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<tr><td colspan="4">16. Abstract
A 5-year research project was sponsored by the Texas Department of Transportation (TxDOT) to evaluate the laboratory-field correlation for the Hamburg Wheel Tracking Device (HWTD) equipment. This equipment measures the combined effects of rutting and moisture damage by rolling a steel wheel across the surface of an asphalt concrete slab that is immersed in hot water. The HWTD was developed in the 1970s by Esso A.G. of Hamburg, Germany. The HWTD has been gradually gaining acceptance by some state highway agencies within the last 5 years. The test results from this laboratory equipment have been promising in regard to evaluating the moisture susceptibility of hot mix asphalt (HMA) mixtures. While there is some information on the relationship between the laboratory results from this test and the field performance, it is quite limited. This 5 year research project will be an important step in validating the test and ensuring that the test results could be reliably used to predict performance. The research includes a sequence of pertinent tasks. Briefly, these include monitoring the construction of test sections, collection of construction data, performance data over a 5-year period, performance of laboratory tests using the HWTD, and analysis of the collected information. This first report presents the results and findings of the lab tests, and information collected on test sections in the first year of this research project.</td></tr>
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CORRELATION OF FIELD PERFORMANCE TO HAMBURG WHEEL TRACKING DEVICE RESULTS

by

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Research Report 0-4185-1

Research Project 0-4185

conducted for the

Texas Department of Transportation

by the

CENTER FOR TRANSPORTATION RESEARCH
Bureau of Engineering Research
The University of Texas at Austin

October 2001

PREFACE

This is the first report from the Center for Transportation Research (CTR) on Project 4185. It presents the results and findings of the lab tests, and information collected from test sections for the first year of a 5-year project.

ACKNOWLEDGMENTS

This project has been initiated and sponsored by the Texas Department of Transportation (TxDOT). The financial support of TxDOT is greatly appreciated. The authors would like to thank TxDOT Project Director Miles Garrison for his guidance. Special thanks are extended to Richard Izzo and Dale Rand of TxDOT for their great assistance in conducting the laboratory tests. The assistance of the Atlanta District personnel is greatly appreciated. We are also grateful to Soheil Nazarian and Deren Yuan for their perseverance in carrying forward and conducting the Seismic Pavement Analyzer (SPA) testing.

DISCLAIMERS

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation.

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Research Supervisors

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CHAPTER 1. INTRODUCTION

SUMMARY

A 5-year research project was sponsored by the Texas Department of Transportation (TxDOT) to evaluate the laboratory-field correlation for the Hamburg Wheel Tracking Device (HWTD) equipment. This equipment measures the combined effects of rutting and moisture damage by rolling a steel wheel across the surface of an asphalt concrete slab that is immersed in hot water. The HWTD was developed in the 1970s by Esso A.G. of Hamburg, Germany. The HWTD has been gradually gaining acceptance by some state highway agencies within the last 5 years. The test results from this laboratory equipment have been promising in regard to evaluating the moisture susceptibility of hot mix asphalt (HMA) mixtures. While there is some information on the relationship between the laboratory results from this test and the field performance, it is quite limited. This 5-year research project will be an important step in validating the test and ensuring that the test results could be reliably used to predict performance. The research includes a sequence of pertinent tasks. Briefly, these include monitoring the construction of test sections, collection of construction data, performance data over a 5-year period, performance of laboratory tests using the HWTD, and analysis of the collected information. This first report presents the results and findings of the lab tests, and information collected on test sections in the first year of this research project.

BACKGROUND

Throughout the past 4 years, use of the HWTD in laboratory testing for moisture susceptibility of hot mix asphalt (HMA) mixtures has been extensively evaluated by the TxDOT Materials and Pavements Section, Construction Division (CSTM&P). The wheel-tracking test has shown to be a feasible alternative in evaluating moisture damage of HMA in the laboratory. However, no work has been performed in correlating field performance to test results produced from the Hamburg Wheel Tracking Device test.

The HWTD was developed in Germany to predict rutting potential of HMA. Since then approximately ten agency/suppliers have used this device in the U.S. Work completed in the bituminous laboratory of the TxDOT Construction Division has indicated that the device can be used to predict moisture damage susceptibility of HMA. In addition, visual observations of the wheel-tracked specimens have indicated that mixtures containing soft limestone undergo severe abrasion and aggregate degradation when tested in the Hamburg device.

To evaluate the laboratory-field correlation for the HWTD, nine test sections are being constructed on IH 20 in Harrison County. This research includes monitoring the construction of these test sections, collection of construction data, performance data through a 5-year period, performance of laboratory tests using the HWTD, and analysis of the collected information.

RESEARCH PROGRAM OBJECTIVES

The general objective of the research project is to determine the relationship between the hot mix asphalt concrete (HMAC) field performance and the HWTD test results. To achieve this objective the HWTD test will be conducted on mixtures with three different designs and three different types of aggregates. After that, nine test sections will be constructed using the different mixtures. Performance of the test sections will be monitored through a 5-year period. Finally, the field data and the laboratory test results will be analyzed to establish the correlation.

This 5-year research project will provide a reliable method of correlating the laboratory results from HWTD with the HMAC pavement performance. The procedures or recommendations developed during this research program could be used in district/area offices statewide. The potential benefits include a reliable method of predicting the mixture performance in regard to moisture susceptibility, so that proper materials could be selected for a specific project. The significant consequence will be improved pavement and cost saving for TxDOT.

PAST RESEARCH AND EXPERIENCE

The most extensive research on the HWTD can be found from the studies conducted by the Federal Highway Administration (FHWA) and the Colorado Department of Transportation (CDOT). The work by FHWA covers a wide range of materials and designs including dense-graded and stone-matrix asphalt mixtures, mixes from Westrack in Nevada, and also materials used in their full-scale testing with the Accelerated Loading Facility at Turner Fairbank Highway Research Center (4, 5, 6).

The extensive work conducted by CDOT covers issues such as influence of testing variables and compaction on the results as well as the effect of test temperature, air voids, aging, and antistripping agents (7, 8). The research efforts of CDOT resulted in a test procedure that is currently used by CDOT to evaluate HMA throughout the state for moisture damage. Currently, this state is the only one using a test method with HWTD to evaluate the moisture susceptibility of mixtures. The correlation between HWTD test results and the field performance is also reported by CDOT to a limited extent (7).

Within the last 3 years, TxDOT has been evaluating HWTD very extensively. TxDOT has been investigating the effect of temperature and different antistripping agents on the results. The tests have been conducted on mixtures with aggregate from various sources throughout the state. Limestone, gravel, basalt, and granite have been included in testing. One of the recent research efforts of TxDOT was concentrated on evaluating the repeatability and reproducibility of the HWTD (9). The goal has been to establish a reliable test method for the department.

Other state highway agencies, several universities, and private sector companies have also been looking into this equipment. Utah Department of Transportation, Purdue University, the University of Arkansas, and the Koch Materials Company are among the institutions that have been evaluating equipment similar to HWTD.

SUMMARY OF THE WORK COMPLETED

In the first year of this research project, ten mixture designs were completed. Designs prepared for this project include one Type B mixture and nine surface mixtures meeting specifications for Type C, 12.5 mm Superpave, and CMHB-C mixtures. Each surface mixture type was designed with coarse aggregate of siliceous gravel, quartzite, and sandstone sources. Type B mixture was designed with limestone aggregate. These mixture designs were tested with the HWTD at the CSTM&P, TxDOT.

The location of the nine test sections was selected and the construction started. The test sections were located on IH 20 in Harrison County, Atlanta District. Plans, specifications, and estimates were prepared for the test sections. The same materials used for designing the mixes were used in the test sections.

The pavement condition after milling and before placement of the HMAC was surveyed. This survey included the collection of general information on the severity of different types of distresses as explained in Strategic Highway Research Program (SHRP) Distress Identification Manual. Technical data was collected through the use of a profiler, an Air Launch GPR, a falling weight deflectometer, and a seismic pavement analyzer.

The HWTD tests were conducted on two laboratory-prepared specimens following the gradation and asphalt content selected in design, and delivering 7±1 percent air voids. Results of these tests are presented in this report.

CHAPTER 2. EQUIPMENT USED IN THIS RESEARCH

Field performance monitoring on test sections through a 5-year period will include a visual survey that involves collecting general information on the severity of different types of distresses. Also, performance data will be collected through the use of a falling weight deflectometer (FWD), seismic pavement analyzer (SPA), an inertial profiler, and ground penetrating radar (GPR). A brief description of the Hamburg Wheel Tracking Device (HWTD) and the performance-monitoring equipment is presented in this chapter.

