defined as force amplitude divided by D_O. Any variation in force amplitude, then, is factored out, simplifying the evaluation. Both the closed-form and layered elastic back-calculation procedures as well as the ISM, are discussed in detail in Advisory Circular 150/5370-11A (3).

6.3 PRE-TRAFFIC BACK-CALCULATION RESULTS

The initial pre-traffic closed-form and layered elastic back-calculation results for the APC pavements in the south traffic lanes are summarized in Table 3, “Pre-Traffic Back-Calculation Results for APC Pavements at 36,000 lbs. Load”, for the 36,000 lbs. force data.

Pre-traffic Back-calculation Results for APC Pavements at 36,000 lbs. Load

tests conducted on 06/02/2005

AASHTO Closed-Form (AREA method)					Layered Elastic				
Average E (psi)					Average E (psi)				
Lane	Offset (ft.)	PCC	AC	Subgrade *k*(psi./in.)	Section	PCC	AC	Subgr	Subgrade *k*(psi./in.)
Lane-1	25	4,334,000	289,000	145	MRC	8,318,000	645,000	9,460	99
		3,289,000	219,300	182	MRG	6,534,000	645,000	12,170	120
		4,231,000	282,000	163	MRS	N/A			
Lane-2	15	1,794,000	119,600	170	MRC	2,513,000	645,000	11,350	114
		1,615,000	107,700	203	MRG	1,885,000	645,000	14,350	137
		1,897,000	126,500	206	MRS	1,264,000	645,000	12,650	124
Lane-3	5	2,958,000	197,200	178	MRC	5,945,000	645,000	11,590	116
		3,521,000	234,800	204	MRG	7,559,000	645,000	13,460	130
		4,024,000	268,300	206	MRS	N/A			
Lane-4	12.25	2,818,000	187,900	170	MRC	2,483,000	645,000	11,460	115
		2,514,000	167,600	206	MRG	1,661,000	645,000	14,570	138
		2,781,000	185,400	227	MRS	688,200	645,000	13,650	131

*$E=26k^{1.284}$

TABLE 3

Tables 4, “BackFAA MRC Summary for ARC Pavements”, Table 5, “BackFAA MRG Summary for ARC Pavements”, and Table 6, “BackFAA MRS Summary for ARC Pavements” tabulate results for the uniformity tests performed on MRC, MRG, and MRS rubblized pavement (ARC) test items, respectively, prior to trafficking. The ISM results for each test item indicate the uniformity of support within each item. Finally, a comparison of the average back-calculated rubblized and subgrade moduli from the 24,000 lbs. and 36,000 lbs. force data for each rubblized pavement test item and offset are summarized in Table 7, “Comparison of Pre-Traffic Back-Calculated Moduli”.

BackFAA MRC Summary for ARC Pavements

Sta	Off(ft.)	Load(lbs.)	ISM(*k*/in.)	E-rub(psi)	E-econ(psi)	E-sub(psi)
330	-5	24000	1459	234000		17624
340	-5	24000	1330	260000		14215
350	-5	24000	1469	359000		13622
360	-5	24000	1413	316000		14099
370	-5	24000	1251	221000		13592
380	-5	24000	1040	131530		13938
390	-5	24000	1201	218000		13281
AVG			1309	248504		14339
STD			156	73573		1484
COV			12%	30%		10%

Sta	Off	Load(lbs.)	ISM(*k*/in.)	E-rub(psi)	E-econ	E-sub(psi)
330	-15	24000	1328	223000		15338
340	-15	24000	1228	225000		13300
350	-15	24000	1339	305000		13096
360	-15	24000	1382	350000		12637
370	-15	24000	1294	267000		12891
380	-15	24000	1326	302000		12526
390	-15	24000	1478	413000		12809
AVG			1339	297857		13228
STD			77	68202		967
COV			6%	23%		7%

Sta	Off(ft.)	Load(lbs.)	ISM(*k*/in.)	E-rub(psi)	E-econ(psi)	E-sub(psi)
330	-5	36000	1515	259000		17925
340	-5	36000	1395	298000		14300
350	-5	36000	1530	407000		13700
360	-5	36000	1457	352000		14119
370	-5	36000	1308	251500		13823
380	-5	36000	1087	147000		14173
390	-5	36000	1245	243000		13351
AVG			1362	279643		14484
STD			160	83614		1551
COV			12%	30%		11%

Sta	Off	Load(lbs.)	ISM(*k*/in.)	E-rub(psi)	E-econ	E-sub(psi)
330	-15	36000	1356	229000		15820
340	-15	36000	1263	238000		13700
350	-15	36000	1386	334000		13280
360	-15	36000	1435	377000		12950
370	-15	36000	1350	302000		13023
380	-15	36000	1364	319000		12849
390	-15	36000	1512	444000		12959
AVG			1381	320429		130
STD			77%	75443		8
COV			6%	24%		6%

TABLE 4

BackFAA MRG Summary for ARC Pavements

Sta	Off(ft.)	Load(lbs.)	ISM(*k*/in.)	E-rub(psi)	E-econ(psi)	E-sub(psi)
430	-5	24000	1344	198000		17716
440	-5	24000	1495	302000		17400
450	-5	24000	1391	240000		17350
460	-5	24000	1690	449000		17201
470	-5	24000	1350	219000		17261
480	-5	24000	1518	305000		18062
490	-5	24000	2000	855000		17000
AVG			1541	366857		17427
STD			236	230771		355
COV			15%	63%		2%
430	-5	36000	1399	220000		17942
440	-5	36000	1543	333000		17400
450	-5	36000	1443	268000		17451
460	-5	36000	1738	492000		17267
470	-5	36000	1401	243000		17500
480	-5	36000	1560	330000		18251
490	-5	36000	2030	910000		17111
AVG			1588	339429		17560
STD			228	242358		398
COV			14%	61%		2%

Sta	Off	Load(lbs.)	ISM(*k*/in.)	E-rub(psi)	E-econ	E-sub(psi)
430	-15	24000	1795	488000		17435
440	-15	24000	1688	438000		16286
450	-15	24000	1825	595000		15744
460	-15	24000	1762	501000		16318
470	-15	24000	1691	448000		15993
480	-15	24000	1925	656000		16928
490	-15	24000	2112	964000		16511
AVG			1828	584286		16459
STD			149	185122		571
COV			8%	32%		3%
430	-15	36000	1832	513000		17648
440	-15	36000	1702	471000		16231
450	-15	36000	1857	624000		15960
460	-15	36000	1802	552000		16165
470	-15	36000	1722	478000		16068
480	-15	36000	1968	714000		16918
490	-15	36000	2152	1022000		16527
AVG			1862	624857		16502
STD			155	195247		599
COV			8%	31%		4%

TABLE 5

BackFAA MRS Summary for ARC Pavements

Sta	Off(ft.)	Load(lbs.)	ISM(*k*/in.)	E-rub(psi)	E-econ(psi)	E-sub(psi)
530	-5	24000	2137	313000	650000	15875
540	-5	24000	1896	269000	650000	12973
550	-5	24000	2032	306000	650000	13494
560	-5	24000	2125	416000	650000	12462
570	-5	24000	1839	247000	650000	12474
580	-5	24000	2016	349000	650000	12250
590	-5	24000	1760	201000	650000	12389
AVG			1972	300143		13131
STD			144	70277		1284
COV			7%	23%		10%
530	-5	36000	2193	339000	650000	16168
540	-5	36000	1962	299000	650000	13038
550	-5	36000	2066	378000	650000	12833
560	-5	36000	2130	423000	650000	12406
570	-5	36000	1875	272000	650000	12270
580	-5	36000	2041	358000	650000	12418
590	-5	36000	1783	211000	650000	12491
AVG			2007	325714		13089
STD			144	70917		1384
COV			7%	22%		11%

Sta	Off	Load(lbs.)	ISM(*k*/in.)	E-rub(psi)	E-econ	E-sub(psi)
530	-15	24000	2172	396000	400000	16632
540	-15	24000	1906	320000	400000	13439
550	-15	24000	2001	384000	400000	13576
560	-15	24000	1751	242000	400000	12688
570	-15	24000	1149		400000	
580	-15	24000	1832	279000	400000	13001
590	-15	24000	1872	297000	400000	13172
AVG			1812	319667		13751
STD			322	60275		1446
COV			18%	19%		11%
530	-15	36000	2224	422000	400000	16937
540	-15	36000	1942	348000	400000	13565
550	-15	36000	2041	416000	400000	13692
560	-15	36000	1769	250000	400000	12734
570	-15	36000	1188			
580	-15	36000	1848	288000	400000	13052
590	-15	36000	1885	299000	400000	13297
AVG			1842	337167		13880
STD			324	70712		1537
COV			18%	21%		11%

TABLE 6

Comparison of Pre-Traffic Back-Calculated Moduli

			---24k Force--- Rubblized E (psi)		---36k Force--- Rubblized E (psi)			---24k Force--- Subgrade E (psi)		---36k Force--- Subgrade E (psi)		
Date	**Item**	**Offset ft**	**BackFAA**	**WESDEF**	**BackFAA**	**WESDEF**	**Avg. E (psi) Rubblized**	**BackFAA**	**WESDEF**	**BackFAA**	**WESDEF**	**Avg. E (psi) Subgrade**
6/5/2005	MRC	-5	249,000	287,000	280,000	323,000	**284,750**	143,000	12,700	12,700	14,500	**13,550**
		-15	298,000	346,000	320,000	410,000	**343,500**	13,200	12,100	11,900	17,600	**16,325**
	MRG	-5	367,000	381,000	399,000	428,000	**393,750**	17,700	15,000	15,000	17,600	**16,325**
		-15	584,000	709,000	325,000	782,000	**675,000**	16,500	14,900	14,800	16,500	**15,675**
	MRS	-5	300,000	288,000	326,000	300,000	**303,500**	13,100	12,800	12,800	13,100	**12,950**
		-15	320,000	305,000	337,000	304,000	**316,500**	13,800	13,600	13,700	13,900	**13,750**
Grand Mean							**386,167**					**14,154**
6/17/2005	MRC	-5	293,000	417,000		582,000	**430,667**	15,500	13,100		14,000	**14,200**
		-15	342,000	454,000		484,000	**426,667**	13,300	12,000		12,100	**12,467**
	MRG	-5	246,000	528,000		420,000	**398,000**	17,700	15,300		15,400	**16,133**
		-15	628,000	1,000,000		1,000,000	**876,000**	18,000	15,200		15,300	**16,167**
	MRS	-5	333,000	203,000		189,000	**241,667**	15,300	11,800		11,100	**12,733**
		-15	362,000	224,000		293,000	**293,000**	14,300	13,100		13,100	**13,500**
Grand Mean							**444,333**					**14,200**

TABLE 7

6.4 HWD TEST RESULTS DURING TRAFFICKING

HWD tests were performed at periodic intervals during trafficking to detect any variations in pavement support conditions with loading. The following figures summarize the results during trafficking for ISM, rubblized layer E_r and subgrade E at the 5-ft. and 15-ft. offset:

Figure 13, “ISM at 5-ft. offset”
Figure 14, “ISM at 15-ft. offset”
Figure 15, “Elastic Modulus of Rubblized PCC at 5-ft. offset”
Figure 16, “Elastic Modulus of Rubblized PCC at 15-ft. offset”
Figure 17, “Elastic Modulus of Subgrade at 5-ft. offset”
Figure 18, “Elastic Modulus of Subgrade at 15-ft. offset”

The back-calculation results were from the 24,000 lbs. force using FAA’s BACKFAA program. Similar results were obtained with the WESDEF program.

