NCAT Report 09-01

DESIGN, CONSTRUCTION AND INSTRUMENTATION OF THE 2006 TEST TRACK STRUCTURAL STUDY

By

David H. Timm

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David H. Timm, PhD, P.E.
Gottlieb Associate Professor of Civil Engineering
National Center for Asphalt Technology
Auburn University, Alabama

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ACKNOWLEDGEMENTS

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CHAPTER 1 – INTRODUCTION

BACKGROUND

The National Center for Asphalt Technology (NCAT) Pavement Test Track was originally devoted to accelerated full-scale mixture performance testing. The first experiment, conducted from 2000-2003, consisted of 46 test sections with various asphalt mixtures subjected to approximately ten million equivalent single axle loads (*2*).

The second Test Track experiment, from 2003-2006, continued to examine mixture performance, but also began to investigate mechanistic-empirical (M-E) pavement design and analysis concepts in the so-called "structural experiment" (*14*). The main objective of M-E analysis is to represent a pavement structure in terms of its fundamental properties (i.e., modulus, Poisson ratio, layer thicknesses) and determine the response (i.e., stress, strain) of the structure under traffic. This mechanistic analysis can then be combined with empirical performance observations through so-called "transfer functions" to predict how long the structure will last under the prevailing conditions. While there are many technical areas to research in the context of M-E design, the main objectives of the 2003-2006 experiment were to (*14*):

1. Validate mechanistic pavement models.
2. Develop transfer functions for typical asphalt mixtures and pavement cross-sections.
3. Study dynamic effects on pavement deterioration from a mechanistic viewpoint.
4. Evaluate the effect of thickness and polymer modification on structural performance.

To accomplish the above objectives, eight test sections (pictured in Figure 1.1) were completely reconstructed to more closely simulate actual pavement sections found on the interstate/state highway systems. Additionally, the test sections were embedded with an array of gauges to measure asphalt strain, base pressure, subgrade pressure and pavement temperature.

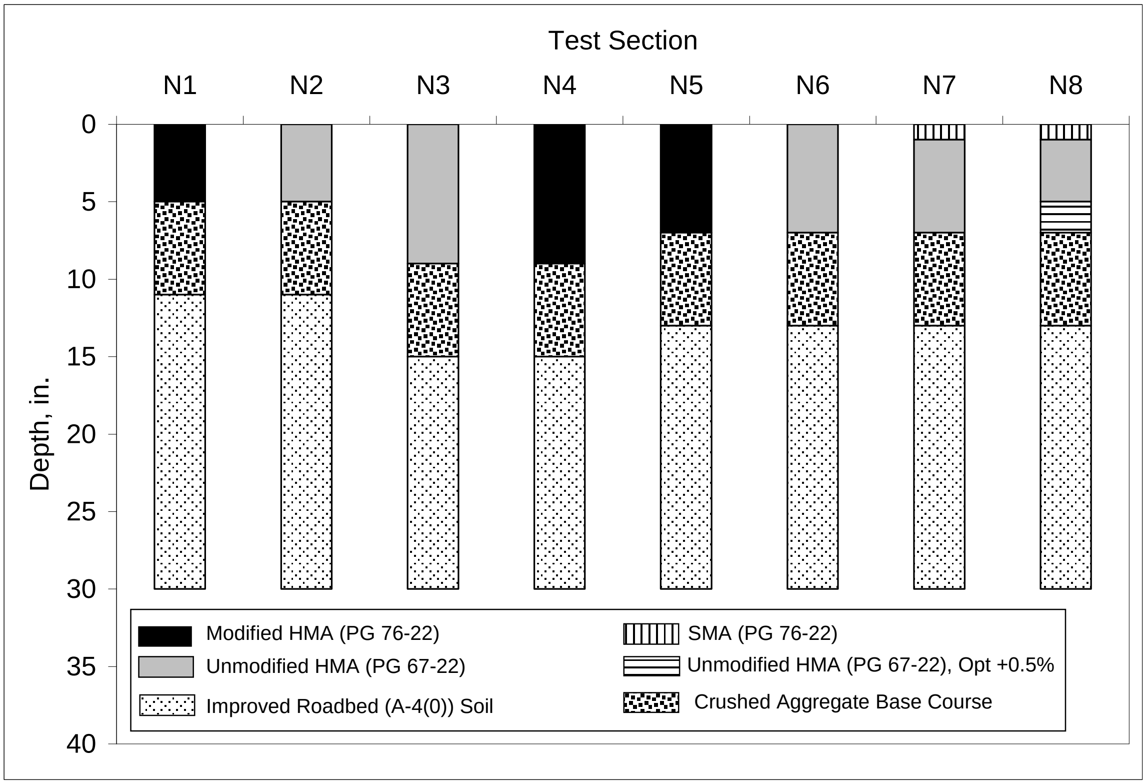


Figure 1.1. 2003 Test Track Structural Experiment (*13*)