HAMBURG WHEEL TRACKING DEVICE

The HWTD was developed in Hamburg, Germany, in the 1970s by Esso A.G. This machine measures the combined effects of rutting and moisture damage by rolling a steel wheel across the surface of an asphalt concrete specimen that is immersed in hot water.

The HWTD test is conducted on a pair of samples simultaneously. Originally, only cubical shaped specimens could be tested. The test can now be performed on both cubical and cylindrical specimens. The cubical specimens are approximately 320 mm long, 260 mm wide, and 40 mm thick. The cylindrical specimens are 150 to 300 mm in diameter and about 40 mm thick. The sample is typically compacted to 7±1 percent air voids. The plate type compactor has been proposed for compacting the specimens. However, use of cylindrical specimens makes it possible to obtain compacted specimens very easily with the aid of the gyratory compactors. Figure 2.1 shows the HWTD equipment.

Figure 2.1 Hamburg Wheel Tracking Device

Traditionally the tests have been performed underwater at 50 °C, even though the temperature can vary between 25 °C to 70 °C. A steel wheel, 47 mm wide, loads the sample with 705 Newtons of load. The wheel makes 50 passes per minute over each sample. The maximum velocity of the wheel is 340 mm/sec in the center of the sample. Each sample is loaded for 20,000 passes or until 20 mm of deformation occurs. Approximately 6.5 hours are required for a test, even though in many cases the samples have failed in a much shorter period of time.

The test results from the HWTD include the post-compaction consolidation, the creep slope, stripping slope, and stripping inflection point (Figure 2.2). The results have been defined by Hines (1). The post-compaction consolidation is the deformation (mm) at 1,000 wheel passes. It is called post-compaction consolidation because it is assumed that the wheel is densifying the mixture within the first 1,000 wheel passes.

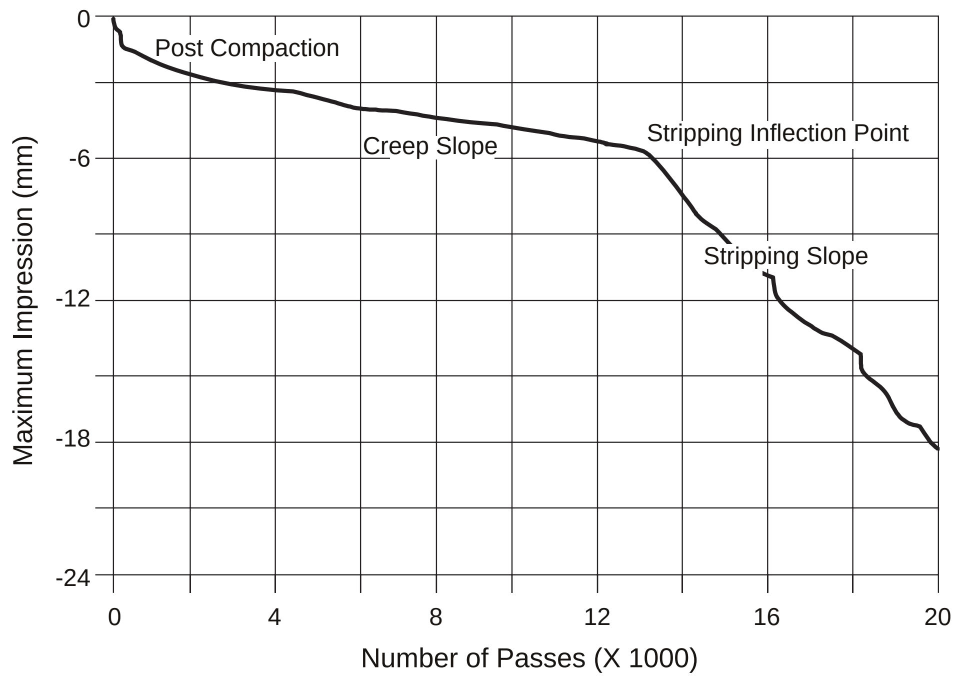

Figure 2.2 Definition of the Hamburg Wheel Tracking Device Results (1)

The creep slope relates to rutting from plastic flow. It is the inverse of the rate of deformation (wheel passes per 1 mm rut depth) in the linear range of the deformation curve, between the post-compaction consolidation and the stripping inflection point. The creep slope is used to measure rutting susceptibility. It measures the accumulation of permanent deformation primarily owing to mechanisms other than moisture damage. Creep slopes have been used to evaluate rutting susceptibility instead of rut depths because the number of wheel passes at which moisture damage starts to affect performance varies widely from mixture to mixture. Furthermore, the rut depths often exceed the maximum measurable rut depth of 25 to 30 mm, even if there is no moisture damage.

The stripping slope is the inverse of the rate of deformation in the linear region of the deformation curve, after stripping begins and until the end of the test. This slope measures the accumulation of permanent deformation primarily owing to moisture damage. It is the inverse of the rate of deformation (wheel passes per 1 mm rut depth) after the stripping inflection point. The stripping slope would then represent the number of passes required to create a 1 mm impression from stripping. The stripping slope is related to the severity of moisture damage.

The stripping point is the number of passes at the intersection of the creep slope and the stripping slope. It is related to the resistance of the hot mix asphalt (HMA) to moisture damage. After this point moisture damage starts to dominate performance. The Colorado Department of Transportation (CDOT) reports that an inflection point below 10,000 wheel passes indicates moisture susceptibility (3).

To report the creep slope and the stripping slope in terms of wheel passes, inverse slopes are used. Higher creep slopes, stripping inflection points, and stripping slopes indicate less damage (4). The City of Hamburg specifies a rut depth of less than 4 mm after 20,000 passes. A previous study (2) found that this specification is very severe for pavements in Colorado. A rut depth of less than 10 mm after 20,000 passes may be more reasonable. Additionally, the test temperature should be adjusted based upon the environment in which the mixture will be placed. The recommendation has been documented elsewhere (3).

The shape of the curve in Figure 2.2 is the same as typical permanent deformation curves provided by creep and repeated load tests. The curves from these tests are also broken down into three regions. The final region, called the tertiary region, is where the specimen is rapidly failing. Based on the examination of many slabs and pavement cores, the tertiary regions of the curves produced by the HWTD appear to be primarily related to moisture damage, rather than to other mechanisms that cause permanent deformation, such as viscous flow. Mixtures that are susceptible to moisture damage also tend to start losing fine aggregates around the stripping inflection point, and coarse aggregate particles may become dislodged. However, there is no method for separating the deformation owing to viscous flow from the deformation resulting from moisture damage, because dry specimens cannot be tested. There is also no method for determining the amount of deformation and the amount of fine particles generated if any of the aggregate particles are crushed by the steel wheel (5).

Additional disadvantages are that the data cannot be used in mechanistic pavement analyses and cannot be used to determine the modulus of the mixture or layer coefficients used by American Association of State Highway and Transportation Officials (AASHTO) thickness design procedures. This is due to the complex and unknown state of stress in the slab.

SEISMIC PAVEMENT ANALYZER

The Seismic Pavement Analyzer (SPA) was developed in 1992 by The University of Texas at El Paso (UTEP) under a Strategic Highway Research Program (SHRP) contract. During its initial testing, the SPA showed promise in identifying distress precursors in pavements at their early stages of deterioration. Knowing the earliest point at which pavements begin to significantly deteriorate gives maintenance engineers an opportunity to perform preventive maintenance to extend the life of the pavement. Preventive maintenance is by far less costly than repairing pavement after it visibly shows distresses.

The SPA is a small trailer equipped with eight transducers and two pneumatic hammers. The trailer is towed to the test site, and the hammers and transducers are lowered to the pavement surface. The hammers then strike the pavement, producing vibrations that are picked up by the transducers, which relay the data to a computer onboard the vehicle towing the SPA. The test is almost fully automated and takes only about 1 minute.

The data is analyzed by a computer software program, which then generates a report describing the condition, thickness, and stiffness of the pavement; any defects in the pavement subgrade; and other properties that are related directly to pavement performance.

The device could be used to pinpoint the location of problems in the pavement or subgrade. It could also reveal the severity of a problem, which would help engineers then select the best maintenance or repair method. In addition, it could be used to test how well a repair or maintenance treatment is working.

GROUND PENETRATING RADAR

GPR is a nondestructive method that produces a continuous cross-sectional profile or record of subsurface features without drilling the pavement. GPR operates by transmitting pulses of ultrahigh frequency radio waves (microwave electromagnetic energy) down into the ground through a transducer or antenna.