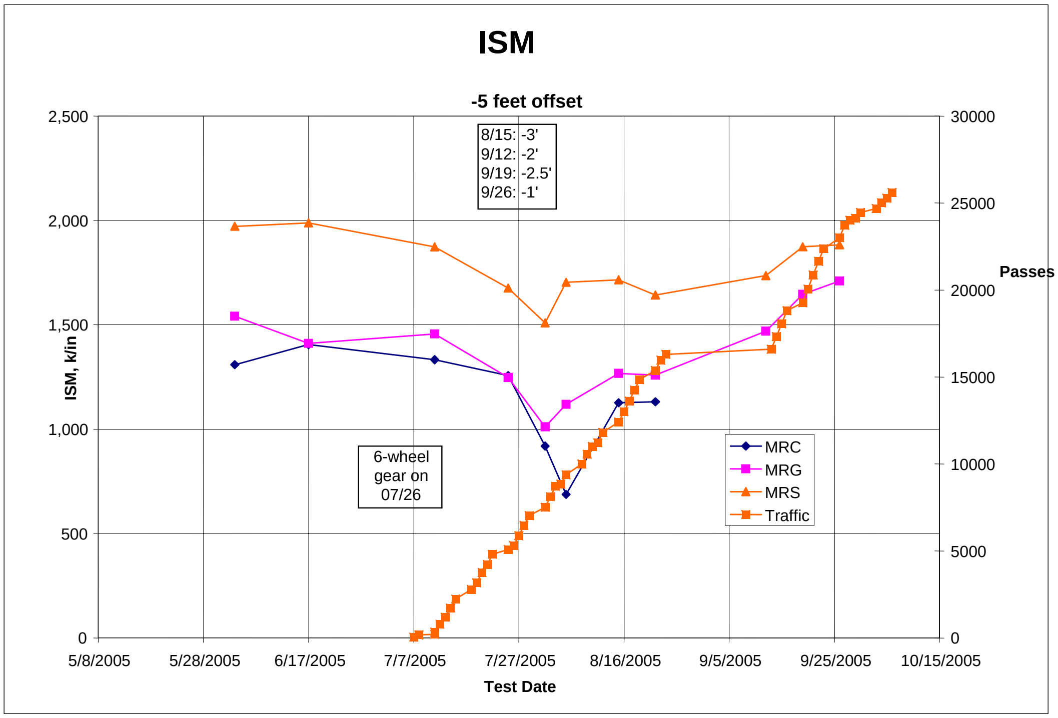


FIGURE 13

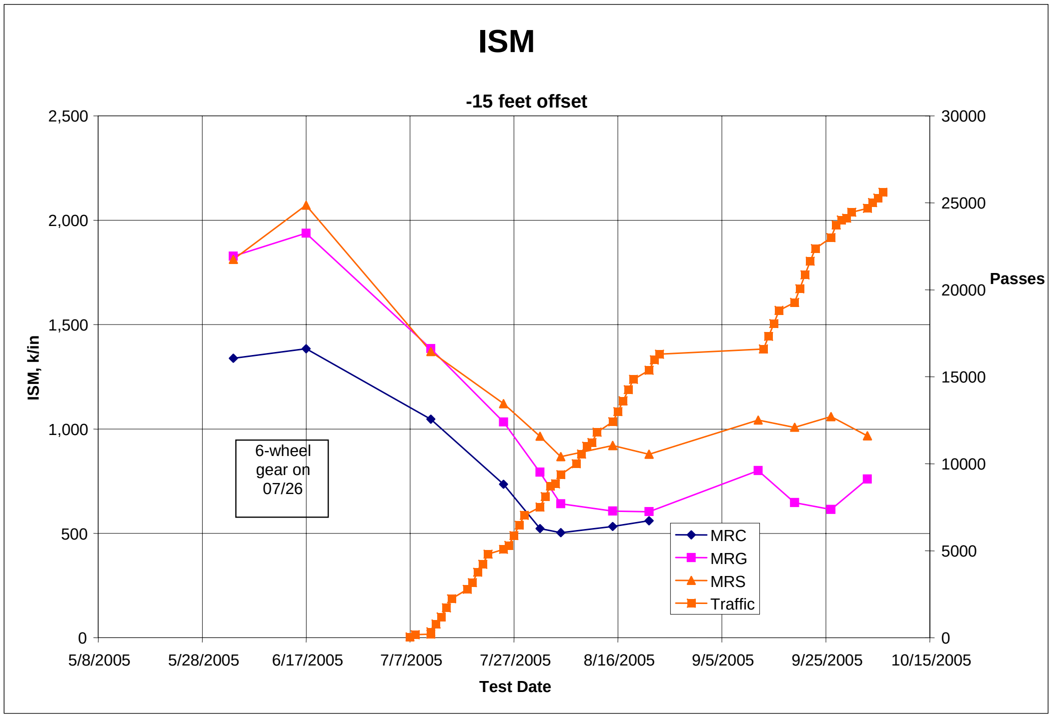


FIGURE 14

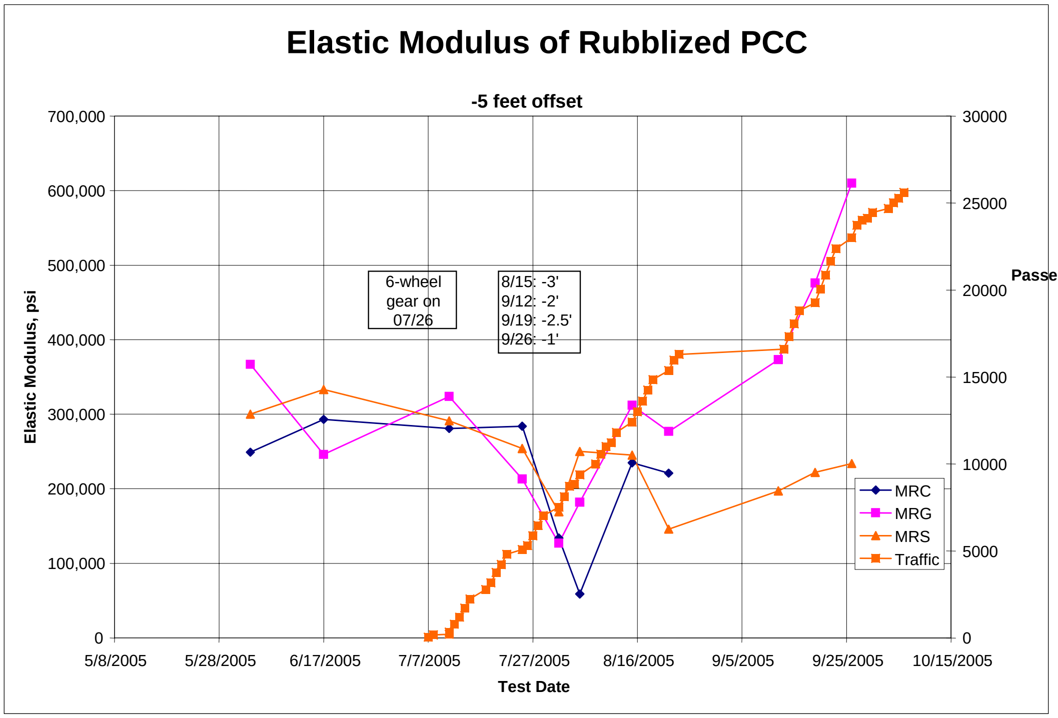


FIGURE 15

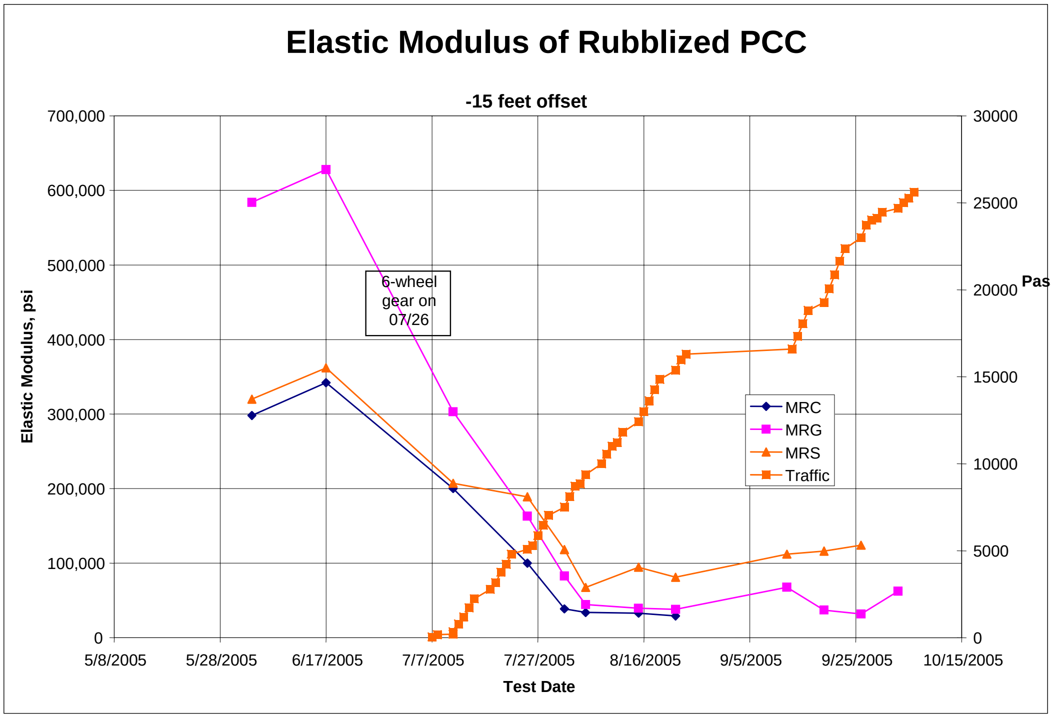


FIGURE 16

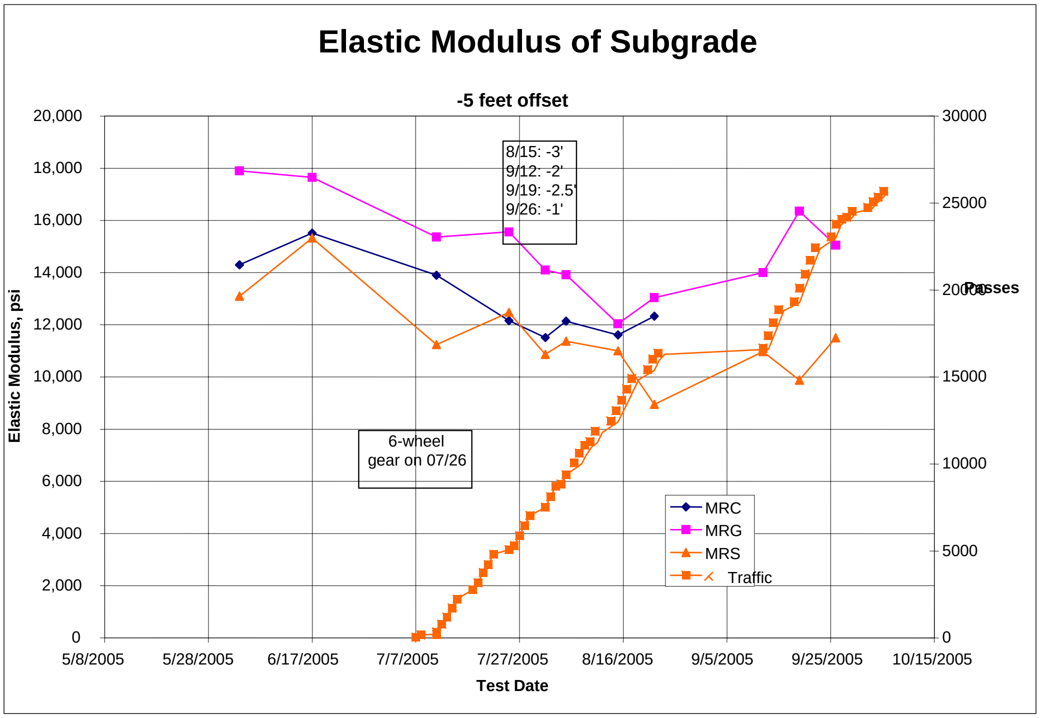


FIGURE 17

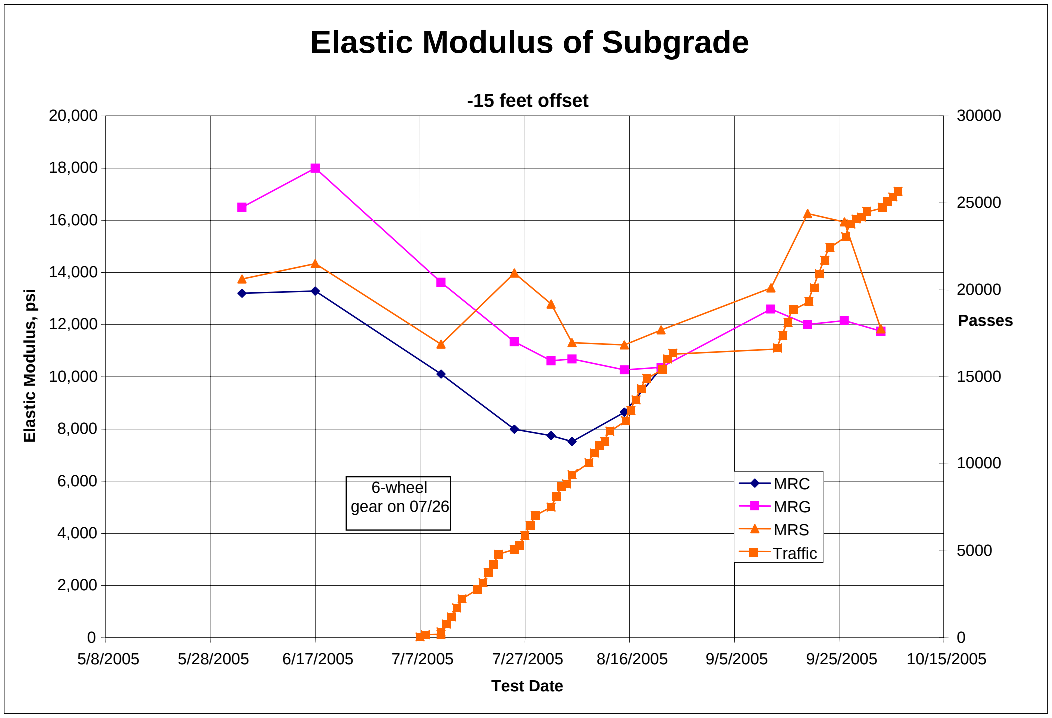


FIGURE 18

6.5 DISCUSSION OF RESULTS

6.5.1 Influencing Factors In evaluating the HWD results, several factors need to be considered when selecting representative values for characterizing the rubblized layer for structural design purposes.