During the course of the experiment, a variety of pavement distresses were observed. These distresses included severe bottom-up fatigue cracking in sections N1 and N2, extensive top-down cracking in section N5, minor bottom-up fatigue cracking in N6 and N7 and fatigue cracking due to layer slippage in section N8 (5, 16). Additionally, minor amounts of HMA rutting was observed and could be distinguished by the type of binder used in each section (9).

The presence of these distresses enabled initial calibration of transfer functions for use in M-E design (5, 9). These transfer functions are the critical link between pavement response (i.e., stress, strain) and pavement performance (i.e., number of load repetitions until failure). At present, these transfer functions are termed “initial” since they are based on a limited set of data (eight test sections). However, they do represent a significant step toward full implementation of M-E flexible pavement design.

Other advances, utilizing the embedded instrumentation, were also made during the 2003-2006 structural experiment. These included validation of WESLEA, a layered elastic analysis program, as a viable model to predict in situ pavement response (1, 6, 9, 11, 16). Other M-E related studies are summarized in Table 1.1.

Table 1.1. Other M-E Related Studies at the 2003 NCAT Test Track

Title of Investigation	Methodology	Main Finding(s)	Publication(s)
Wheel Wander	Axle sensing strips in section N4 were used to measure wheel wander in both the morning and afternoon driving shifts.	Wheel wander was found to reasonably represent open access facilities when all the trucks were considered as a group. Wheel placement was shown to strongly influence pavement response measurement.	Timm and Priest, 2005 Timm and Priest, 2004
Wide-Base Tires	A set of wide-base tires were tested on section N5. Asphalt strain and vertical pressure measurements were made under a standard set of duals and wide-base tires. The data were compared statistically to evaluate the effect of the wide-base tires. Theoretical simulations were also conducted to evaluate the quality of a layered elastic model in predicting pavement response under a wide-base tire.	No statistical or practical difference was found between the dual and wide-base tire configurations. The theoretical model tended to overpredict pavement response under the wide-base tire.	Priest et al., 2005 Priest and Timm, 2006b
Strain Response and Transverse Cracking	Bottom-up fatigue cracking was found to form first in the transverse direction prior to interconnecting into the classical alligator pattern. Strains made in the longitudinal and transverse direction were compared to determine the mechanistic reason for the phenomena. Mechanistic simulations were also conducted using WESLEA.	Transverse strains tended to be approximately 68% of corresponding longitudinal strains. Of the nearly 3,000 paired strain readings, the longitudinal strain was greater than transverse strain 84% of the time. These two pieces of information, coupled with theoretical simulation, explained transverse cracking due to higher longitudinal strains.	Timm and Priest, 2008

It was recognized by the project sponsors at the conclusion of the 2003 Test Track that further study in the area of structural pavement response was required. Sponsors had the option of reconstructing, resurfacing or simply continuing traffic on the structural test sections. Each of these options were exercised and several new structural test sections were added to achieve the objectives noted below.

EXPERIMENTAL OBJECTIVES

To address the needs stipulated above, a number of broadly-defined experimental objectives were developed for the 2006 Test Track structural experiment. These objectives, with brief explanations, included:

1. **Further validate and calibrate new transfer functions for M-E design.**
   On sections left in place from the 2003 experiment, initial transfer functions had been developed. These models require further refinement and validation before they can be widely applied. Additional calibration activities on new test sections will increase the size of the calibration data set which can then be applied to a wider set of real-world design scenarios.

2. **Develop recommendations for mechanistic-based material characterization that yields accurate pavement response predictions.**
   To optimize pavement design it is important to accurately characterize the material properties which directly affect predictions of pavement response under load. There are currently many methods of material characterization in the context of M-E design. These methods range from laboratory-based to field-based and include direct measurement versus correlation equations. Furthermore, the methods can often produce conflicting sets of information regarding the same material. Therefore, there is a need to investigate the various methods and recommend best practices toward mechanistic characterization of material properties.