A GPR system radiates short pulses of high-frequency EM energy into the ground from a transmitting antenna. This EM wave propagates into the ground at a velocity that is related to the electrical properties of subsurface materials (specifically, the materials' relative dielectric permitivity). When this wave encounters the interface of two materials having different dielectric properties (i.e., soil and water), a portion of the energy is reflected back to the surface where it is detected by a receiver antenna and transmitted to a control unit for processing and display.

When the transmitted signal enters the ground, it contacts objects or subsurface strata with different electrical conductivities and dielectric constants. Part of the ground penetrating radar waves reflect off of the object or interface while the rest of the waves pass through to the next interface. The reflected signals return to the antenna, pass through the antenna, and are received by the digital control unit. The control unit registers the reflections against two-way travel time in nanoseconds and then amplifies the signals. The output signal voltage peaks are plotted on the GPR profile as different color bands by the digital control unit. For each reflected wave, the radar signal changes polarity twice. These polarity changes produce three bands on the radar profile for each interface contacted by the radar wave.

Depth penetration is a function of antenna frequency and the electrical conductivity of the pavements in the survey area. Lower frequency antennas achieve greater depth penetration than higher frequency antennas, but have poorer spatial resolution.

FALLING WEIGHT DEFLECTOMETER

FWDs are systems for performing nondestructive testing of pavement and other foundation structures. The system develops forces from the acceleration caused by the arrest of a falling weight and these forces are transmitted onto the surface of a structure causing it to deflect, much as it would due to the weight of a passing wheel load. The mass is dropped from a chosen height generating a dynamic load. The pulse load produced by the FWD simulates the effect of a moving wheel load in magnitude. The applied load is measured by a heavy-duty load cell and the load is transmitted to the pavement through a plate (300 mm diameter) resulting in a deflection of the pavement surface. The deformation of the structure is referred to as a "deflection basin." FWD uses a series of user-positioned velocity sensors to automatically determine the amplitude and shape of this deflected basin. The deflection response, when related to the applied loading, can provide information about the strength and condition of the various elements of the test structure. In general, this deflection response is used for evaluation of multi-layer pavement structures and back-calculation of the elastic moduli.

The measured set of data (peak load, deflection values, distance from start point, air and surface temperatures) is displayed on the microcomputer for direct visual inspection and is printed out and stored on disk when accepted by the operator.

Information about layer thicknesses and expected traffic load during the desired period, combined with the FWD-generated data, enable the calculation of the elastic moduli of the pavement. Structural analyses to determine the bearing capacity and to estimate expected service life and required overlay are easy and fast with the developed computer programs.

CHAPTER 3. MATERIALS AND MIXTURE DESIGNS

MATERIALS

A PG 76-22 binder was used for this project. The source of the binder was Wright Asphalt of Houston, Texas. The same asphalt binder was used for all ten mix designs prepared for this project.

Table 3.1 Aggregates Used for Different Surface Mixture Designs

	12.5 mm Superpave	CMHB-C	Type C	TOTAL
Gravel	1	1	1	3
Quartzite	1	1	1	3
Sandstone	1	1	1	3
TOTAL	3	3	3	

The surface mixtures, Type C, 12.5 mm Superpave, and CMHB-C mixture, were designed with coarse aggregate of gravel, quartzite, and sandstone sources. Table 3.1 shows the aggregates used for each surface mixture design. As can be seen from this table, nine different surface mixture designs were prepared for this project. Only one base course was designed for this project. This Type B base course, which was designed with 90 percent limestone from Hanson and 10 percent field sand from Marshall, was used in all test sections. Sources of aggregates and binder for each mix design were listed in Table 3.2.

Table 3.2 Sources of the Materials Used in This Research Project

ID Marks	Mix Design	Aggregate Type	Aggregate Source	Aggregate Location
A 0111 (H 01-07)	12.5 mm Superpave	Siliceous Gravel	Hanson	Prescott
A 0112 (H 01-08)	12.5 mm Superpave	Sandstone	Meridian	Sawyer
A 0113 (H 01-09)	12.5 mm Superpave	Quartzite	Martin Marietta	Jones
A 0114 (H 01-15)	CMHB-C	Siliceous Gravel	Hanson	Prescott
A 0115 (H 01-16)	CMHB-C	Quartzite	Martin Marietta	Jones
A 0116 (H 01-17)	CMHB-C	Sandstone	Meridian	Sawyer
A 0117 (H 01-18)	Type C	Siliceous Gravel	Hanson	Prescott
A 0118 (H 01-19)	Type C	Quartzite	Martin Marietta	Jones
A 0119 (H 01-20)	Type C	Sandstone	Meridian	Sawyer
A 0120 (H 01-21)	Type B	Limestone	Hanson	Perch Hill

MIXTURE DESIGNS

Summary about the design information for the mixes used in this project are presented in this part. For this project, three 12.5 mm Superpave mixes, three CMHB-C mixes, three Type C mixes, and one Type B base course were designed.

The nominal maximum aggregate size for all three Superpave mixes designed for this project is 12.5 mm. For each Superpave mix design, three trial blends were attempted. These trial blends were evaluated by compacting specimens and determining the volumetric properties of each trial blend. Acceptable trial blends were selected for each Superpave mix design. After the selection of trial blends, specimens were compacted at three different asphalt contents. Volumetric properties were calculated at the design number of gyration. Based on the estimated relations between asphalt content and volumetric properties, the design asphalt contents were established at 4 percent air voids.

Superpave Mixes

The first Superpave mix is composed of 67 percent siliceous gravel, 32 percent limestone screenings, and 1 percent lime. The design asphalt binder content for this mix is 5.0

percent. The second Superpave mix is composed of 91 percent sandstone, 8 percent igneous screenings and 1 percent lime. The design asphalt binder content for this mix is 5.1 percent. The third Superpave mix is composed of 89 percent quartzite, 10 percent igneous screenings, and 1 percent lime. The design asphalt binder content is 5.1 percent. All three Superpave mix designs' gradations are passing under the Superpave restricted zone. Table 3.3 shows the aggregate gradations for these mixes.

Table 3.3 Aggregate Gradations for Superpave Mixes

Sieve Size	**Cumulative Pass A0111(H01-07) Siliceous Gravel**	**Cumulative Pass A0112(H01-08) Sandstone**	**Cumulative Pass A0113(H01-09) Quartzite**
19	100	100	100
12.5	92	92.1	93.7
9.5	84.8	79.4	81.7
4.75	52.4	49	45.5
2.36	30.9	29.2	31.4
1.18	20.4	22.4	21
0.6	13.9	18.9	17.7
0.3	8.8	14.9	11.8
0.15	4.5	10.2	8.2
0.075	3.2	6.5	5.6

Table 3.4 summarizes the mixture properties for Superpave mixes at design binder contents. Because all of the Superpave mixes are 12.5 mm, a minimum of 14.0 percent VMA value was used as criteria. As can be seen from Table 3.4, based on the expected traffic level, specification for VFA is selected between 65 to 75 percent. Densification requirements at the initial number of gyrations and maximum number of gyrations are maximum 89.0 percent and 98.0 percent, respectively. An acceptable dust portion (DP) ranges from 0.6 to 1.2 for all Superpave mixtures. All three Superpave mixes satisfy all the specified requirements.

Table 3.4 Summary of Design Mixture Properties for Superpave Mixes

ID Marks	% Air Voids	% VMA	%VFA	%G_{mm}@N_{ini}	%G_{mm}@N_{max}	DP
A 0111 (H 01-07)	3.7	15.3	73.9	86.9	97.5	0.6
A 0112 (H 01-08)	3.8	15.1	73.1	86.0	97.4	1.3
A 0113 (H 01-09)	3.8	15.6	73.1	86.5	97.4	1.1
Specifications	4.0±1.0	14.0 min	65 -75	Max. 89.0	Max. 98.0	0.6 – 1.2

CMHB-C Mixes

The first CMHB-C mix is composed of 79 percent siliceous gravel, 20 percent igneous screenings, and 1 percent lime. The design asphalt binder content for this mix is 4.7 percent. The second CMHB-C mix is composed of 87 percent quartzite, 12 percent igneous screenings, and 1 percent lime. The design asphalt binder content for this mix is 4.8 percent. The third CMHB-C mix is composed of 87 percent sandstone, 12 percent igneous screenings, and 1 percent lime. The design asphalt binder content is 4.8 percent. Table 3.5 shows the aggregate gradations for these mixes.