First, as stated previously, the HWD tests at the 15-ft. offset (-15-ft.) were centered over an underlying dowelled longitudinal joint. The post traffic trenching (see Section 7.0) showed that the rubblizing did not debond the dowels from the two adjacent slabs. Therefore, the semi-intact joint could have influenced the HWD results and the apparent sharp decline in ISM and elastic modulus of the rubblized layers (E_r) with increasing load repetitions for all the test items. This becomes more apparent when comparing the results from the -5-ft. and the -15-ft. offset. It may be possible that successive loading at -15-ft. could have caused more displacement from “rocking” or other movement at the joint, rather than from deterioration of the rubblized layer, thereby influencing the displacement sensor reading.

On the other hand, the ISM and elastic modulus results from the -5-ft offset, which did not coincide with a longitudinal joint location, were more uniform. However, the results for the -5-ft. offset show a drop and then a gradual rise in ISM and E_r with increasing load repetitions.

It should be noted that the HWD offsets were varied in steps from 5-ft. to 1-ft. after the “dip” in ISM and E_r to avoid the more severely rutted area (see Appendix A.4 for Transverse Profile Plots). In this case, moving the HWD locations from rutted to less rutted areas could explain the variations of ISM and E_r for the -5-ft. offset results.

Also for back-calculation of the unrubblized concrete elastic modulus on the APC test items, the method of back-calculation will influence the result. This may become important if a predictive equation to compute the probable modulus of a rubblized layer from the modulus of unrubblized concrete is desirable and can be developed. From Table 3, it appears that the concrete modulus results from the closed-form AREA method are more consistent than the layered elastic back-calculations. The average pre-rubblized PCC modulus is approximately 3,000,000 psi from the closed-form method and 3,900,000 psi from the layered elastic back-calculations.

6.5.2 Range in Pre-Trafficked Rubblized Modulus From Table 7, the pre-trafficked elastic moduli of the rubblized layers ranged from a high of approximately 1,000,000 psi for MRG to a low of approximately 200,000 psi for MRS, depending on back-calculation method, date tested, test item, and HWD offset (i.e., -5-ft. or -15-ft.). If only the -5-ft. offset data are used to eliminate any possible influence of the underlying dowelled joint at the -15-ft. offset locations, the range narrows from approximately 200,000 psi to approximately 600,000 psi.

The grand mean of the pre-trafficked rubblized modulus for all offsets ranges from approximately 400,000 psi to 450,000 psi, depending on date tested, while for the -5-ft. offset data, only, the range is approximately 325,000 psi to 350,000 psi. For the -5-ft. offsets, there does not appear to be a consistent trend in the averages between test items. Based on review of the grand means for all data and the -5-ft. offset data, the probable range in the pre-trafficked rubblized layer moduli at the NAPTF is 350,000 psi to 450,000 psi. This seems to fit into the range of those identified from other projects, as discussed in the main report.

6.5.3 Range in Rubblized Moduli During Trafficking

The average rubblized and subgrade layer moduli for the -5-ft. offset tests during trafficking from the 24,000 lbs. force amplitude HWD data are summarized in Table 8, "Comparison of Back-calculated Moduli During Trafficking". The table excludes any questionable data. The data indicate a trend in layer moduli for each test item, with MRG having the highest average. The grand mean of all the data is approximately 300,000 psi with a range of approximately 200,000 psi (MRS) to 400,000 psi (MRG).

Comparison of Back-calculated Moduli During Trafficking

Date	Item	Offset ft	Rubblized E (psi) BackFAA	Rubblized E (psi) WESDEF	Avg. E (psi) Rubblized	Subgrade E (psi) BackFAA	Subgrade E (psi) WESDEF	Avg. E (psi) Subgrade	Approx *k*(psi/in)
6/3/2005	MRC	-5	255,250	300,825	**278,038**	12,275	10,612	**11,443**	**115**
	MRG	-5	430,833	384,000	**407,417**	14,381	12,674	**13,527**	**130**
	MRS	-5	223,111	175,300	**199,206**	10,918	9,660	**10,289**	**105**
Grand Mean					**294,887**			**11,753**	**117**

TABLE 8

6.5.4 Subgrade Modulus

The subgrade moduli prior to and during trafficking for each test item are summarized on Tables 3 through 7. From Table 3, it appears that the closed-form solution may overestimate the subgrade *k*. The layered elastic solutions, while apparently overestimating the concrete moduli, do seem to provide more realistic estimates of subgrade moduli.

Tables 7 and 8 contain layered elastic back-calculations for the rubblized concrete sections for pre-trafficked HWD testing and for tests conducted during trafficking. From Table 7, the grand means for the 6/15/2005 and 6/17/2005 pre-trafficked subgrade moduli for each test item are:

Test Item	Esub (psi)	Correlated *k* (psi/in.)
MRC	13,200	128
MRG	16,100	149
MRS	13,200	128

The correlation from E to *k* is based on $E=26k^{1.284}$ as described in Advisory Circular 150/5320-6D (4). From Table 8, the grand means for E and *k* from layered elastic back-calculations from HWD data acquired during trafficking are:

Test Item	Esub (psi)	Correlated *k* (psi/in.)
MRC	11,400	115
MRG	13,500	130
MRS	10,300	105

As discussed previously, the subgrade moduli for the MRC and MRS test items are composite moduli reflecting the influence of both the P-154 subbase layer and the subgrade. The actual subgrade moduli for these test items, then, would be lower than the reported values.

SECTION 7.0

POST TRAFFIC TESTING

SECTION 7.0 POST TRAFFIC TESTING

At the completion of the traffic testing, trenches were cut across the rubblized (ARC) test items to:

- Identify deformation in pavement and subgrade layers;
- Perform plate load tests; and
- Perform in-situ CBR and other subgrade testing.

7.1 TRENCH PHOTOS

Figure 19, “MRC Trench – East End”, and Figure 20, “MRC Trench – West End”, depict the condition of pavement and subgrade layers for ARC pavements in the MRC test item. Figure 21, “MRG Trench”, and Figure 22, “MRS Trench”, depict ARC pavements in the MRG and MRS test items. As shown, more rutting and layer deformation was observed in the MRC test item. Figure 23, “Close-Up of MRC Failure” is a close up of subgrade intrusion into the P-154 subbase on the MRC test items. From inspection of the trenches, classical subgrade (shear) failure is believed to have occurred in MRC, but not necessarily in MRG, and MRS.

Figures 24 and 25, Figures 26 and 27, and Figures 28 and 29 depict the rubblized concrete pieces that were removed from the MRC, MRG and MRS test items, respectively. The largest pieces were observed in the MRS test items. Also note the embedded dowel bars in the rubblized concrete pieces, indicating that the rubblization did not fully debond the steel.

Finally Figure 30 depicts the surface of the econcrete base in the MRS test item after removal of the asphalt overlay and rubblized concrete layers. The photo and inspection of the econcrete indicate that the resonant breaker did not damage the econcrete during rubblization.

MRC Trench – East End

FIGURE 19

MRC Trench – West End

FIGURE 20

MRG Trench

FIGURE 21

MRS Trench

FIGURE 22

CLOSE-UP OF MRC FAILURE

FIGURE 23

MRC-RUBBLIZED CONCRETE

FIGURE 24

MRC

FIGURE 25

MRG

FIGURE 26

MRG

FIGURE 27

MRS

FIGURE 28

MRS

FIGURE 29

MRS

FIGURE 30

7.2 TRENCH PROFILES

For the ARC test items, profiles across MRC trenches are depicted in Figure 31, “MRC-E: Layer Profiles” and Figure 32, “MRC-W: Layers Profiles”, and profiles across MRG and MRS trenches are depicted in Figure 33, “MRG: Layers Profiles” and Figure 34, “MRS: Layer Profiles”, respectively. The trench profiles confirm that the failures in the MRC test items were more severe than in the MRG and MRS test items. The profiles provide further support that the MRC sections can be considered as failed with respect to the classic definition of subgrade failure for flexible pavement design.

MRC-E: LAYER PROFILES

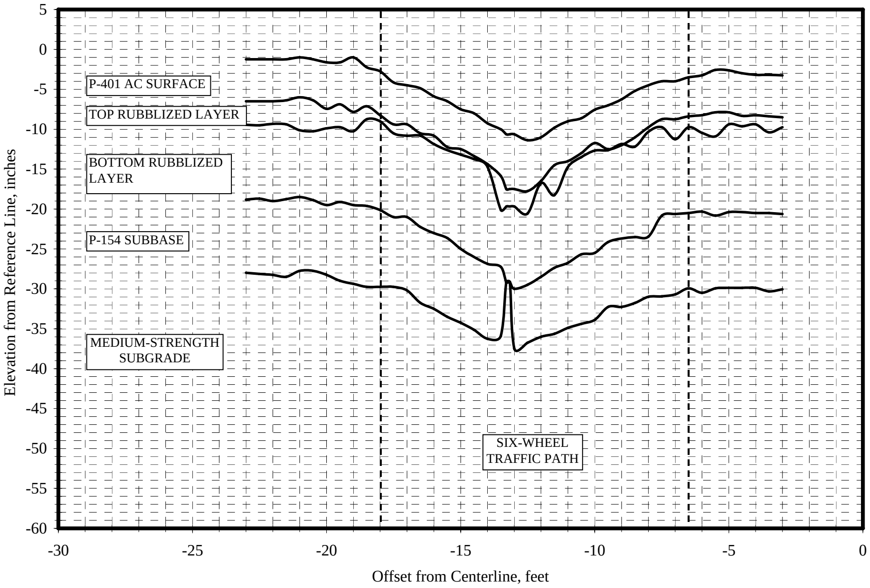


FIGURE 31

MRC-W: LAYER PROFILES

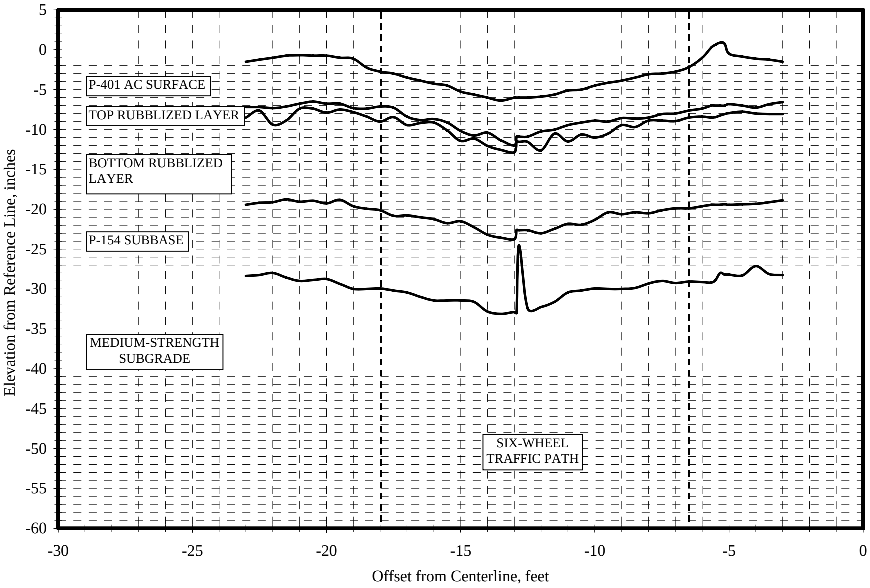


FIGURE 32

MRG: LAYER PROFILES

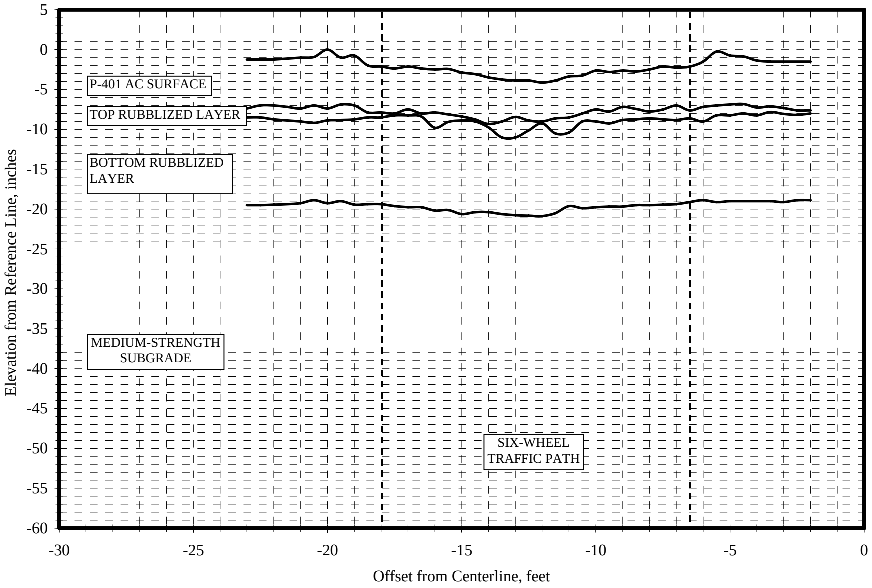


FIGURE 33

MRS: LAYER PROFILES

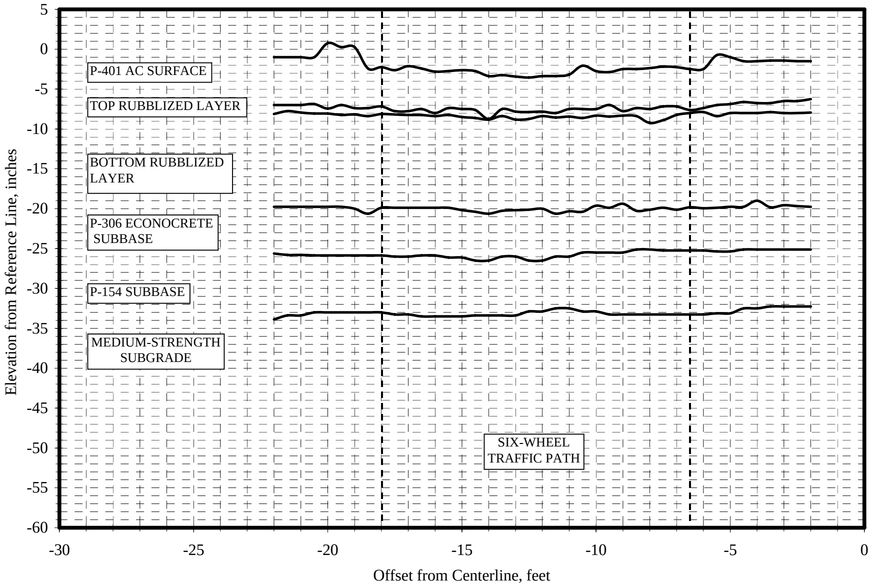


FIGURE 34

7.3 PLATE LOAD AND CBR TESTS

Plate load test results conducted in trafficked and non-trafficked areas in the MRC, MRG, and MRS test items after pavement removal are summarized in Table 9, “Summary of Plate Load Test Results on CC2-OL Post Traffic Trenches”. Average in-situ subgrade CBR results for ARC pavements for each test item are summarized in Table 10, “Average Subgrade CBR Results”. Point by point subgrade CBR test data are contained in Appendix A.5. The tables and Appendix A.5 also include in-situ subgrade moisture contents.