3. **Characterize pavement response in rehabilitated flexible pavement structures.**
   Many agencies are faced with rehabilitating flexible pavements, typically with overlay or mill and overlay techniques. There is a need to validate pavement response predictions made in rehabilitation design methodologies to improve and/or refine these methods.

4. **Determine field-based fatigue response thresholds for perpetual pavements.**
   Many state agencies have begun to design and construct so-called perpetual pavements (a.k.a., long-life pavements). A critical component of the design process is the selection of the fatigue threshold. Most laboratory fatigue testing of asphalt mixtures have set a conservative strain threshold of 70 microstrain ($\mu\varepsilon$) to prevent bottom-up fatigue cracking. However, it is believed that the threshold may be much higher due to rest periods and other differences between the field and lab. Pavement response and performance measurements can help refine and update the strain threshold for fatigue performance.

REPORT OBJECTIVES

As noted above, the 2006 Test Track structural study objectives are very broad and cover a diverse set of topics in the general area of M-E design and analysis. At the conclusion of the 2006 experiment, which is expected in December of 2008, one or more reports in each of the areas listed above will be written. The objective of this report is to provide a common reference document that details the following:

1. 2006 structural test sections.
2. Instrumentation plan.
3. Construction and installation of instrumentation.

SCOPE OF WORK

Eleven test sections comprise the 2006 Test Track structural study. Five test sections (N3 through N7) were left in place at the conclusion of the 2003 experiment, though section N5 did receive a shallow mill and inlay to mitigate top-down cracking throughout the section. Three sections (N1, N2 and N8) were completely reconstructed while three new sections were added to the experiment (N9, N10 and S11). All of the sections included embedded instrumentation (either new or left in place) featuring asphalt strain gauges and earth pressure cells. Laser-based lateral position measurement devices were added to each section to measure wheel wander. Extensive laboratory and field testing programs were utilized to characterize material properties in addition to weekly performance monitoring (rutting, cracking, ride quality) for the purposes of model calibration.

The following chapters detail the test sections, instrumentation plan, construction and gauge installation. A conclusions and recommendations chapter is provided at the end of the report.

CHAPTER 2 – TEST SECTIONS

SECTION STATUS AT END OF 2003 TEST TRACK

At the conclusion of the 2003 Test Track, the structural sections had exhibited a variety of distresses. As shown in Figure 2.1, sections N1 and N2 had failed in fatigue while N8 was rapidly approaching failure. Each of these sections was selected for complete reconstruction in the 2006 Test Track. Section N6, and to a lesser extent, N7, also were showing signs of fatigue cracking at the end of the 2003 experiment. However, it was decided to leave these sections in place and subject them to further traffic so that full fatigue transfer function calibration could be performed. It should be noted that the vertical scales in Figure 2.1 include "Percent of Lane" and "Percent of Wheelpath." The "Percent of Wheelpath" can exceed 100% if the cracking spreads outside of the wheelpath.

Low-severity top-down cracking, not quantified in Figure 2.1, was observed in section N5 (Figure 2.2). Cores taken throughout the section confirmed that the cracking was top-down and confined to the upper lift of the HMA. Therefore, section N5 was a candidate for a mill and inlay rehabilitation treatment.