Table 3.5 Aggregate Gradations for CMHB-C Mixes

Sieve Size	Cumulative Pass A0114(H01-15) Siliceous Gravel	Cumulative Pass A0115(H01-16) Quartzite	Cumulative Pass A0116(H01-17) Sandstone
7/8"	100	100	100
5/8"	99.7	99.6	100
3/8"	64.5	65.6	65.4
#4	34.3	34.2	38
#10	21.8	24	24
#40	16.2	14.5	16.4
#80	9.8	9.1	10.9
#200	6.4	5.9	6.4

Table 3.6 shows the volumetric properties for CMHB-C mixes. A 0114 (H 01-15) and A 0115 (H 01-16) mixes has 4.8 percent asphalt content and A 0116 (H 01-17) has 4.7 percent asphalt content. The level of air void at design is 3.5 percent for CMHB-C mixes.

Table 3.6 Summary of Design Mixture Properties for CMHB-C Mixes

ID Marks	% Asphalt	% Air Voids	% VMA
A 0114 (H 01-15)	4.7	3.5	14.1
A 0115 (H 01-16)	4.8	3.5	14.6
A 0116 (H 01-17)	4.8	3.5	14.1

Type C Mixes

Aggregate gradations for Type C mixes are shown in Table 3.7. The first Type C mix is composed of 61 percent siliceous gravel, 30 percent limestone screening, 8 percent igneous screenings and 1 percent lime. The design asphalt binder content for this mix is 4.4 percent. The second Type C mix is composed of 91 percent quartzite, 8 percent igneous screenings and 1 percent lime. The design asphalt binder content for this mix is 4.6 percent. The third Type C mix is composed of 99 percent sandstone and 1 percent lime. The design asphalt binder content for this one is 4.5 percent.

Table 3.7 Aggregate Gradations for Type C Mixes

Sieve Size	Cumulative Pass A0119(H01-20) Siliceous Gravel	Cumulative Pass A0117(H01-18) Quartzite	Cumulative Pass A0118(H01-19) Sandstone
7/8"	100	100	100
5/8"	100	99.8	99.8
3/8"	75.8	79.1	80.7
#4	49.2	51.4	46.2
#10	31.5	34	30.9
#40	18.2	17.9	15.6
#80	11.7	10	9.6
#200	5.8	5.3	5.8

Table 3.8 summarizes the results of stability, TSR (tensile strength ratio), and the Hamburg Wheel Tracking Device (HWTD) tests. The lowest stability value was recorded as 41 on the A 0113 (H 01-09) Superpave mix, and the highest value is recorded as 51 on the A 0112 (H 01-08) Superpave mix. Stability tests were not conducted on the A 0115 (H

01-16) and A 0116 (H 01-17) mixes. The highest TSR value was recorded as 1.06 on the A 0118 (H 01-19) Type C mix and the lowest value was recorded as 0.90 on the A 0119 (H 01-20) Type C mix. HWTD tests were conducted for 20,000 passes. The deformations recorded after 20,000 passes are shown in Table 3.8. The highest deformation observed was 3.1 on the A 0111 (H 01-07) Superpave mix and the lowest deformation recorded was 1.4 on the A 0116 (H 01-17) CMHB-C mix.

Table 3.8 Summary of Stability, TSR, and HWTD Tests Results

ID Marks	Aggregate Type	Mix Design	Stability	TSR	HWTD (mm)
A 0111 (H 01-07)	Siliceous Gravel	12.5 mm Superpave	43	0.97	3.1
A 0112 (H 01-08)	Sandstone	12.5 mm Superpave	51	0.93	1.8
A 0113 (H 01-09)	Quartzite	12.5 mm Superpave	41	0.94	2.2
A 0114 (H 01-15)	Siliceous Gravel	CMHB-C	42	0.99	2.5
A 0115 (H 01-16)	Quartzite	CMHB-C	-	0.99	2.7
A 0116 (H 01-17)	Sandstone	CMHB-C	-	1.05	1.4
A 0117 (H 01-18)	Siliceous Gravel	Type C	48	0.96	2.5
A 0118 (H 01-19)	Quartzite	Type C	50	1.06	2.2
A 0119 (H 01-20)	Sandstone	Type C	43	0.90	1.6
A 0120 (H 01-21)	Limestone	Type B	46	0.92	2.9

CHAPTER 4. HAMBURG WHEEL TRACKING DEVICE TEST RESULTS

For each mix design, two Hamburg Wheel Tracking Device (HWTD) specimens were prepared and tested. Because all of the HWTD specimens were prepared with PG 76-22 binder, specimens were tested at 50 °C. The HWTD specimens were prepared by a Superpave Gyratory Compactor (SGC) at 7 ± 1 percent air voids. One HWTD test specimen consists of two SGC specimens. The specimens were secured in the mounting tray with two molds and two spacer plates. The spacer plates, which aid in securing the configuration, are placed behind each mold at opposite ends. Figure 4.1 illustrates a top view of the setup. The SGC specimens were fabricated with a diameter of 152 mm (6 in.) and a height of 62 ± 2 mm (2.4 ± 0.1 in). The specimens were sawed to fit into the molds. The sawed portion was about 5 percent of one specimen's total volume. Before starting testing, the specimens were tightly fastened in the mounting tray. SGC specimens were adequately secured so that movement during testing did not occur other than the degradation resulting from the test. The testing matrix is presented in Table 4.1.

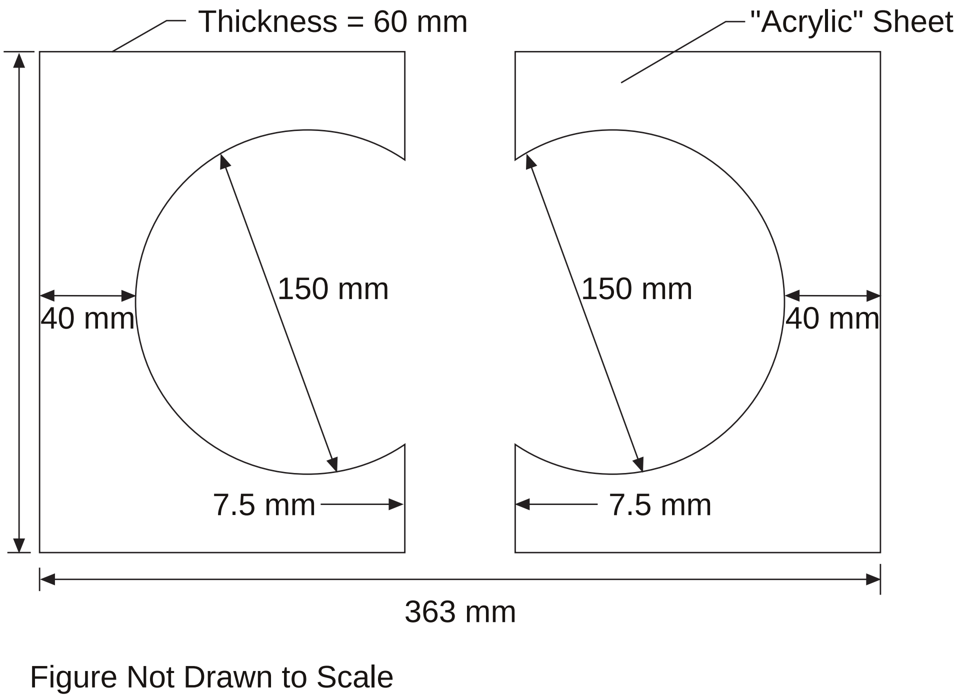

Figure 4.1 Top View of the Test Setup (9)

Table 4.1 HWTD Testing Matrix for the HWTD Specimens

ID Marks	Mix Design	No. of Specimens	No. of HWTD Tests
A 0111 (H 01-07)	12.5 mm Superpave	2	1
A 0112 (H 01-08)	12.5 mm Superpave	2	1
A 0113 (H 01-09)	12.5 mm Superpave	2	1
A 0114 (H 01-15)	CMHB-C	2	1
A 0115 (H 01-16)	CMHB-C	2	1
A 0116 (H 01-17)	CMHB-C	2	1
A 0117 (H 01-18)	Type C	2	1
A 0118 (H 01-19)	Type C	2	1
A 0119 (H 01-20)	Type C	2	1
A 0120 (H 01-21)	Type B	2	1
TOTAL		18	9