The plate load test data summarized in Table 9 indicate lower *k*-values at the top of subgrade and P-154 subbase for the MRC test items, as compared to the MRG and MRS test items. Table 10 indicates that average in-situ MRC CBR at the top of the subgrade is lower than the CBR 1-foot from the surface. The average in-situ CBR at the top of the subgrade for MRC is approximately 4.3% versus 7.6% one foot below the surface. A similar trend is noted for MRS. The lower in-situ CBR at the surface is believed to be a result of water “drain down” form the P-154 subbase. The lower MRC subgrade CBR (4.3% at surface) explains the relatively poorer performance of MRC vs MRG, which had an in-situ CBR of 11% at the surface of the subgrade.

SUMMARY OF PLATE LOAD TEST RESULTS ON CC2-OL POST TRAFFIC TRENCHES

TRENCH ID	LAYER	k_u, psi/in.	
		TRAFFIC PATH	NON-TRAFFIC AREA
MRC-W	Top of Rubblized Concrete	479	-
	Top of P-154 Subbase	144	92
	Top of Subgrade	-	70
MRC-E	Top of Rubblized Concrete	-	270
	Top of P-154 Subbase	-	87
	Top of Subgrade	-	60
MRG	Top of Rubblized Concrete	322	457
	Top of Subgrade	106	149
MRS	Top of Rubblized Concrete	780	579
	Top of P-306 Econocrete Subbase	409	
	Top of P-154 Subbase	270	
	Top of Subgrade		

TABLE 9

AVERAGE SUBGRADE CBR RESULTS

Test Item	Subgrade Elevation	Average CBR (%)	Average Moisture (%)
MRC-E	Top 0 ft.	3.8	37.2
	-1 ft	8.7	30.4
MRC-W	Top 0 ft.	4.7	33.9
	-1 ft	6.6	31.5
MRG	Top 0 ft.	11.1	30.5
	-1 ft	8.5	31.5
MRS	Top 0 ft.	6.5	32.6
	-1 ft	9.8	30.3

TABLE 10

SECTION 8.0

PERFORMANCE PREDICTION

SECTION 8.0 PERFORMANCE PREDICTION

Since MRC appears to constitute a failed pavement as defined by the FAA and military flexible pavement failure criteria, it should be possible to test this using the FAA's mechanic pavement design procedures embedded in their LEDFAA program. This can be done by inputting the pavement and subgrade layer properties for MRC to LEDFAA and computing the number of repetitions to failure for the tridem gear configuration and wheel loads. It is also possible to compute layer equivalency factors for the rubblized layer vs. aggregate base and granular subbase for use in the conventional CBR design procedure.

8.1 MECHANISTIC ANALYSIS

For the mechanistic analysis, FAA's LEDFAA program was used to compute the number of load repetitions to failure for MRC for various subgrade and rubblized layer moduli (E_{sub} and E_r, respectively). E_r was varied from 300,000 psi to 900,000 psi For $E_{sub,}$ estimates were generated from the back-calculated subgrade moduli before (14,000 psi) and during (11,500 psi) trafficking, with E_{sub} = 13,000 psi representing the average of the two. It should be noted that for MRC the subgrade moduli are actually composite moduli including both the 8-inch subbase and the prepared subgrade. The actual subgrade modulus, then, would be less than the composite modulus.

The dual tandem (2D) and tridem (3D) gear configuration used for the traffic tests was added to LEDFAA's external library with 54-inch dual spacing and 57-inch tandem spacing. For the MRC test item, 5,500 repetitions of the 2D gear at 55,000 wheel load and 11,500 repetitions of the 3D gear at 65,000 lbs. wheel load were input to LEDFAA and the CDF was computed for the various combinations of E_{sub} and E_r. The computations resulted in the following rubblized concrete moduli for the different subgrade moduli for CDF = 1.0:

E_{sub} (psi)	E_r (psi)
11,500	850,000
13,000	650,000
14,000	550,000

Therefore, while the layered elastic back-calculations suggested a range of rubblized modulus of 350,000 psi to 450,000 psi, the LEDFAA predictions suggest a range of 550,000 psi to 850,000 psi, which although more than the back-calculated average, still fall within the range of E_r computed prior to trafficking. Given the potential problems associated with the HWD results discussed in Section 6.0 (i.e., surface profile during trafficking), the pre-trafficked subgrade modulus of 14,000 psi is probably the more reliable estimate. Therefore, the likely range in E_r from the LEDFAA computations is 550,000 psi to 650,000 psi.

However, the back-calculated composite subgrade modulus reflects not only the influence of the 8-inch granular subbase, but will average any variation in subgrade strength with depth. If the average of the CBR values at the top of the MRC subgrade and at 1-foot below the surface (i.e., CBR = 6.0%, or E = 9,000 psi) are input to LEDFAA with an 8-inch subbase, rubblized layer modulus of 1,500,000 psi result, which does not seem reasonable.

Therefore, from the back-calculated rubblized layer moduli and the LEDFAA predictions, the likely range in the average rubblized layer moduli is 400,000 psi to 600,000 psi.

8.2 LAYER EQUIVALENCY

The CBR design procedures include equivalency factors for equating stabilized base materials to aggregate base and subbase. FAA equivalency factors range from 1.2 to 1.6 when converting stabilized base/subbase to crushed aggregate base (P-209), and 1.0 to 2.3 when converting stabilized base/subbase to granular (P-154) subbase. Although there are several methods to compute equivalency factors, a simplified method included in the American Association of Highway and Transportation Officials (AASHTO) is based on the ratio of moduli as:

$$EF = (E_1/E_2)^{1/3}$$

Where:

EF = equivalency factor

E_1 = Modulus of "new" material, in this case the stabilized base modulus

E_2 = Modulus of the "standard" material, in this case the granular base/subbase modulus.

This equation is applicable with materials having equal poisson's ratio, which in LEDFAA was assumed to be 0.35 for the rubblized and granular layers.

In LEDFAA, the granular base/subbase modulus is a function of the layer thickness and the modulus of the underlying layer(s). However, it can be shown that typical moduli are 20,000 psi to 30,000 psi for P-154 subbase, and 50,000 psi to 60,000 psi for P-209 base. Given the typical base/subbase moduli and the likely range in rubblized layer moduli, the following range in equivalency factors were computed:

- $2.4 < EF < 3.1$ for subbase
- $1.9 < EF < 2.3$ for base

For the MRC subgrade conditions (i.e., average CBR within top 1-foot = 6.0), a subbase modulus of 17,200 psi (for 8-inch subbase) and base modulus of 52,320 psi (for 12-inch rubblized layer) result from the algorithms embedded in LEDFAA.

These result in an equivalency factor range of 2.9 to 3.3 when converting to granular subbase (P-154) and 2.0 to 2.3 when converting to aggregate base (P-209), or average values of 3.1 and 2.1 for subbase and base, respectively, for a range in rubblized modulus of 400,000 psi < E_r < 600,000 psi. In either case, it is clear that the rubblized layer can be considered as a high quality stabilized base layer, providing stiffer support than a crushed aggregate (P-209) base layer.

SECTION 9.0

CONCLUSIONS

SECTION 9.0 CONCLUSIONS

The rubblization process and resulting materials and traffic tests at the NAPTF provided valuable data for developing thickness design procedures incorporating rubblized layers.

9.1 CONSTRUCTION

With respect to the procedures used to rubblize the concrete slabs, it is noteworthy that the resonant breaker did not damage the underlying econcrete slab in the MRS test item (see Figure 30). However, the resonant breaker did not fully debond the dowels from the concrete (see Figures 24, 27, and 29). This could influence the performance of the rubblized layer in the field and, as discussed, may have influenced the HWD response data and back-calculated rubblized layer moduli. Also, rubblization with the resonant breaker resulted in relatively fine, aggregate size pieces in the top 3-inches of the test items and larger (9-inch to 12-inch) pieces in the bottom 9-inches. The ramifications of this on pavement performance may not be fully understood and are discussed in more detail in the main report.

9.2 MATERIAL CHARACTERIZATION

Based on evaluation of the back-calculated moduli of the rubblized layers from pre-traffic HWD tests and HWD tests conducted during trafficking, the grand mean from the data reductions for the rubblized concrete ranges from approximately 350,000 psi to 450,000 psi.

Given the potential influence of surface rutting and HWD tests conducted over longitudinal dowelled joints, it is possible that the computed decrease in the rubblized layer moduli may not be as drastic as the data acquired during a trafficking suggest.

LEDFAA was also used to compute the theoretical number of load repetitions to failure for the MRC test items for various E_r inputs and the results compared to the observed number of load repetitions to failure during the traffic tests. The theoretical analysis indicated a likely range in rubblized layer moduli of 550,000 psi to 650,000 psi.

Combining the LEDFAA results with the back-calculated moduli suggests a realistic range in rubblized layer moduli of 400,000 psi to 500,000 psi for material characterization for layered elastic computations. For conventional CBR analysis, equivalency factors near the upper range of those contained in FAA Advisory Circular 150/5320-6D for stabilized base appear to be appropriate.

9.3 RELATIVE STRUCTURAL PERFORMANCE

Based on the initial trafficking results when both ARC and APC were subjected to equal 2D gear at 55,000 lbs., the performance of the two sections were about the same, with only minor rutting observed. For the MRC and MRG pavement sections, the 55,000 lbs 2D wheel loads are probably more severe than a comparable pavement section would be subjected to in practice.

The expectation, then, is that the ARC test items would have performed satisfactorily, with much longer life, had the original 2D loading continued. As discussed, the only reason for increasing the loading to 3D with 65,000lbs. wheel loads was to invoke structural failure within a reasonable time frame.

SECTION 10

REFERENCES

SECTION 10 REFERENCES

(1) Galaxy Technology, "Reconstruction of Rigid Pavement Test Items in the Medium Strength Subgrade Area (CC-2)," Draft report to FAA, August 2005.

(2) Hayhoe, Gordon F. and Navneet Garg, "Characterization of Rubblized Concrete Pavements with HMA Overlays at the National Airport Pavement Test Facility", American Society of Civil Engineers Transportation Conference, November 2005, Atlanta, GA.

(3) FAA Advisory Circular 150/5370-11A, "Use of Nondestructive Testing in the Evaluation of Airport Pavement", U.S. Department of Transportation, Federal Aviation Administration, December 2004.

(4) FAA Advisory Circular 150/5320-6D, "Airport Pavement Design and Evaluation", U.S. Department of Transportation, Federal Aviation Administration, July 1995.