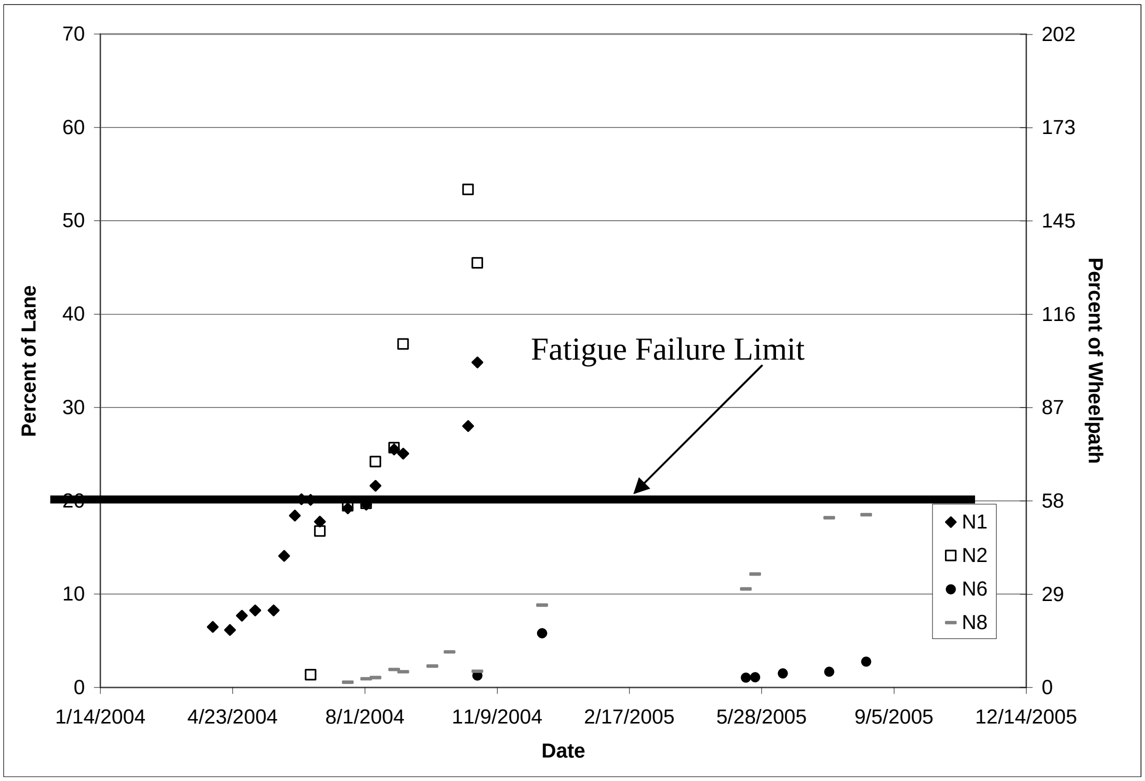


Figure 2.1. Fatigue Cracking Progression in 2003 Test Track Structural Sections (5)

Figure 2.2. Top-Down Cracking in Section N5

Sections N3 and N4 exhibited excellent performance during the 2003 traffic cycle. As shown in Figure 2.3, these sections had very little rutting and no cracking was observed within the 150 ft research portion of each section. Consequently, these sections were also left in place to be subjected to additional traffic during the 2006 study. Also of note in Figure 2.3 are the low rut depths in sections N1 and N2. As explained above, these sections had failed in fatigue and were in need of repair during the 2003 test cycle. On October 28, 2005, after approximately 7.4 million ESAL, N1 and N2 were milled through the entire depth of HMA (5 inches) and replaced with warm mix asphalt (8). Though only subjected to the remaining traffic in the 2003 experiment (515,333 ESAL), they passed the early-life rutting test as illustrated in Figure 2.3.