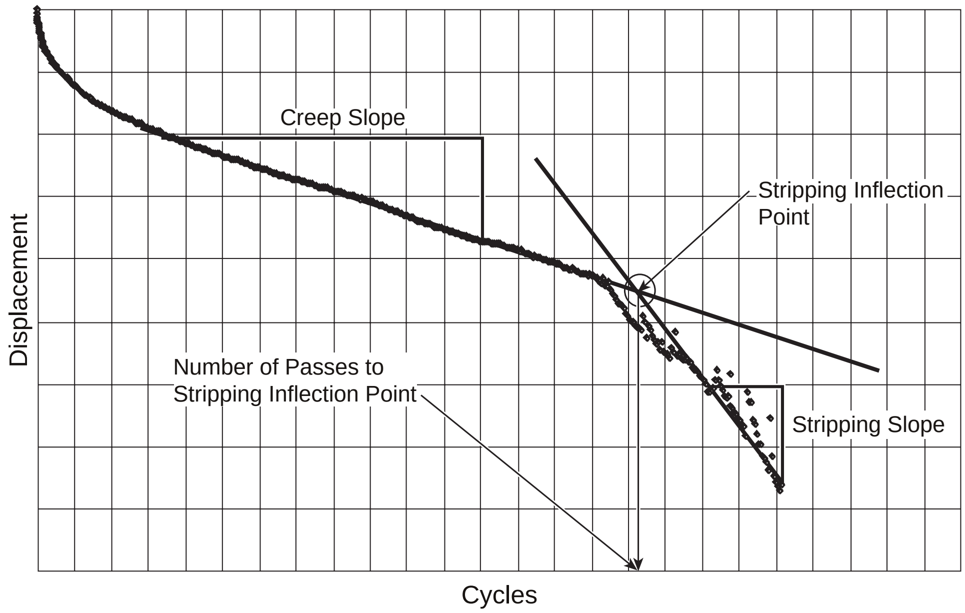

Figure 4.2 Rut Depth versus Number of Wheel Passes Graph with Test Parameters

The HWTD test data was analyzed to determine the post-compaction consolidation, creep slope, stripping inflection point, stripping slope, and deformation values at 20,000 wheel passes. Figure 4.2 shows an example of a test result with these parameters. The post-compaction consolidation data, which shows the densification of the mix in the early stages of the testing, was recorded. The creep slope of the test data, which is used to measure rutting susceptibility, was measured. The creep slope measures the accumulation of permanent deformation primarily owing to mechanisms other than moisture damage. The stripping inflection point is the number of wheel passes at the intersection of the creep slope and the stripping slope. After this point, moisture damage starts to dominate performance. The stripping slope measures the accumulation of permanent deformation primarily owing to moisture damage.

Table 4.2 shows the deformation on the specimens after 1,000; 5,000; 10,000; 15,000; and 20,000 wheel passes. Graphs showing the relation between deformation and number of passes are included in Appendix A. Two of the files were deleted from the testing computer. The values for the specimens A 0119 (H 01-20), which is Type C mix composed of sandstone, and A 0120 (H 01-21), which is Type B mix, were not available.

Table 4.2 Rut Depth at Different Number of Wheel Passes

ID Marks	**Cycles**				
	1,000	5,000	10,000	15,000	20,000
A 0111 (H 01-07)	1.05	2.09	2.53	2.89	3.13
A 0112 (H 01-08)	0.80	1.30	1.51	1.64	1.76
A 0113 (H 01-09)	0.96	1.59	1.84	2.04	2.16
A 0114 (H 01-15)	0.82	1.47	1.96	2.28	2.54
A 0115 (H 01-16)	1.09	1.69	1.96	2.15	2.66
A 0116 (H 01-17)	0.74	1.14	1.11	1.31	1.42
A 0117 (H 01-18)	0.97	1.52	1.97	2.24	2.48
A 0118 (H 01-19)	1.20	1.76	1.99	2.11	2.21
A 0119 (H 01-20)	-	-	-	-	1.60
A 0120 (H 01-21)	-	-	-	-	2.90

It is observed from HWTD test data that none of the mixes prepared for this project showed a stripping inflection point after 20,000 wheel passes. Only the post-compaction consolidation, creep slope, and deformation at the end of testing could be recorded from HWTD test data. The post-compaction consolidation data was recorded after the first 1,000 wheel passes. The creep slope values were recorded as the inverse of the rate of deformation (wheel passes per 1 mm rut depth) in the linear region of the plot between the post-compaction consolidation and 20,000 wheel passes. In addition to post-compaction consolidation and creep slope values, the deflection on the specimens after 20,000 wheel passes was recorded. Table 4.3 shows these values.

A 0111 (H 01-07) showed the minimum number of creep slope passes, and the final deformation after 20,000 wheel passes was the highest. A 0116 (H 01-17) showed the minimum deformation after 20,000 passes. Although, creep slope passes for A 0116 (H 01-17) were close to the average creep slope value, it showed the smallest post compaction, and its deformation value at the end of the testing period was the smallest.

The Texas Department of Transportation (TxDOT) specification for all types of mixes is 12.5 mm after 20,000 passes. As can be seen from Table 4.3, all of the specimens prepared for this project pass the TxDOT specification for HWTD.

Table 4.3 Summary of the HWTD Test Results

ID Marks	Post-Compaction (mm)	Creep Slope (Passes)	Deflection After 20,00 Passes (mm)
A 0111 (H 01-07)	1.05	15814	3.13
A 0112 (H 01-08)	0.80	29608	1.76
A 0113 (H 01-09)	0.96	31563	2.16
A 0114 (H 01-15)	0.82	14868	2.54
A 0115 (H 01-16)	1.09	45238	2.66
A 0116 (H 01-17)	0.74	25593	1.42
A 0117 (H 01-18)	0.97	18525	2.48
A 0118 (H 01-19)	1.20	39667	2.21
A 0119 (H 01-20)	-	-	1.60
A 0120 (H 01-21)	-	-	2.90
AVERAGE	0.95	27610	2.29

During the data analysis, it was observed that the recording of the final data after 20,000 wheel passes might be misleading for evaluation of the HWTD test results. Complete analysis of the data can be achieved only by establishing the relation between deformation and the number of wheel passes.

For example, specimen A 0115 (H 01-16) has a high post-compaction value. Although it has the highest value for creep slope passes, its deformation after 20,000 passes is high relative to the others. If only the number of passes after 20,000 passes were to be used as a criterion, it is possible to evaluate the performance of this mix incorrectly.

Problems of recording only the final data also might originate from variance of the test data, loose particles, or influence of other specimens, which are tested in the same equipment at the same time. Because of these factors, prosperous data analysis can be achieved only by establishing the relation between deformation and the number of passes for the whole testing period.

CHAPTER 5. VISUAL PAVEMENT CONDITION SURVEY

For the visual pavement condition survey, the distress identification manual for long-term pavement performance prepared during Strategic Highway Research Program (SHRP) was used. This manual was initially developed for use in the long-term pavement performance, asphalt characteristics, maintenance cost-effectiveness, and cement and concrete studies being conducted under SHRP.

The manual classifies distresses in pavements into four general modes: cracking, joint deficiencies, surface defects, and miscellaneous distresses. Cracking distresses include corner breaks, longitudinal cracking, and transverse cracking. Joint deficiencies consider joint seal damage of transverse joints, longitudinal joints, and transverse joints. Surface defects include map cracking and scaling, polished aggregate, and popouts. Finally, miscellaneous distresses include blowups, faulting of transverse joints and cracks, lane-to-shoulder drop-off and separation, patch/patch deterioration, water bleeding, and pumping.

The visual pavement survey was conducted by the Center for Transportation Research (CTR) on east and west bond outside lanes before the placement of Type B mix. Appendix B gives information about the layout of the test sections. The tables in Appendix C summarize the results of these surveys. Mainly, three types of distresses were observed on the continuously reinforced concrete. These distresses were transverse cracking, longitudinal cracking, and patch deterioration. For each mode, severity levels were defined in terms of low, moderate, and high damage.

Longitudinal cracking refers to those cracks relatively parallel to the pavement centerline. This type of crack is reported in linear feet. Three severity levels are defined as: Low — Well sealed or hairline cracks with no spalling or faulting; Moderate — Crack widths .50 in. or less with low or moderate spalling, and faulting less than .50 in; High — Crack widths greater than .50 in. with high-severity spalling, and faulting of .50 in. or more.

Transverse cracking refers to the cracks that were relatively perpendicular to the pavement centerline. Cracks were reported in linear feet. Severity levels were reported as: Low — Hairline cracks that present no spalling or faulting; Moderate — Crack widths .50 in. or less with low or moderate spalling, and faulting less than .25 in; High — Crack widths greater than .50 in. with high severity spalling, and faulting of .50 in. or more. On these sections, the transverse cracks were going all the way across the lanes.

Patch deterioration was defined as a portion of the concrete slab that has been removed and replaced. The replaced concrete was measured in feet and reported as an area (ft^2). Severity levels were reported as: Low — Patch is in good condition and has low severity distress of any type and faulting or settlement is less than .25 in; Moderate — Moderate severity distress of any type, and faulting or settlement is .25 in. to .50 in; High — Faulting or settlement greater than .50 in., and high-severity distress of any type.