APPENDIX A.1

IN-SITU CBR TEST RESULTS CC-2

LIFT 0 SUMMARY

Lot ID	Test Item	Sublot ID	Test ID	Station	Lane	CBR	Test Avg.	Lot Avg.	Moisture
Lot 1	MRC	A	5-1	3+60	North	8.5	8.9		28.06
			5-2	3+60	North	8.2			
			5-3	3+60	North	9.9		8.6	
	MRG	B	7-1	4+43	North	8.0	8.3		28.92
			7-2b	4+43	North	9.2			
			7-3	4+43	North	7.6			
Lot 2	MRC	A	4-1	3+60	South	9.9	8.3		28.95
			4-2	3+60	South	7.3			
			4-3	3+60	South	7.6		8.4	
	MRG	B	6-1	4+43	South	7.7	8.4		28.41
			6-2	4+43	South	9.0			
			6-3	4+43	South	8.6			

East

1B 8.3	2B 8.4	
8.6	8.4	South
1A 8.9	2A 8.3	
Lot 1	Lot 2	

LIFT 1 SUMMARY

Lot ID	Test Item	Sublot ID	Test ID	Station	Lane	CBR	Test Avg.	Lot Avg.	Moisture
Lot 1	MRC	A	1-1	3+70	North	11.6	11.5		27.33
			1-2	3+70	North	11.1			
			1-3	3+70	North	11.7		11.0	
	MRG	B	4-1	4+65	North	10.9	10.5		27.80
			4-2	4+65	North	10.1			
			4-3	4+65	North	10.5			
Lot 2	MRC	A	2-1	3+70	South	11.6	11.3		27.96
			2-2	3+70	South	11.7			
			2-3	3+70	South	10.6		11.3	
	MRG	B	3-1	4+65	South	11.4	11.4		28.74
			3-2	4+65	South	11.6			
			3-3	4+65	South	11.1			

East

1B 10.5	2B 11.4	
11.0	11.3	South
1A 11.5	2A 11.3	
Lot 1	Lot 2	

LIFT2 SUMMARY

Lot ID	Test Item	Sublot ID	**Test ID**	**Station & Offset**	**Lane**	**CBR**	**Test Avg.**	**Lot Avg**	**Moisture**
Lot 1			2-1	3+40 10L	North	6.1	6.0		30.36
	MRC	A	2-2	3+40 10L	North	4.6			
			2-3a	3+40 10L	North	6.3			
			2-3b	3+40 10L	North	6.8		5.5	
			2-10	4+50 10 L	North	4.4	5.0		31.49
	MRG	B	2-11	4+50 10 L	North	5.5			
			2-12'	4+50 10 L	North	4.8			
			2-12a	4+50 10 L	North	5.4			
Lot 2			2-4	3+40 11R	South	5.5	5.6		30.99
	MRC	A	2-5	3+40 11R	South	5.5			
			2-6	3+40 11R	South	5.7		5.9	
			2-7	4+50 10 R	South	5.9	6.3		30.28
	MRG	B	2-8	4+50 10 R	South	6.9			
			2-9	4+50 10 R	South	6.0			
			2-9a	4+50 10 R	South	6.3			

East

1B 5.0	2B 6.3	
5.5	5.9	South
1A 6.0	2A 5.6	
Lot 1	Lot 2	

			2-13	4+53 10 L	North	5.0	
Lot 1	MRG	B	2-14	4+53 10 L	North	5.9	5.1
			2-15	4+53 10 L	North	4.4	

LIFT 3 SUMMARY

Lot ID	Test Item	Sublot ID	**Test ID**	**Station**	**Lane**	**CBR**	**Test Avg.**	**Lot Avg**	**Moisture**
Lot 1	MRC	A		3+85 10L	North	6.7	6.9		30.45
				3+85 10L	North	6.3			
				3+85 10L	North	7.8		7.7	
	MRG	B		4+70 10L	North	8.3	8.4		28.99
				4+70 10L	North	8.8			
				4+70 10L	North	8.1			
Lot 2	MRC	A		3+85 10 R	South	8.8	7.9		30.1
				3+85 10 R	South	7.4			
				3+85 10 R	South	7.4		7.7	
	MRG	B		4+65 10R	South	7.5	7.6		29.49
				4+65 10R	South	8.2			
				4+65 10R	South	7.0			

East

1B 8.4	2B 7.6	
7.7	7.7	South
1A 6.9	2A 7.9	
Lot 1	Lot 2	

LIFT 4 SUMMARY

Lot ID	Test Item	Sublot ID	**Test ID**	**Station**	**Lane**	**CBR**	**Test Avg.**	**Lot Avg**	**Moisture**
Lot 1	MRC	A	4-1	3+42 11L	North	7.4	7.9		30.27
			4-2	3+42 11L	North	7.7			
			4-3	3+42 11L	North	8.7		7.7	
	MRG	B	4-10	4+78 11 L	North	8.6	7.4		31.45
			4-11	4+78 11 L	North	6.2			
			4-11a	4+78 11 L	North	7.3			
			4-12	4+78 11 L	North	7.9			
			4-12a	4+78 11 L	North	7.2			
Lot 2	MRC	A	4-4	3+42 11R	South	6.8	6.3		30.17
			4-5	3+42 11R	South	5.6			
			4-6	3+42 11R	South	6.4		6.5	
	MRG	B	4-7	4+78 11 R	South	6.3	6.7		30.54
			4-8	4+78 11 R	South				
			4-9	4+78 11 R	South	6.0			
			4-9a	4+78 11 R	South	7.9			

Rejected

East

Lot 1	Lot 2	
1B 7.4	2B 6.7	
7.7	6.5	South
1A 7.9	2A 6.3	

LIFT 4 Set 2 SUMMARY

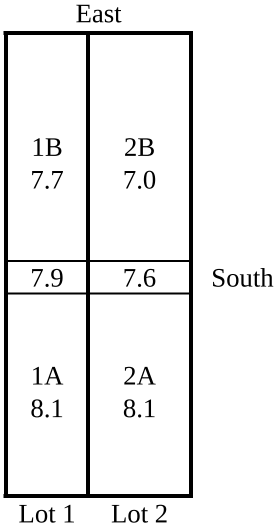
Lot ID	Test Item	Sublot ID	**Test ID**	**Station**	**Lane**	**CBR**	**Test Avg.**	**Lot Avg**	**Moisture**
Lot 1	MRC	A	4-13	3+47 11L	North	7.0	7.4		30.71
			4-14	3+47 11L	North	8.2			
			4-15	3+47 11L	North	7.1		7.3	
	MRG	B	4-22	4+75 11 L	North	7.3	7.1		31.36
			4-22a	4+75 11 L	North	7.3			
			4-23	4+75 11 L	North	7.3			
			4-24	4+75 11 L	North	6.4			
Lot 2	MRC	A	4-16	3+47 11R	South	7.8	7.3		30.17
			4-17	3+47 11R	South	6.8			
			4-18	3+47 11R	South	7.3		7.5	
	MRG	B	4-19	4+75 11 R	South	6.8	7.6		29.83
			4-20	4+75 11 R	South	7.7			
			4-21	4+75 11 R	South	8.4			

East

Lot 1	Lot 2	
1B 7.1	2B 7.6	
7.3	7.5	South
1A 7.4	2A 7.3	

LIFT 5 SUMMARY

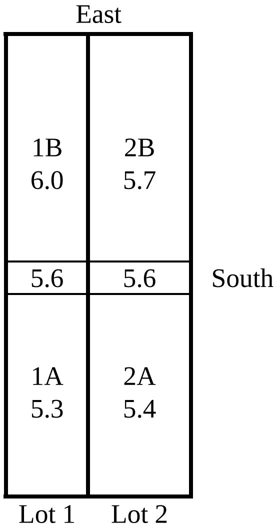
Lot ID	Test Item	Sublot ID	**Test ID**	**Station**	**Lane**	**CBR**	**Test Avg.**	**Lot Avg**	**Moisture**
Lot 1	MRC	A	1	3+31	North	8.6	8.1		29.82
			2	3+31	North	7.8			
			3	3+31	North	7.9		7.9	
	MRG	B	10	4+56	North	7.8	7.7		30.42
			11	4+56	North	7.6			
			12	4+56	North	7.8			
Lot 2	MRC	A	4	3+31	South	8.0	8.1		31.02
			5	3+31	South	8.0			
			6	3+31	South	8.4		7.6	
	MRG	B	7	4+56	South	6.9	7.0		30.03
			8	4+56	South	7.0			
			9	4+56	South	7.2			



1B 7.7	2B 7.0
7.9	7.6
1A 8.1	2A 8.1
Lot 1	Lot 2

LIFT 5 SUMMARY - REWORKED
LIFT TESTED ON 10/16/03

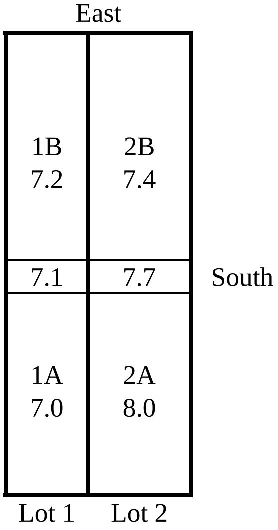
Lot ID	Test Item	Sublot ID	**Test ID**	**Station**	**Lane**	**CBR**	**Test Avg.**	**Lot Avg**	**Moisture**
Lot 1	MRC	A	1	3+50 11L	North	5.2	5.3		30.68
			2	3+50 11L	North	5.6			
			3	3+50 11L	North	5.0		5.6	
	MRG	B	10	4+50 10L	North	5.2	6.0		30.53
			11	4+50 10L	North	6.0			
			12	4+50 10L	North	6.8			
Lot 2	MRC	A	4	3+50 10R	South	5.6	5.4		30.07
			5	3+50 10R	South	5.0			
			6	3+50 10R	South	5.7		5.6	
	MRG	B	7	4+50 10R	South	6.4	5.7		29.37
			8	4+50 10R	South	5.7			
			9	4+50 10R	South	5.0			



1B 6.0	2B 5.7
5.6	5.6
1A 5.3	2A 5.4
Lot 1	Lot 2

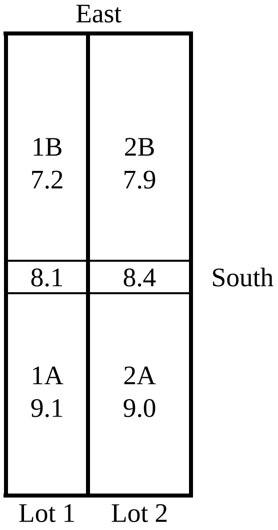
LIFT 6 SUMMARY - LIFT TESTED ON 10/28/03

Lot ID	Test Item	Sublot ID	**Test ID**	**Station**	**Lane**	**CBR**	**Test Avg.**	**Lot Avg**	**Moisture**
Lot 1	MRC	A	1	3+40 11L	North	6.9	7.0		31.41
			2	3+40 11L	North	6.8			
			3	3+40 11L	North	7.2		7.1	
	MRG	B	10	4+40 10L	North	7.5	7.2		31.02
			11	4+40 10L	North	7.6			
			12	4+40 10L	North	6.6			
Lot 2	MRC	A	4	3+40 10R	South	8.0	8.0		30.32
			5	3+40 10R	South	8.1			
			6	3+40 10R	South	7.9		7.7	
	MRG	B	7	4+40 10R	South	7.0	7.4		31.86
			8	4+40 10R	South	7.1			
			9	4+40 10R	South	8.2			



LIFT 7 SUMMARY - LIFT TESTED ON 11/21/03

Lot ID	Test Item	Sublot ID	**Test ID**	**Station**	**Lane**	**CBR**	**Test Avg.**	**Lot Avg**	**Moisture**
Lot 1	MRC	A	1	3+70 10L	North	8.8	9.1		30.51
			2	3+70 10L	North	8.6			
			3	3+70 10L	North	9.8		8.1	
	MRG	B	10	4+80 10L	North	6.6	7.2		31.26
			11	4+80 10L	North	8.1			
			12	4+80 10L	North	6.9			
Lot 2	MRC	A	4	3+70 10R	South	9.4	9.0		30.89
			5	3+70 10R	South	8.7			
			6	3+70 10R	South	8.9		8.4	
	MRG	B	7	4+70 10R	South	8.0	7.9		30.41
			8	4+70 10R	South	7.5			
			9	4+70 10R	South	8.1			



LIFT 8 SUMMARY - LIFT TESTED ON 12/04/03

Lot ID	Test Item	Sublot ID	**Test ID**	**Station**	**Lane**	**CBR**	**Test Avg.**	**Lot Avg**	**Moisture**
Lot 1	MRC	A							
								7.9	
	MRG	B	1	4+75 10L	North	7.8	7.9		31.5
			2	4+75 10L	North	8.0			
			3	4+75 10L	North	7.8			
Lot 2	MRC	A							
								7.9	
	MRG	B	4	4+75 10R	South	7.6	7.9		31.06
			5	4+75 10R	South	7.4			
			6	4+75 10R	South	8.6			

East

1B 7.9	2B 7.9	
7.9	7.9	South
1A	2A	
Lot 1	Lot 2	

LIFT 9 SUMMARY - LIFT TESTED ON 12/17/03

Lot ID	Test Item	Sublot ID	**Test ID**	**Station**	**Lane**	**CBR**	**Test Avg.**	**Lot Avg**	**Moisture**
Lot 1	MRC	A							
								6.2	
	MRG	B	1	4+60 10L	North	6.4	6.2		32
			2	4+60 10L	North	6.1			
			3	4+60 10L	North	6.2			
Lot 2	MRC	A							
								6.6	
	MRG	B	4	4+60 10R	South	6.5	6.6		31.8
			5	4+60 10R	South	6.4			
			6	4+60 10R	South	6.8			

East

1B 6.2	2B 6.6	
6.2	6.6	South
1A	2A	
Lot 1	Lot 2	

APPENDIX A.2

PSPA TEST RESULTS

PSPA TESTS ON RUBBLIZED TEST ITEMS (6/17/2005)