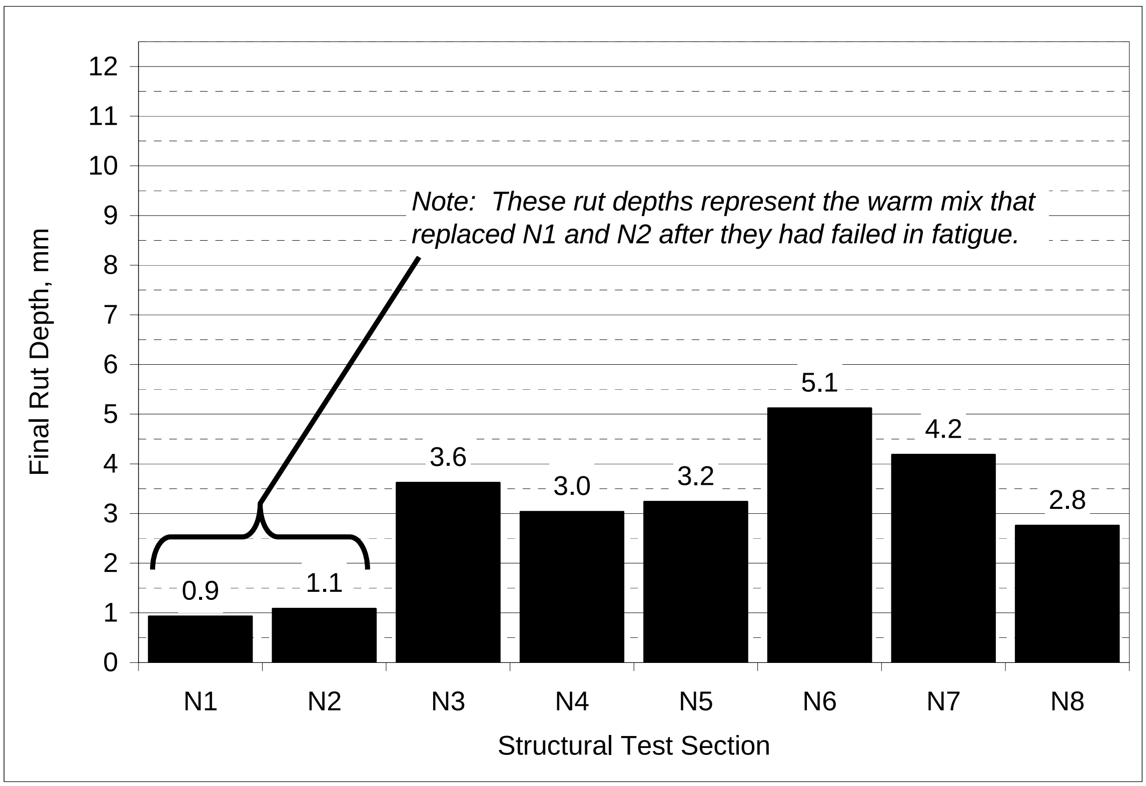


Figure 2.3. Rutting Performance at End of 2003 Test Track

2006 TEST SECTIONS

As noted above, the sections comprising the 2006 structural study were a blend of new construction, left-in-place and rehabilitated sections. Figure 2.4 illustrates the as-built thicknesses in the vicinity of the instrumentation, and the constituent materials, in each section. There are five different types of unbound materials that are utilized for the structural study at the Test Track (*Taylor*, *2008*). A Florida limerock base was utilized as the base layer material in sections N1 and N2. This material was quarried in Alachua, Florida, and is commonly utilized by the Florida DOT. The granite graded aggregate base material supplied by Vulcan Materials, Inc. was utilized as the base layer material in section N3, N4, N5, N6, N7, and S11. This material is commonly used by ALDOT in the southeastern part of the state and was quarried in Columbus, GA. The Type 5 material supplied by the Missouri DOT was used as the base material in section N10. This material is a dolomitic limestone that was quarried in Maryland Heights, Missouri, and is commonly used by the Missouri DOT. The Seale subgrade material was employed by the Oklahoma DOT as the subgrade layer in sections N8 and N9. This material is high clay content borrow material imported from Seale, Alabama. This soil is classified as an A-7-6 material by AASHTO soil classification. Finally, the metamorphic quartzite soil excavated from the Test Track property was utilized as the fill material in every section except N8 and N9. This material was used as the base layer material for N8 and N9 to simulate lime stabilization often used in Oklahoma and formed the deep subgrade material for each structural section. This material is classified as an A-4(0) soil by AASHTO classification, and is referred to as "Track Soil" throughout this report. Further details regarding these materials are provided in the next chapter while the following subsections discuss the experimental objectives of each sponsor.