CHAPTER 6. CONCLUSION AND FURTHER RESEARCH

In the first year of this 5-year project, most of the planned work was completed successfully. Three Superpave, 3 CMHB-C, 3 Type C and 1 Type B mixture designs were completed as planned. Laboratory molded specimens from each designed mix was tested with the Hamburg Wheel Tracking Device (HWTD). The results were analyzed and included in this report. The location of the test sections was selected on IH 20 in Harrison County. Visual survey and nondestructive testing were conducted on the concrete surfaces after milling and before the placement of Type B mix. The data from the visual survey was included in this report. Construction of the test sections is still in progress.

Further research findings will be conveyed in three annual progress reports, a comprehensive final report, and a summary report. The annual progress reports will contain the information on different aspects of the project, including data collection, as activities move forward. The final report will include detailed documentation of all the research performed. It will include the results of analysis and the developed correlation. This final report will also address the activities that need to be pursued in further research. A final summary report concisely describing project information of interest to the Texas Department of Transportation (TxDOT) users and highlighting the important information. This last report will include all deliverables and recommendations.

The Center for Transportation Research (CTR) will investigate pavement failures on an annual basis, and determine the cause and type of failure. Failures needing repair will be reported by TxDOT to the research agency for investigation, if it is determined that both the failure and its repair will occur between annual visits to the project site.

After the hot mix asphalt concrete is placed, visual survey of the project and data collection with a seismic pavement analyzer (SPA), ground penetrating radar (GPR), inertial profiler, and falling weight deflectometer (FWD) will be conducted at regular intervals through 2005. At the end of the project, at the discretion of TxDOT and the pavement condition, data collection and visual survey may be continued for additional years.

The technical information from SPA, GPR, and FWD, as well as the results from visual survey of the test sections, will be analyzed in relationship to the HWTD test results. At this stage, it will be determined if the HWTD will correctly predict the performance of pavement mixtures constructed in the field, and if so, a correlation will be developed between the field performance and the HWTD test results. Interpretation of the data and conclusions about the conditions of the pavement layers will be analyzed. The type and cause of failures, if any, will be documented.

Every year following construction, four cores will be obtained from each test section mainly for visual observation of signs of stripping and failure. While it is believed that the results from SPA and, specifically, GPR can indicate presence of water in the underlying layers and the possible progress of moisture damage, a physical observation of some cores from the test sections is essential to validate the test data. Even though these cores are obtained mainly for visual observation, once they become available, it takes little extra effort to conduct an indirect tensile strength test on them. The reason for running these tests is simply to see if the strength for each section has changed from the previous year. The strength tests are not meant to compare different sections with each other since they all have different original strengths to start with. Rather, the strength tests are meant to compare the strength of a section at a specific year with the strength of the same section at previous years. This way, if a reduction in strength is observed, it could be investigated to see if it has to do with stripping. In addition, this strength data could be correlated to the HWTD test results.

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APPENDIX A. HAMBURG WHEEL TRACKING DEVICE TEST RESULTS

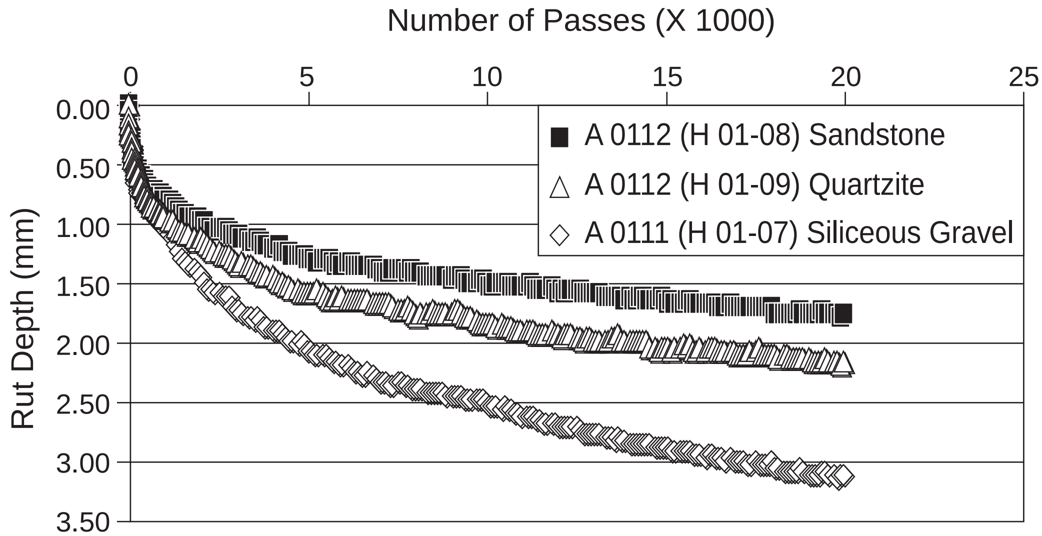

Figure A.1 HWTD Test Results for Superpave Mixes

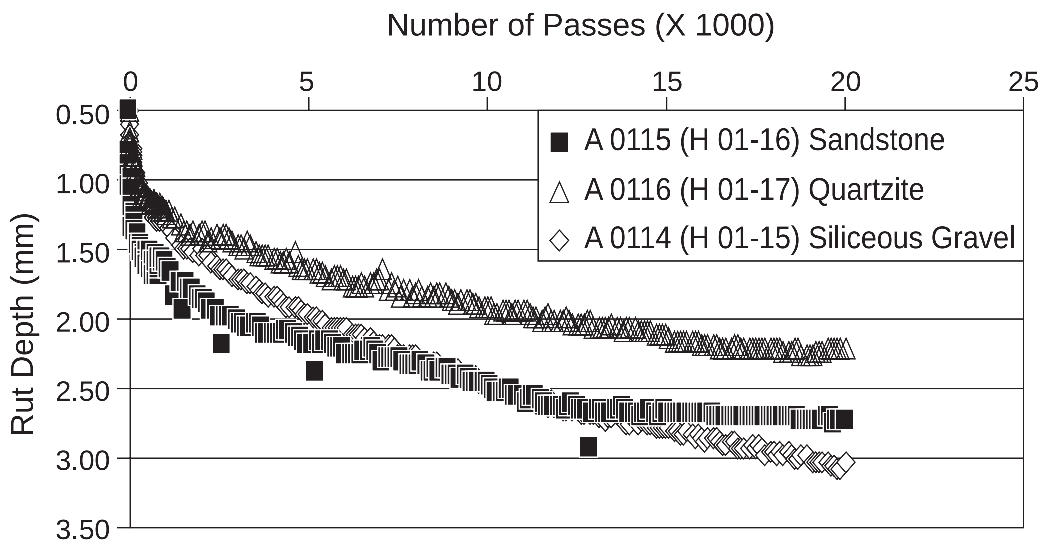

Figure A.2 HWTD Test Results for CMHB-C Mixes

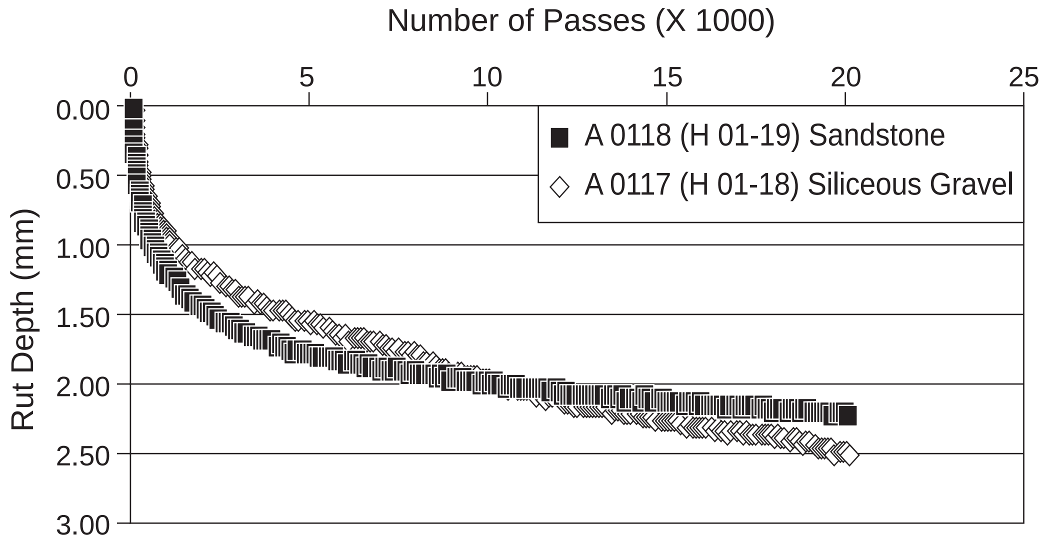

Figure A.3 HWTD Test Results for Type C Mixes

APPENDIX B. ORIENTATION OF THE TEST SECTIONS

MIX DESIGN SUMMARY (SURFACE)