Test No.	Test Item	Offset	Station	Date	E, ksi	Adjusted E, ksi	Tpave, F
2	MRC	-25	330	6/17/2005 7:17	2070	590	68
4	MRC	-25	350	6/17/2005 7:19	2220	633	70
4	MRC	-25	350	6/17/2005 7:20	2270	647	70
5	MRC	-25	370	6/17/2005 7:21	2350	670	70
6	MRC	-25	390	6/17/2005 7:22	2370	675	70
8	MRG	-25	430	6/17/2005 7:25	1920	547	70
9	MRG	-25	450	6/17/2005 7:27	2260	644	70
10	MRG	-25	470	6/17/2005 7:27	2370	675	70
11	MRG	-25	490	6/17/2005 7:28	2410	687	70
13	MRS	-25	530	6/17/2005 7:33	2250	641	70
14	MRS	-25	550	6/17/2005 7:34	2300	655	70
15	MRS	-25	570	6/17/2005 7:36	2160	615	70
16	MRS	-25	590	6/17/2005 7:37	2300	655	70
17	MRS	-15	590	6/17/2005 7:40	2270	647	70
18	MRS	-15	570	6/17/2005 7:41	2150	613	70
19	MRS	-15	550	6/17/2005 7:43	2670	761	70
20	MRS	-15	530	6/17/2005 7:43	2160	615	70
23	MRG	-15	490	6/17/2005 7:47	2510	715	72
23	MRG	-15	490	6/17/2005 7:48	2510	715	72
24	MRG	-15	470	6/17/2005 7:49	2200	627	72
25	MRG	-15	450	6/17/2005 7:50	2240	638	72
26	MRG	-15	430	6/17/2005 7:51	2190	624	72
29	MRC	-15	390	6/17/2005 7:54	2160	615	72
30	MRC	-15	370	6/17/2005 7:55	2190	624	72
31	MRC	-15	350	6/17/2005 7:56	2300	655	72
32	MRC	-15	330	6/17/2005 7:57	2210	630	72
35	MRC	-5	330	6/17/2005 8:01	2050	584	72
36	MRC	-5	350	6/17/2005 8:02	2200	627	72
37	MRC	-5	370	6/17/2005 8:03	2360	672	72
37	MRC	-5	370	6/17/2005 8:03	2450	698	72
38	MRC	-5	390	6/17/2005 8:04	2200	627	72
40	MRG	-5	430	6/17/2005 8:07	2190	624	73
41	MRG	-5	450	6/17/2005 8:09	2150	613	73
42	MRG	-5	470	6/17/2005 8:10	2280	650	73
43	MRG	-5	490	6/17/2005 8:11	2210	630	73
43	MRG	-5	490	6/17/2005 8:12	2190	624	73
45	MRS	-5	530	6/17/2005 8:14	2450	698	73
46	MRS	-5	550	6/17/2005 8:15	2370	675	73

47	MRS	-5	570	6/17/2005 8:16	2350	670	73
48	MRS	-5	590	6/17/2005 8:17	2080	593	73
					Min.	***547***	
					Max.	***761***	
					Mean	***645***	
					Std. Dev.	***40***	
					COV, %	***6***	

PSPA TESTS ON NON-RUBBLIZED TEST ITEMS (6/17/2005)

Test No.	Test Item	Offset	Station	Date	E, ksi	Adjusted E, ksi	Tpave, F	Summary	
49	MRS	5	590	6/17/2005 8:19	2700	769	73	***Min.***	***556***
49	MRS	5	590	6/17/2005 8:20	2130	607	73	***Max.***	***798***
50	MRS	5	570	6/17/2005 8:21	2140	610	73	***Mean***	***665***
51	MRS	5	550	6/17/2005 8:21	2800	798	73	***Std. Dev.***	***66***
51	MRS	5	550	6/17/2005 8:23	2200	627	73	***COV, %***	***10***
52	MRS	5	530	6/17/2005 8:24	2270	647	73		
53	MRG	5	490	6/17/2005 8:26	2170	618	73		
54	MRG	5	470	6/17/2005 8:26	2160	615	73		
55	MRG	5	450	6/17/2005 8:28	2590	738	73		
55	MRG	5	450	6/17/2005 8:28	2520	718	73		
55	MRG	5	450	6/17/2005 8:28	2580	735	73		
56	MRG	5	430	6/17/2005 8:29	2150	613	73		
57	MRC	5	390	6/17/2005 8:30	1950	556	73		
58	MRC	5	370	6/17/2005 8:31	2280	650	73		
59	MRC	5	350	6/17/2005 8:32	2400	684	73		
59	MRC	5	350	6/17/2005 8:33	2380	678	73		
60	MRC	5	330	6/17/2005 8:34	2270	647	73		
63	MRC	15	330	6/17/2005 8:39	2090	595	73	***Min.***	***578***
64	MRC	15	350	6/17/2005 8:41	2040	581	73	***Max.***	***698***
65	MRC	15	370	6/17/2005 8:42	2140	610	75	***Mean***	***622***
66	MRC	15	390	6/17/2005 8:43	2450	698	75	***Std. Dev.***	***38***
67	MRG	15	430	6/17/2005 8:45	2230	635	75	***COV, %***	***6***
68	MRG	15	450	6/17/2005 8:46	2170	618	75		
69	MRG	15	470	6/17/2005 8:47	2230	635	75		
70	MRG	15	490	6/17/2005 8:48	2420	690	75		
71	MRS	15	530	6/17/2005 8:49	2030	578	75		
72	MRS	15	550	6/17/2005 8:49	2150	613	75		
73	MRS	15	570	6/17/2005 8:50	2190	624	75		

74	MRS	15	590	6/17/2005 8:51	2070	590	75		
75	MRS	25	590	6/17/2005 8:52	2580	735	75	***Min.***	***527***
75	MRS	25	590	6/17/2005 8:53	2290	652	75	***Max.***	***735***
76	MRS	25	570	6/17/2005 8:53	2390	681	75	***Mean***	***635***
77	MRS	25	550	6/17/2005 8:55	2290	652	75	***Std. Dev.***	***58***
78	MRS	25	530	6/17/2005 8:55	2030	578	75	***COV, %***	***9***
78	MRS	25	530	6/17/2005 8:56	2480	707	75		
79	MRG	25	490	6/17/2005 8:57	2450	698	75		
80	MRG	25	470	6/17/2005 8:58	2150	613	75		
81	MRG	25	450	6/17/2005 8:58	1850	527	75		
81	MRG	25	450	6/17/2005 8:59	2000	570	75		
82	MRG	25	430	6/17/2005 8:59	2280	650	75		
83	MRC	25	390	6/17/2005 9:00	2390	681	75		
84	MRC	25	370	6/17/2005 9:03	2050	584	75		
84	MRC	25	370	6/17/2005 9:04	2280	650	75		
85	MRC	25	350	6/17/2005 9:04	2060	587	75		
86	MRC	25	330	6/17/2005 9:06	2090	595	75		
					Min.	***527***			
					Max.	***798***			
					Mean	***643***			
					Std. Dev.	***59***			
					COV, %	***9***			

APPENDIX A.3

TRAFFIC HISTORY

CC2 Overlay Daily Traffic Repetitions

July 2005

Date	MRC (N)	MRC (S)	MRG	MRS	No. of Wheels North	No. of Wheels South	Wheel Load, Lbs.	Comments
7/7/2005	38	38	38	38	4	4	55,000	
7/8/2005	134	134	134	134	4	4	55,000	Rut Depth Measurements taken at pass 94 (132 total passes)
7/11/2005	26	26	26	26	4	4	55,000	Rut Depth Measurements taken at pass 26 (198 total passes)
7/11/2005	132	132	132	132	4	4	55,000	Rut Depth Measurements taken at pass 132 (330 total passes)
7/12/2005	462	462	462	462	4	4	55,000	Rut Depth Measurements taken at pass 462 (792 total passes)
7/13/2005	396	396	396	396	4	4	55,000	Rut Depth Measurements taken at pass 396 (1188 total passes)
7/14/2005	532	532	532	532	4	4	55,000	Rut Depth Measurements taken at pass 396 (1584 total passes)
7/15/2005	512	512	512	512	4	4	55,000	Rut Depth Measurements taken at pass 446 (2166 total passes)
7/18/2005	546	546	546	546	4	4	55,000	Rut Depth Measurements taken at pass 546 (2778 total passes)
7/19/2005	390	390	390	390	4	4	55,000	Rut Depth Measurements taken at pass 390 (3168 total passes)
7/20/2005	594	594	594	594	4	4	55,000	No Rut depth measurements taken
7/21/2005	462	462	462	462	4	4	55,000	Rut Depth Measurements taken at pass 330 (4092 total passes)
7/22/2005	576	576	576	576	4	4	55,000	Rut Depth Measurements taken at pass 330 (4554 total passes)
7/25/2005	284	284	284	284	4	4	55,000	Rut Depth Measurements taken at pass 284 (5084 total passes)
7/26/2005	220	220	220	220	6	4	65,000	Rut Depth Measurements taken at pass 66 (5150 total passes)
7/27/2005	570	570	570	570	6	4	65,000	Rut Depth Measurements taken at pass 372 (5676 total passes)
7/28/2005	594	594	594	594	6	4	65,000	Rut Depth Measurements taken at pass 396 (6270 total passes)
7/29/2005	560	560	560	560	6	4	65,000	Rut Depth Measurements taken at pass 338 (6806 total passes)
Monthly Total	**7028**	**7028**	**7028**	**7028**				

August 2005

Date	MRC (N)	MRC (S)	MRG	MRS	No. of Wheels North	No. of Wheels South	Wheel Load, Lbs.	Comments
8/1/2005	478	478	478	478	6	4	65,000	Rut Depths at pass 364 (7392 Total passes)
8/2/2005	612	612	612	612	6	4	65,000	Rut Depths at pass 348 (7854 Total passes)
8/3/2005	594	594	594	594	6	4	65,000	Rut Depths at pass 396 (8514 Total passes)
8/4/2005	132	132	132	132	6	4	65,000	Rut Depths before testing (8712 Total Passes)
8/5/2006	528	528	528	528	6	4	65,000	Rut Depths at pass 396 (9240 Total passes)
8/8/2005	628	628	628	628	6	4	65,000	Rut Depths at pass 396 (9768 Total passes)
8/9/2005	560	560	560	560	6	4	65,000	Rut Depths at pass 362 (10362 Total passes)
8/10/2005	443	443	443	443	6	4	65,000	Rut Depths at pass 330 (10890 Total passes)
8/11/2005	216	216	216	216	6	4	65,000	No Rut Depth measurements
8/12/2005	594	594	594	594	6	4	65,000	Skipping MRC-NE, Rut Depths at pass 396 (11616 Total passes)
8/15/2005	594	594	594	594	6	4	65,000	Skipping MRC-NE, Rut Depths at pass 396 (12210 Total passes)
8/16/2005	594	594	594	594	6	4	65,000	Skipping MRC-NE, Rut Depths at pass 396 (12804 Total passes)
8/17/2005	618	618	618	618	6	4	65,000	Skipping MRC-NE, Rut Depths at pass 396 (13398 Total passes)
8/18/2005	636	636	636	636	6	4	65,000	Skipping MRC-NE, Rut Depths at pass 372 (13992 Total passes)
8/19/2005	594	594	594	594	6	4	65,000	Skipping MRC-NE, Rut Depths at pass 396 (14652 Total passes)
8/22/2005	528	528	528	528	6	4	65,000	Skipping MRC-NE, Rut Depths at pass 330 (15180 Total passes)
8/23/2005		594	594	594	6	4	65,000	Rut Depths at pass 396 (15774 Total passes)
8/24/2005		330	330	330	6	4	65,000	Rut Depths at pass 330 (16302 Total passes)
Monthly Total	**8349**	**9273**	**9273**	**9273**				

September 2005

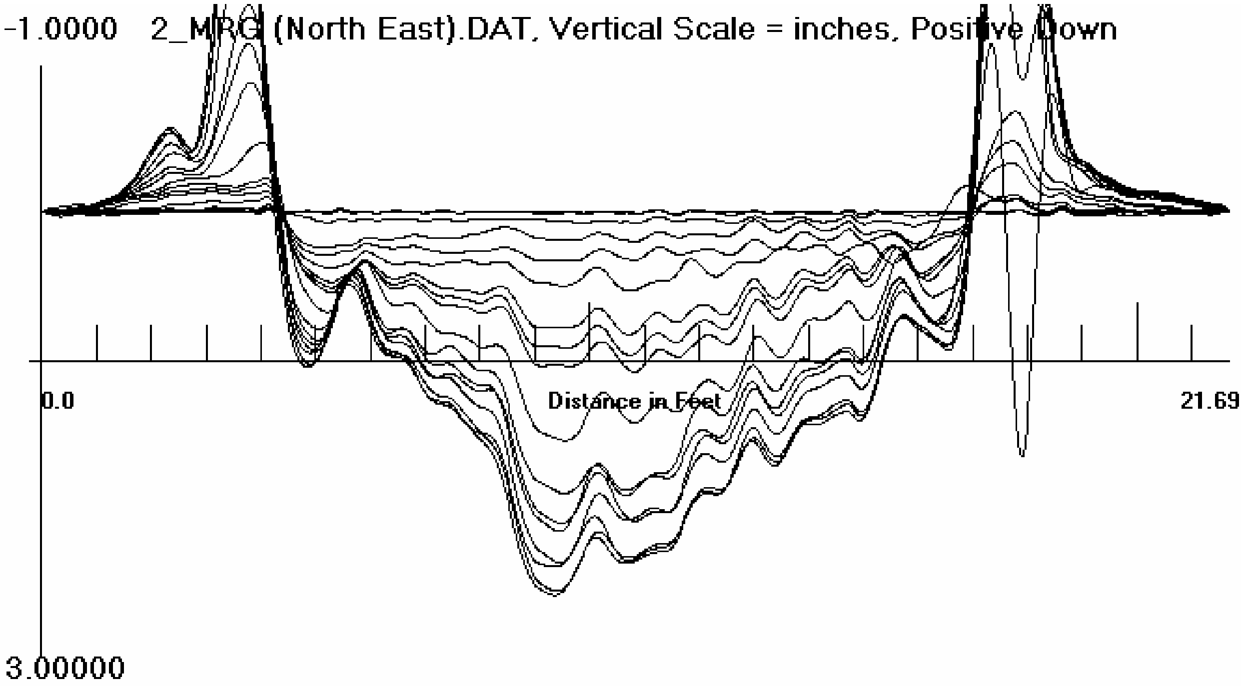
Date	MRC (N)	MRC (S)	MRG	MRS	No. of Wheels North	No. of Wheels South	Wheel Load, Lbs.	Comments
9/13/2005		298	298	298	6	4	65,000	No Rut depth measurements taken
9/14/2005		722	722	722	6	4	65,000	Rut Depths at pass 722 (17844 Total passes)
9/15/2005		738	738	738	6	4	65,000	Rut Depths at pass 522 (17844 Total passes)
9/16/2005		750	750	750	6	4	65,000	Rut Depths at pass 484 (18544 Total passes)
9/19/2005		462	462	462	6	4	65,000	Rut Depths at pass 462 (19272 Total passes)
9/20/2005		792	792	792	6	4	65,000	Rut Depths at pass 462 (19734 Total passes)
9/21/2005		792	792	792	6	4	65,000	Rut Depths at pass 464 (20528 Total passes)
9/22/2005		792	792	792	6	4	65,000	Rut Depths at pass 466 (21322 Total passes)
9/23/2005		726	726	726	6	4	65,000	Rut Depths at pass 726 (22374 Total passes)
9/26/2005		632	632	632	6	4	65,000	Rut Depths at pass 462 (22836 Total passes)
9/27/2005		724	724	724	6	4	65,000	Rut Depths at pass 724 (23730 Total passes)
9/28/2005		282	282	282	6	4	65,000	No Rut depth measurements taken
9/29/2005		110	110	110	6	4	65,000	Rut Depths at pass 12 (24024 Total passes)
9/30/2005		338	338	338	6	4	65,000	No Rut depth measurements taken
Monthly Total		**8158**	**8158**	**8158**				

October 2000

Date	MRC (N)	MRC (S)	MRG	MRS	No. of Wheels North	No. of Wheels South	Wheel Load, Lbs.	Comments
10/3/2005		224	224	224	6	4	65,000	Rut Depths at pass 224 (24684 Total passes)
10/4/2005		330	330	330	6	4	65,000	No Rut depth measurements taken
10/5/2005		264	264	264	6	4	65,000	Rut Depths at pass 264 (25278 Total passes)
10/6/2005		330	330	330	6	4	65,000	Rut Depths at pass 330 (25608 Total passes)
Monthly Total		**1148**	**1148**	**1148**				

APPENDIX A.4

PROFILE PLOTS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2_MRG (North East).DAT, Vertical Scale = inches, Positive Down
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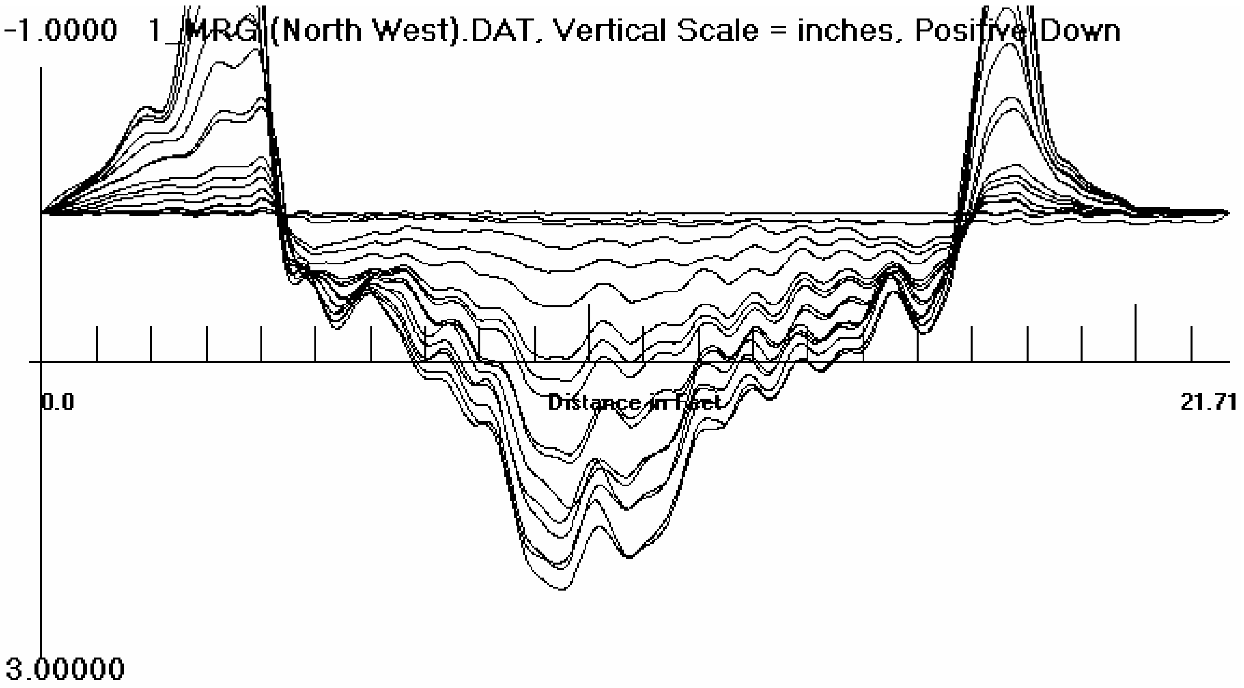
Distance in Feet
21.69
3.00000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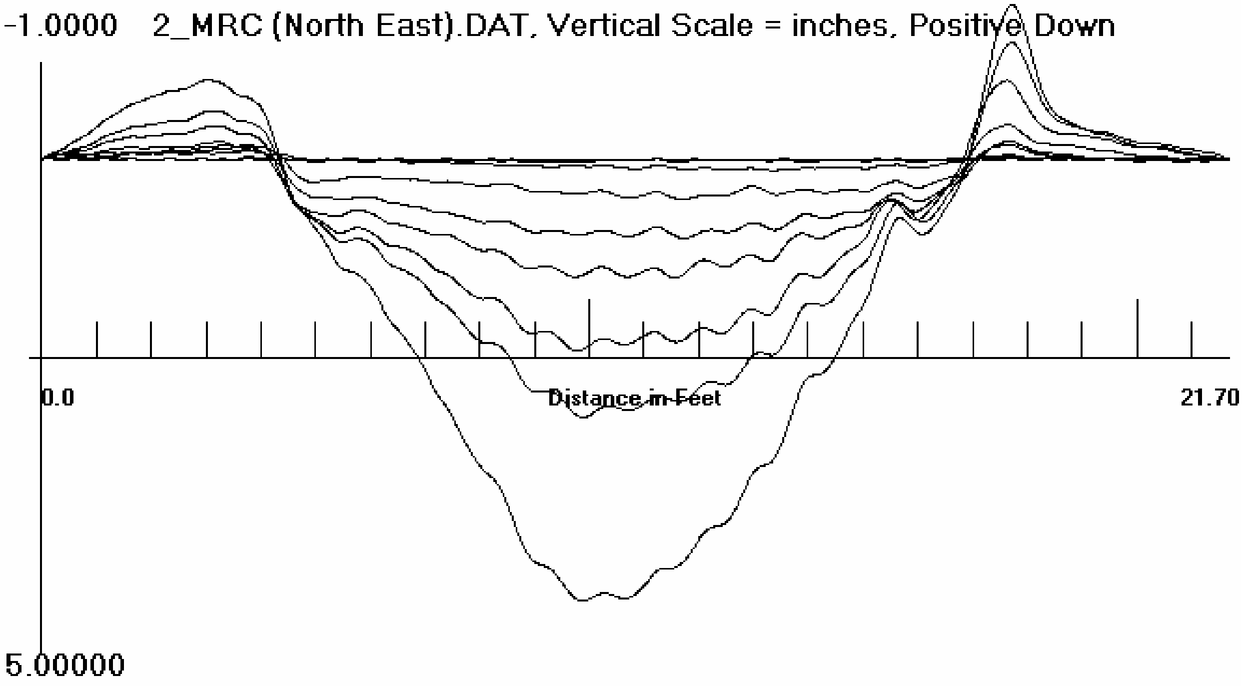
3.00000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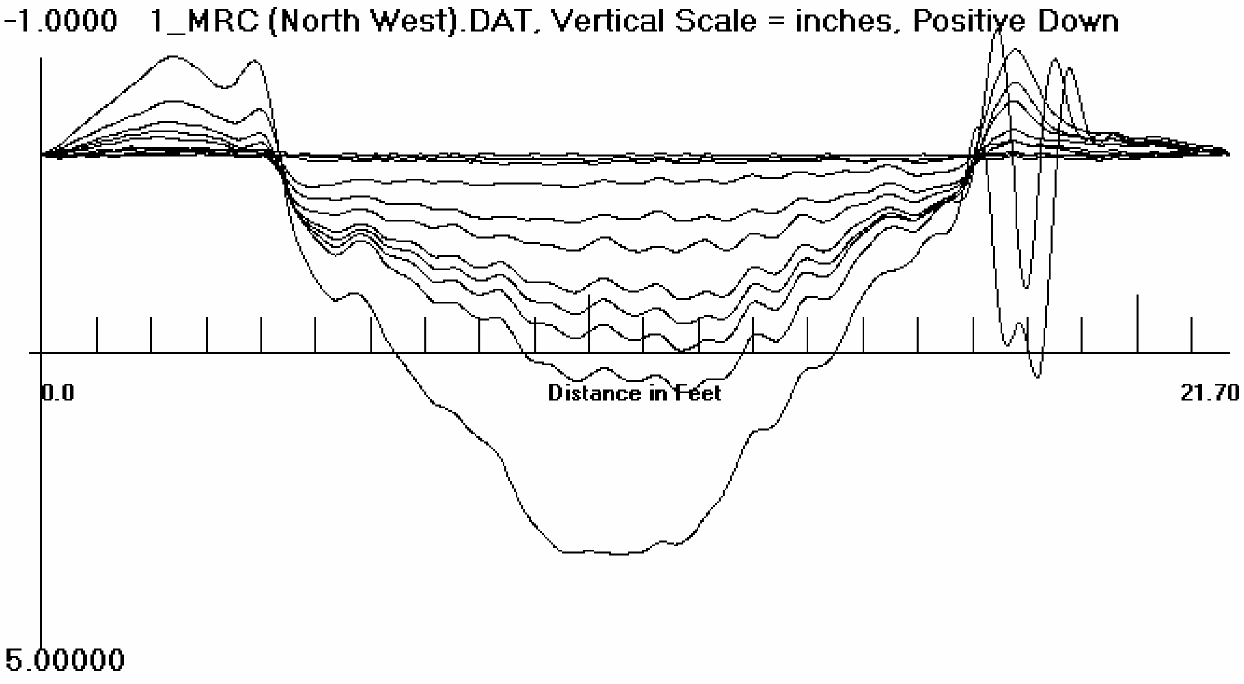
21.70
5.00000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1_MRC (North West).DAT, Vertical Scale = inches, Positive Down
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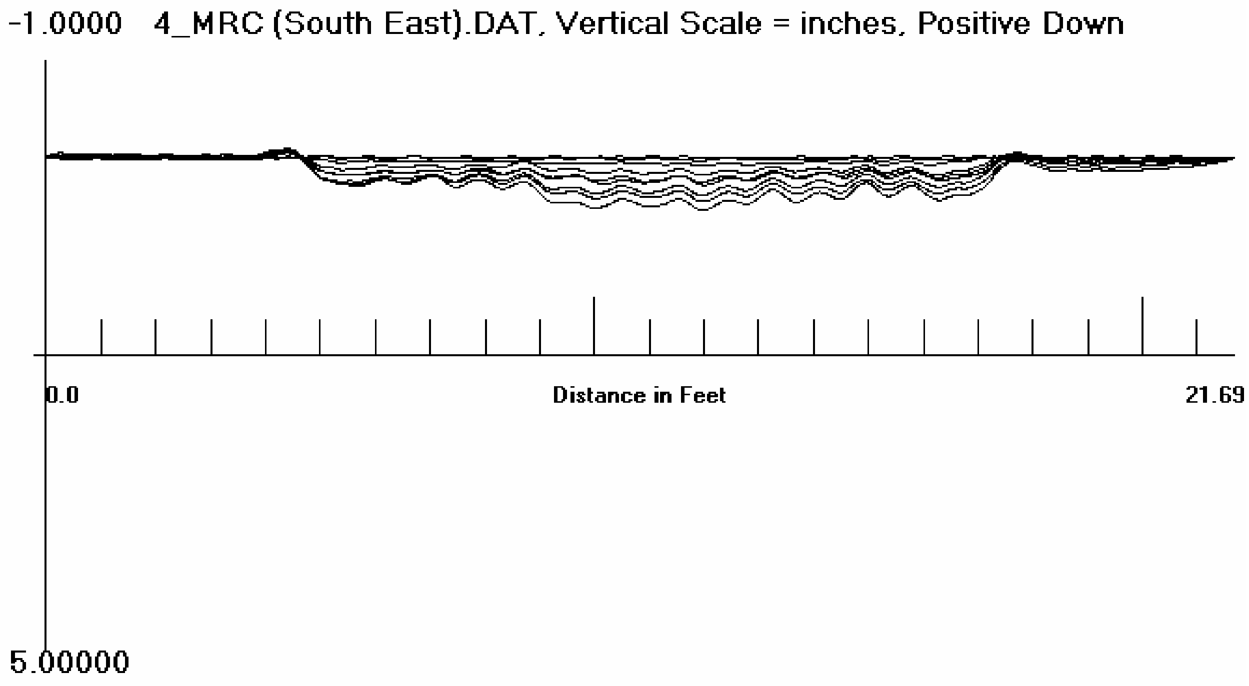
Distance in Feet
21.70
5.00000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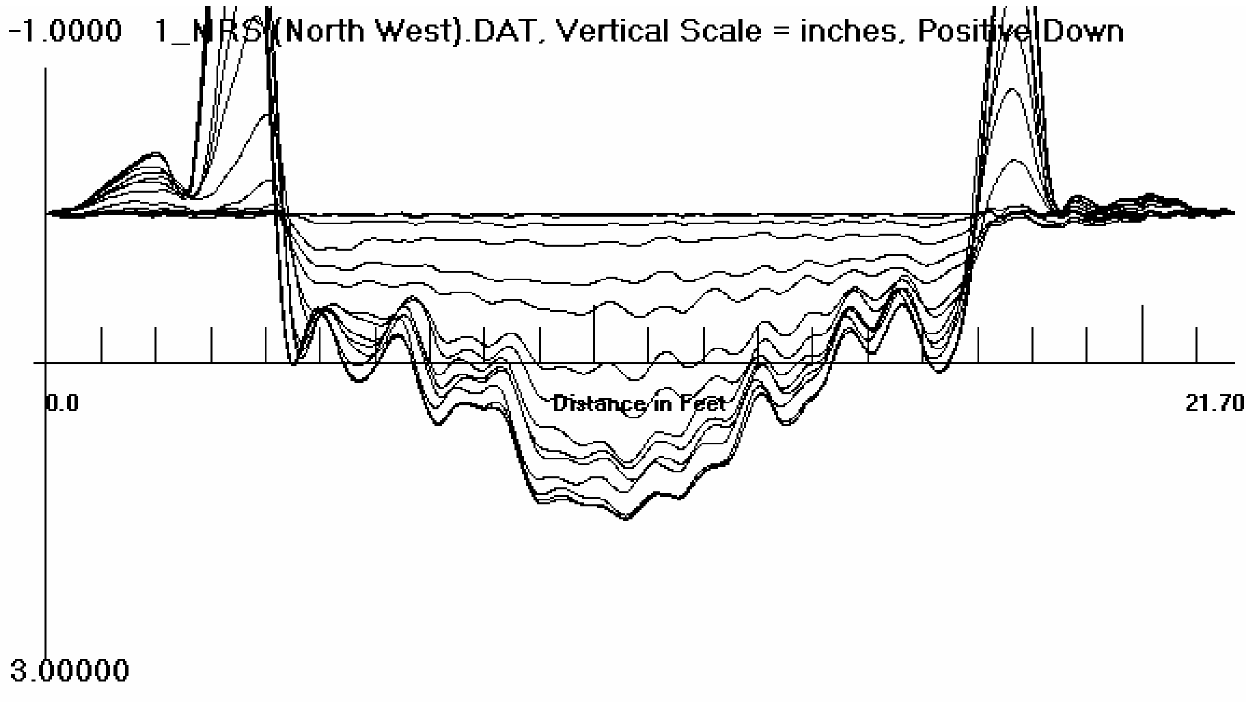
Distance in Feet
21.69
5.00000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Distance in Feet
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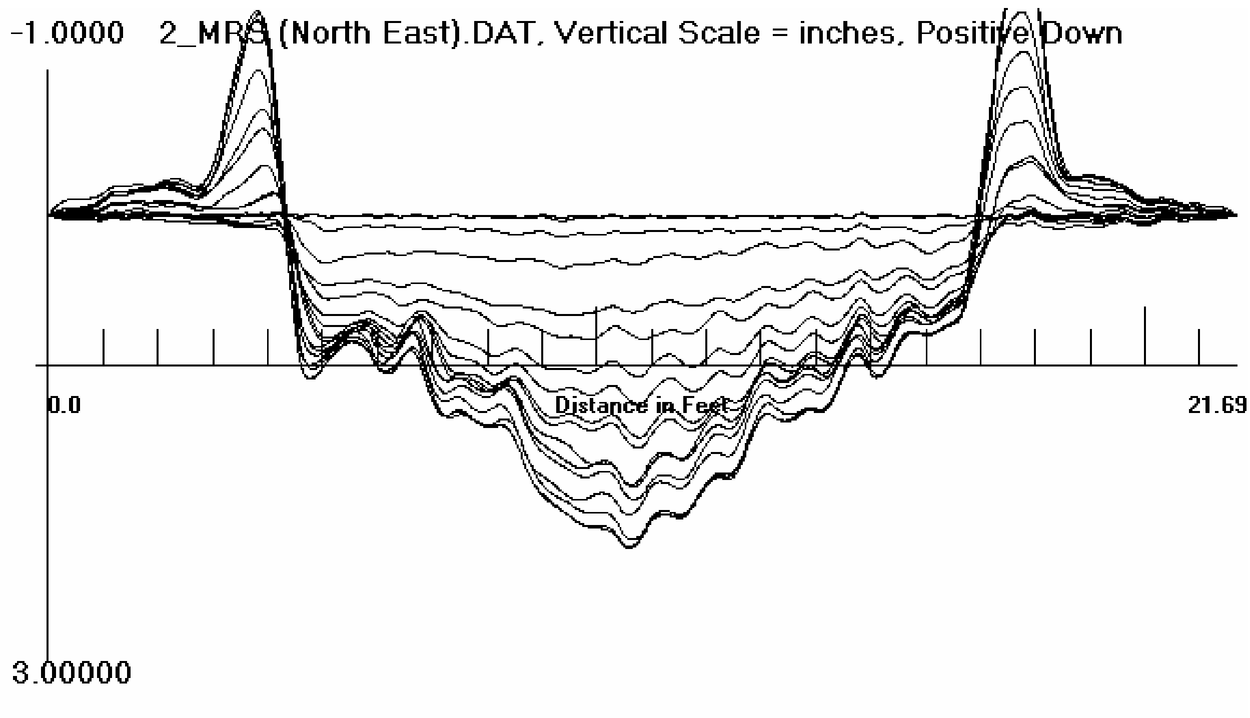
3.00000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Distance in Feet
21.69
3.00000