WEST BOUND

STATIONS	SECTION	MIX DESIGN	SY	TONS
1135 to 1188	3	SUPERPAVE ½", Quartzite Coarse Aggregate (MARTIN MARIETA JONES MILL)	24482	2693
1193 to 1235	8	TY C, Sandstone Coarse Aggregate (MERIDIAN SAWYER)	18037	1984
1235 to 1278	5	CMHB-C, Sandstone Coarse Aggregate (MERIDIAN SAWYER)	18037	1984
1278 to 1321	2	SUPERPAVE ½", Sandstone Coarse Aggregate (MERIDIAN SAWYER)	18040	1984
		SUBTOTAL	78596	8645

Table B.1 Summary of Test Section, West Bound

EAST BOUND

STATION LIMITS	SECTION	MIX DESIGN	SY	TONS
1135 to 1185	6	CMHB-C, Quartize Coarse Aggregate (MARTIN MARIETA JONES MILL)	15530	1708
1190 to 1218	9	TY C, Quartize Coarse Aggregate (MARTIN MARIETTA JONES MILL)	15197	1672
1218 to 1245	1	SUPERPAVE ½", Siliceous Gravel Coarse Aggregate (HANSON EAGLE MILLS, PRESCOTT, OR LITTLE RIVER)	15956	1755
1245 to 1282	4	CMHB-C, Siliceous Gravel Coarse Aggregate (HANSON EAGLE MILLS, PRESCOTT, OR LITTLE RIVER)	15956	1755
1282 to 1321	7	TY C, Siliceous Gravel Coarse Aggregate (HANSON EAGLE MILLS, PRESCOTT, OR LITTLE RIVER)	15958	1755
		SUBTOTAL	78597	8645
		TOTAL	157193	17290

Table B.2 Summary of Test Section, East Bound

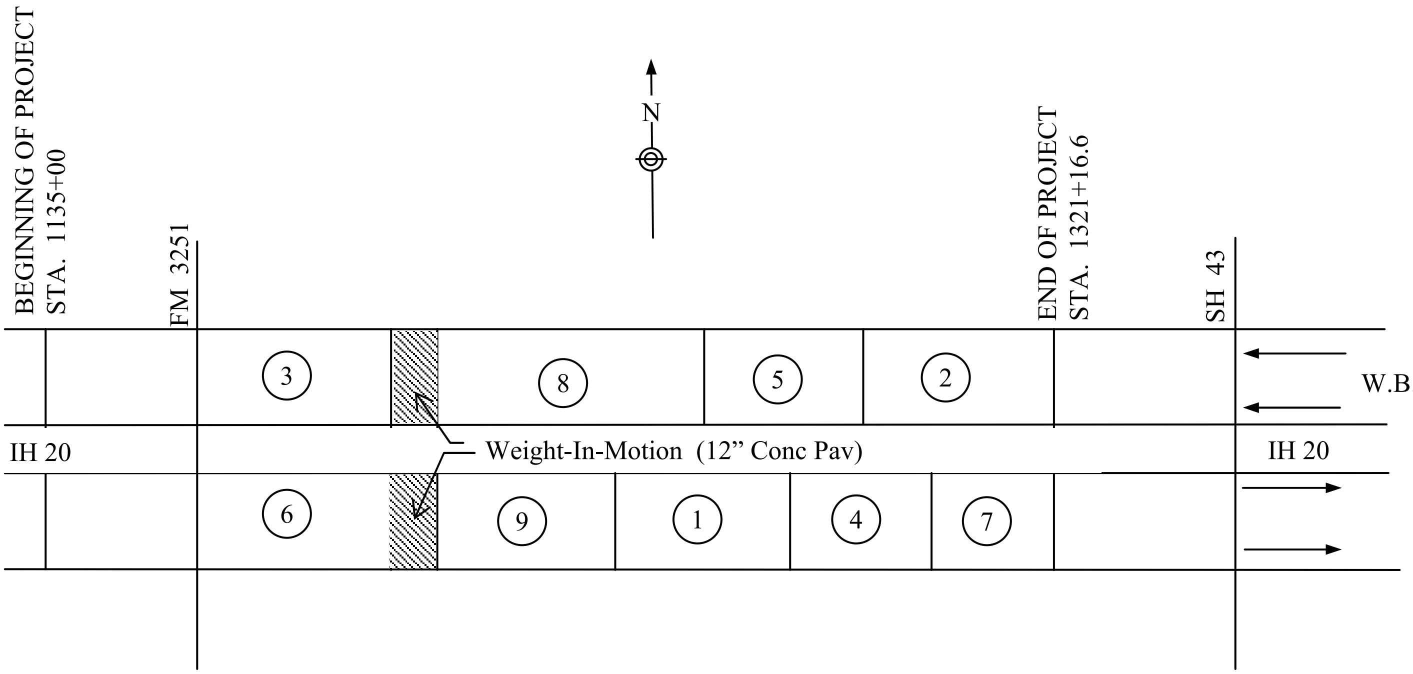

Figure B.1 Layout of the Test Sections

APPENDIX C. VISUAL PAVEMENT SURVEY

DISTRESSES FOR PAVEMENTS

PROJECT 4185 **LANE East B. Outside Lane**

DATE 9/28/01 TYPE OF PAVEMENT CRCP

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1136 - 1137	3						(6*12)		
1137-1138	3						(6*12)		
1138-1139	1						(11*12)(6*12)(11*12)		
1139-1140	2						(6*12)(6*12)		
1140-1141	3								
1141-1142	5								
1142-1143	1								
1143-1144									
1144-1145	1						(6*12)		
1145-1146	3						(6*12)		
1146-1147	1								
1147-1148									
1148-1149	2						(6*12)		
1149-1150	2						(6*12)		
1152-1153	3						(12*12)		
1153-1154	1						(6*12)		
1154-1155									

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1155-1156	2								
1156-1157	1								
1157-1158	7								
1158-1159	3						(6*6)		
1159							(13*6)		
1159-1260	2						(15*12)		
1260-1261 Bridge	8						(20*12)(11*6)		
1161-1162	6								
1162-1163	6								
1163-1164	8								
1164-1165	7						(24*12)		
1165-1166	21								
1166-1167	14						(21*12)		
1167-1168	7						(4*12)(4.5*12)		
1168-1169	9						(8*12)(6*12)(4.5*12)		
1169-1170	14								
1170-1171	1						(6*12)		

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1171-entran.									
1177-1178	8								
1178-1179							(6*12)		
1179-1180	6								
1180-1181	4								
1181-1182	14								
1182-1183	4								
1183-1184	4						(6*12)		
1184	1								
1184-1185	2						(6*12)		
1185-1190									
1190-1191	6						(5*12)(10*12)(5.5*12)		
1191-1192	18								
1192-1193	5								
1193-1194	13						(17*12)		
1194							(7.5*12)(6*12)		
1194-1195	11								
1195-1196	17								
1196-1197	18						(6*6)		

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1197-1198	14								
1198-1199	9						(7*12)(12.5*8)		
1199-1200	2								
1200-1201	3								
1201-1202	5								
1202-1203	3						(6*12)(10*12)		
1203-1204	8						(6*12)(15*12)		
1204-1205	9						(17*12)(10*12)(6*12) (5*6)		
1205-1206	10						(28*6)(16*6)		
1206-1207	9						(19*12)		
1207-1208	6						(6*12)		
1208-1209	8						(7*12)(14*12)(13*12)		
1209-1210	7								
1210-1211	3								
1211-1212	2						(11*12)(5.5*12)		
1212-1213	6						(18*12)(7*12)(6*12) (7*12)		
1213-1214	4								
1214-1215	9						(8*12)(8*12)		
1215-1216	6								

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1216-1217	3						(10*12)(5*12)(4.5*12) (3*12) (11*12)(6*12)		
1217-1218	5								
1218-1219	5								
1219-1220	6								
1220-1221	9						(6*12)		
1221-1222	11								
1222-1223	3						(5*12)(13*12)(8*12) (8*12)		
1223-1224	6						(6*12)(16*12)(7*12) (19*12) (8*12)		
1224-1225	6						(19.5*12)(5*12)(10*12)		
1225-1226	4			1			(7.5*12)(7.5*12)		
1226-1227	10						(4*12)(6*12)(18*12) (9*12) (11.5*12)(6*12)		
1227-1228	15						(6*12)		
1228							(8*12)		
1228-1229	11						(5*12)		
1229-1230	13						(4*12)		
1230-1231	4						(10*12)(12*12)(6*12)		
1231-1232	5						(28*12)(6*12)		
1232-1233	2						(6*12)		
1233-1234	3								

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1234-1235	3								
1235-1236	1								
1236-1237	1								
1237-1238	5								
1238-1239	4								
1239-1240									
1240-1241	2								
1241-creek potters	2								
Bridge									
1246-1247	3								
1247-1248	6						(17*12)(6*12)(6*12) (5*12)		
1248-1249	8								
1249-1250	5	3							
1250-1251	2	1					(6*12)(10*12)(4.5*12)		
1251-1252	3								
1252-1253	3						(6*6)		
1253-1254	1								
1254-1255									
1255-1256	1								

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1256-1257									
1257-1258	2						(5*6)(6*6)		
1258-1259							(6*12)(3.5*12)(2.5*12)		
1259-1260	1						(6*12)(27*6)		
1260							(28*6)		
1260-1261							(6*12)		
1261-1262	3						(36*6)(18*6)(6*12) (11*12) (6*12)(6*12)		
1262-1263	3	1							
1263-1264	7	1							
1264-1265	4						(5*12)(6*12)		
1265-1266	5								
1266-1267	6						(6*12)		
1267-1268	3								
1268-1269	2								
1269-1270	6						(6*6)		
1270-1271	9						(6*12)		
1271-1272	2								
1272-1273	1						(26*12)		
1273-1274							(6*12)(12*12)(8*12)		

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1274-1275	9			1					
1275-1276	5						(44*6)(17*6)		
1276-1277	4			1			(6*6)(8*12)(7*12) (12*12)		
1277-1278	2			1			(6*12)		
1278-1279	9								
1279-1280	6								
1280-1281	7								
1281-1282	5								
1282-1283	6			1					
1283-1284									
1284-1285	2								
1285-1286	3								
1286-1287	6						(12*12)(8*12)		
1287-1288	1						(6*12)		
1288-1289							(6*12)		
1289-1290	5						(6*12)		
1290-1291	3						(6.5*12)(3*12)(8.5*6)		
1291-1292	3						(14*12)		
1292-1293	1						(39*12)		

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1293-1294	7						(10.5*12)		
1294-1295									
1295-1296	9						(6*12)		
1296-1297							(22*12)(8*12)(10*12) (6*12)		
1297-1298	6								
1298-1299	3								
1299-1300							(26*6)(5*6)		
1300-1301	2	1							
1301-1302	4								
1302-1303	2								
1303-1304	3						(6*12)		
1304-1305									
1305-1306	2								
1306-1307	2						(8*12)(6*12)		
1307-1308	2						(8*6)(6*12)		
1308-1309									
1309-1310	3								
1310							(13*12)		
1310-1311	1						(2.5*12)(6*12)		

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1311-1312									
1312-1313									
1313-1314	6								
1314-1315	3								
1315-1316	3								
1316-1317	4								
1317-1318	1						(17*6)		
1318-1319	2						(29*6)		
1319-1320							(22*6)		
1320-1321	2						(22*6)		
1321-1322									

DISTRESSES FOR PAVEMENTS

PROJECT 4185 **LANE West B. Outside Lane**

DATE 8/30/01 TYPE OF PAVEMENT CRCP

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1321 - 1320	1			1					
1320 - 1319	1			1					
1319 - 1318	1			1			(6*6) (6*12)		
1318 – 1317	1	1		1					
1317 – 1316	1			1			(8*12)		
1316 – 1315	1			1					
1315 – 1314	1			1					
1314 – 1313	1			1					
1313 – 1312	1	2		1			(13*12)		
1312 - 1311	1			1					
1311 - 1310	1	1		1					
1310 – 1309	1			1					
1309 – 1308	1			1			(10*12) (14*12)		

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1308 – 1307	1	1		1			(8*12)		
1307 – 1306	1			1			(13*12)		
1306							(5*12)		
1306 – 1305	1	2		1					
1305 – 1304	1	1		1			(9*12) (6*12) (6*12)		
1304 – 1303	1	1		1			(6*12)		
1303 - 1302	1	6		1					
1302 - 1301	1	3		1					
1301	1			1			(6*12)		
1301 - 1300	1	2		1			(10*12)		
1300 - 1299	1			1			(14*12) (6*12)		
1299 - 1298	1			1	1		(13*12)		
1298 - 1297	1	2		1			(8*12) (12*12) (12*12)		
1297 - 1296	1	1		1					
1296 - 1295	1	1		1			(8*12)		
1295 - 1294		1			2				
1294 - 1293		2			1				
1293 - 1292		3			1				
1292 - 1291	1	1		1	1		(18*12)		
1291 - 1290	1	1		1					
1290 - 1289							(6*12)		

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1289 - 1288									
1288 - 1287	1			1					
1287 - 1286							(14*12) (13*12) (12*12)		
1286 - 1285									
1285 - 1284		1					(12*12)		
1284 - 1283									
1283 - 1282									
1282 - 1281									
1281 - 1280									
1280 - 1279									
1279 - 1278									
1278 - 1277									
1277 - 1276		1					(6*12)		
1276 - 1275		2					(7*12)		
1275 - 1274		1							
1274 - 1273									
1273 - 1272									
1272 - 1271									
1271 - 1270									
1270 - 1269									
1269 - 1268									

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1268 - 1267									
1267 - 1266									
1266 - 1265							(14*12)		
1265 - 1264									
1264 - 1263									
1263 - 1262	1			1					
1262 - 1261	1			1					
1261 - 1260									
1260 - 1259		3 mod							
1259 - 1258	1	2 mod		1					
1258 - 1257							(12*12) (12*12)		
1257 - 1256							(12*12) (12*12)		
1256 - 1255	1			1					
1255 - 1254	1			1			(6*12) (12*12) (7*12)		
1254 - 1253		mod							
1253 - 1252							(5*12)		
1252 - 1251	1	2		1					
1251 - 1250		1					(6, 7, 6, 6, 12, 4)*(12)		
1250 - 1249		2					(8*12)(9*12)		
1249 - 1248		5					(6*12)(6*12)		
1248 - 1247	1	7							

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1247 - 1246	1	4							
1246 - 1245	1	5							
B. Potters Cr									
Bridge-1241	1	1		1			(8*12)		
1241 - 1240	1	7							
1240 - 1239							4(18*12)		
1239 - 1238		12							
1238 - 1237		9					1		
1237 - 1236		4							
1236 - 1235	1	3							
1235 - 1234	1	6							
1234 - 1233	1	3							
1233 - 1232	1	4							
1232 - 1231	1	9							
1231 - 1230	1	13							
1230 - 1229	1	13					(16*12)		
1229 - 1228	1	10					(12*12)		
1228 - 1227	1						(12*12)		
1227							(4*12)		

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1227 - 1226	1	1					(14*12)(8*12)		
1226 - 1225	1	1							
1225							(6*12)		
1225 - 1224		5					(6*12)		
1224 - 1223		2					(6*12)(12*12)		
1223		4					(6*12)		
1222		1					(14*12)(14*12)		
1221		1					(12*12)(8*12)		
1220		3							
1219									
1218	1								
1217									
1216		2					(6*12)		
1215									
1214							(14*12)		
1213							(14*12)		
1212	1	1					(6*12)(7*12)		
1211		3					(12*12)		
1210									
1209		1					(14*12)(8*12)		
1208	1	5							
1207		1					(8*12)		

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1206		5					(8*12)(8*12)		
1205		3					(6*12)(12*12)		
1204		1					2(6*12) 2(8*12)		
1203		1					(6*12)(6*12)		
1202	1	1							
1201		3					(9*12)(13*12)		
1200	1								
1199		1							
1198		2					(11*12)		
1197		4							
1196		2					(6*12)		
1195		3							
1194 - CC		2					(7*12)		
CC - 1187									
1187 - 1186									
1186 - 1185		3							
1185 - 1184		1							
1184 - 1183		2					(13*12)(9*12)		
1183 - 1182		1							
1182 - 1181							(6*12)(8*12)		
1181 - 1180									

STATION	TRANSVERSE CRACK			LONGITUDINAL CRACK			PATCH DETERIORATION		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1180 - 1179							(10*12)		
1179 - 1178	1								
1178 - 1177									
1177 - 1176	1								
1176 - 1175	1								
1175 - Exit	1						(8*12)		
1172 - 1171									
1171 - 1170	1						(6*12)		
1170									
1169							(6*12)		
1168									
1167		2					(10*12)(13*12)		
1166		2							
1165	1								
1164									
1163	1	4							
1162	1								