APPENDIX A.5

POST-TRAFFIC SUBGRADE CBR TEST RESULTS

TRENCH: **MRC-E**
LAYER: **SUBGRADE TOP**
TEST: **CBR**
DATE: **11/2/2005**

Test No.	Offset, feet	CBR	Mean CBR	Moisture Content, %
1	3	4.7	4.3	36.4
2		3.9		
3		-		
4	7	5.5	5.0	34.89
5		5		
6		4.6		
7	10	4.6	5.1	34.32
8		5.2		
9		5.4		
10	13	4.2	3.4	37.42
11		2		
12		4.1		
13	16	2.8	3.1	37.96
14		3.6		
15		3		
16	19	3.3	3.4	38.53
17		2.8		
18		4		
19	20	2.5	2.4	40.58
20		2.4		
21		2.3		
Average			**3.8**	**37.2**

TRENCH: **MRC-E**
LAYER: **1-FEET BELOW SUBGRADE TOP**
TEST: **CBR**
DATE: **11/16/2005**

Test No.	Offset, feet	CBR	Mean CBR	Moisture Content, %
1	6	8	7.6	30.56
2		7.1		
3		-		
4	13	9.3	9.4	29.18
5		9.4		
6		9.5		
7	18	8.8	9.3	30.78
8		9.7		
9		9.4		
10	20	8.8	8.7	30.93
11		8.4		
12		8.8		
13	3	-	-	-
14		-		
15		-		
16	9	-	-	-
17		-		
18		-		
19	15	-	-	-
20		-		
21		-		
22	24	-	-	-
23		-		
24		-		
Average			**8.7**	**30.4**

TRENCH: **MRC-W**
LAYER: **SUBGRADE TOP**
TEST: **CBR**
DATE: **11/1/2005**

Test No.	Offset, feet	CBR	Mean CBR	Moisture Content, %
1	7	5.2	5.3	35.18
2		5.1		
3		5.6		
4	10	5	4.9	33.67
5		4		
6		5.8		
7	13	5	5.0	32.34
8		5.2		
9		4.8		
10	16	3.7	4.1	34.35
11		4.2		
12		4.3		
13	19	4.2	4.4	33.84
14		4.7		
15		4.4		
16	3	-	-	36.03
17		-		
18		-		
19	22	-	-	35.82
20		-		
21		-		
Average			**4.7**	**33.9**

TRENCH: **MRC-W**
LAYER: **1-FEET BELOW SUBGRADE TOP**
TEST: **CBR**
DATE: **11/17/2005**

Test No.	Offset, feet	CBR	Mean CBR	Moisture Content, %
1	4	5.9	6.1	31.8
2		6		
3		6.4		
4	11	7.8	7.3	31.06
5		7.3		
6		6.8		
7	16	6.8	6.4	31.5
8		7		
9		5.3		
10	20	6.7	6.7	31.44
11		6.2		
12		7.3		
13	6	-	-	-
14		-		
15		-		
16	9	-	-	-
17		-		
18		-		
19	18	-	-	-
20		-		
21		-		
22	24	-	-	-
23		-		
24		-		
Average			**6.6**	**31.5**

TRENCH: **MRG**
LAYER: **SUBGRADE TOP**
TEST: **CBR**
DATE: **10/28/2005**

Test No.	Offset, feet	CBR	Mean CBR	Moisture Content, %
1	2	12.3	11.3	30.61
2		11.4		
3		10.3		
4	6	13	13.1	30.21
5		12.2		
6		14		
7	10	13.8	12.4	30.72
8		11.1		
9		12.3		
10	14	7.9	9.3	30.55
11		9.3		
12		10.6		
13	18	10.6	11.5	30.56
14		12.4		
15		11.4		
16	21	8.7	9.2	30.59
17		9.6		
18		9.4		
19	24		-	
20				
21				
Average			**11.1**	**30.5**

TRENCH: **MRG**
LAYER: **1-FEET BELOW SUBGRADE TOP**
TEST: **CBR**
DATE: **11/3/2005**

Test No.	Offset, feet	CBR	Mean CBR	Moisture Content, %
1	3	6.2	7.1	31.42
2		8.8		
3		6.4		
4	6	9.3	9.4	31.89
5		9		
6		9.9		
7	9	10.2	8.8	31.41
8		6.8		
9		9.3		
10	12	8	7.7	31.5
11		8.4		
12		6.7		
13	15	6.8	8.0	31.8
14		7.4		
15		9.9		
16	18	10.3	10.6	31.3
17		10.9		
18		10.6		
19	20	9.6	8.2	31.1
20		7.8		
21		7.2		
22	22	-	-	-
23		-		
24		-		
Average			**8.5**	**31.5**

TRENCH: **MRS**
LAYER: **SUBGRADE TOP**
TEST: **CBR**
DATE: **11/15/2005**

Test No.	Offset, feet	CBR	Mean CBR	Moisture Content, %
1	3	6	5.7	33.88
2		5.9		
3		5.2		
4	6	5.8	5.9	34.98
5		6		
6		6		
7	9	6.4	6.3	33.53
8		5.4		
9		7.1		
10	12	7.1	7.0	31.92
11		6.6		
12		7.2		
13	15	7.2	7.5	31.21
14		7.7		
15		7.6		
16	18	7.2	6.9	31.43
17		7.2		
18		6.4		
19	20	7	6.3	31.58
20		5.4		
21		6.6		
22	24	-	-	-
23		-		
24		-		
Average			**6.5**	**32.6**

TRENCH: **MRS**
LAYER: **1-FEET BELOW SUBGRADE TOP**
TEST: **CBR**
DATE: **11/21/2005**

Test No.	Offset, feet	CBR	Mean CBR	Moisture Content, %
1	5	8.6	8.8	30.3
2		9.8		
3		8		
4	12	10.8	10.3	30.34
5		10.4		
6		9.8		
7	15	10	10.4	30.37
8		10.3		
9		10.8		
10	20	9.7	9.8	30.06
11		10.2		
12		9.6		
Average			**9.8**	**30.3**