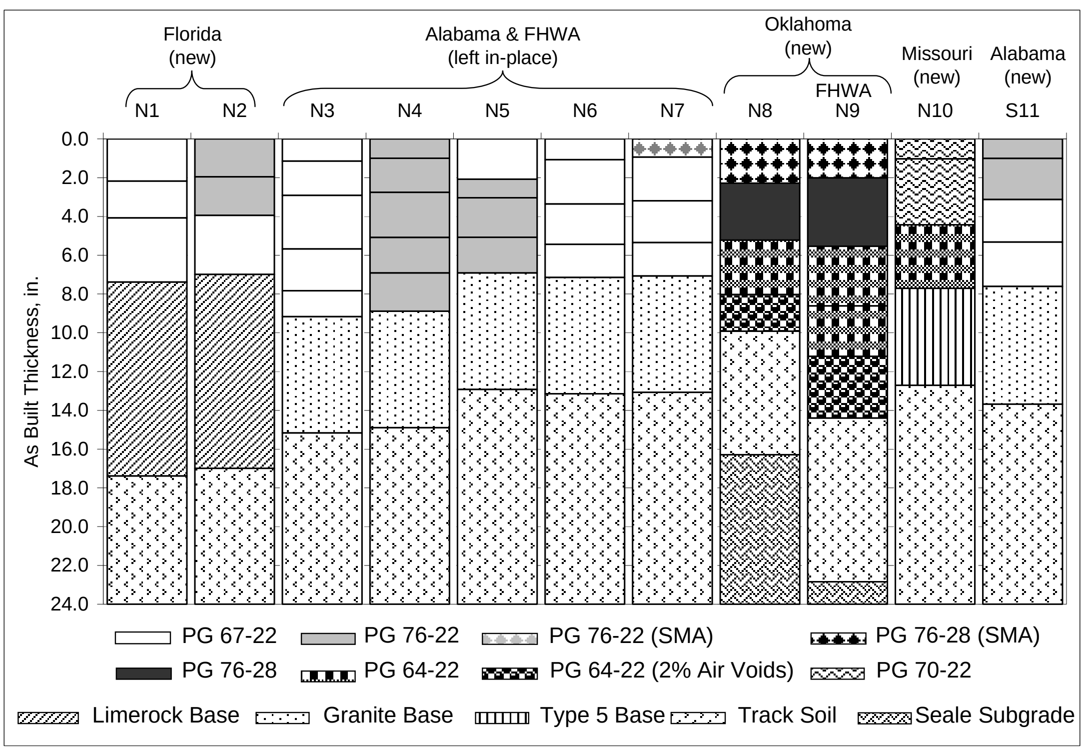


Figure 2.4. As-Built Pavement Cross Sections

Florida DOT: Sections N1 and N2

The Florida DOT (FDOT) sponsored two structural sections (N1 and N2) consisting of approximately seven inches of HMA over ten inches of limerock base. The main difference between the sections is that N2 included a styrene-butadiene-styrene (SBS) modified PG 76-22 binder in the upper four inches of HMA, whereas N1 used an unmodified PG 67-22 throughout the full seven inches of HMA. The upper lifts from the two test sections were designed to yield significantly different resistance to cracking as indicated by their indirect tension (IDT) energy ratios. It was expected that section N1 would crack before N2. Also, the introduction of a base material different from the other structural test sections allows for interesting comparisons between the performance of granular base layers.

Alabama DOT and FHWA: Sections N3 – N7

As noted previously, sections N3 through N7 were left in place from the 2003 Test Track. They all share the same high-quality subgrade and 6 inch unbound granite base layer. Sections N3 and N4, both consisting of 9 inches of HMA, are companion sections with the binder type as the main experimental variable. N5 and N6 were also companion sections consisting of 7 inches of HMA, though N5 was milled 2 inches and inlaid with new HMA to mitigate the top-down cracking problem. N7 was also left in place and features stone-matrix asphalt (SMA) as the surface course.

Oklahoma DOT: Sections N8 and N9

The Oklahoma DOT (ODOT) also sponsored two new structural test sections (N8 and N9) intended to study the perpetual pavement concept. These sections represent the thickest cross-sections built, to date, as part of the structural experiment. The ODOT sections feature a soft subgrade which was more representative of some soils in Oklahoma. Section N8, the first of the two ODOT sections, has ten inches of asphalt which is made up of a two inch rich bottom layer, six inches of Superpave mix, and capped with a two inch layer of SMA. The second section, N9, has a total HMA thickness of fourteen inches. The rich bottom layer was increased to three inches and an additional three inch Superpave lift was added for this section. It should be noted that the so-called “rich-bottom” was simply a mixture designed to 2% air voids rather than 4%. The net result was a 6% design, and 7% as-built, asphalt content in the rich-bottom.

FHWA: Supplemental N9

Accounting for the viscoelastic nature of hot-mix is a critical component of any M-E design methodology. Specifically, it is important to account for pavement temperature and loading frequency (i.e., truck speed) when predicting pavement response using a mechanistic model. While viscoelastic properties of individual mixtures can be readily measured in the laboratory through dynamic modulus testing, translating the results into a form useful for predicting pavement response can be complicated due to differences in mode of loading, rest periods and other factors. There is an added level of complexity due to the layered nature of flexible pavements with each layer potentially having different viscoelastic properties. Furthermore, temperature and loading frequency change with depth through the layers so establishing representative temperatures and frequencies can be particularly challenging.

Methods for handling the above complexities of mechanistic modeling have been well-documented and even implemented within design programs such as the MEDPG. However, there are a large number of simplifying assumptions that require validation to ensure maximum accuracy within the design system. Therefore, the supplemental section sponsored by FHWA was intended to provide a model validation data set for evaluating the accuracy of various material characterization and modeling approaches currently available. One feature of this investigation was embedment of strain gauges at lift interfaces to a minimum depth of five inches to quantify pavement response with depth. N9 was selected for this supplemental investigation because it was the thickest HMA section available and allowed for the greatest strain and temperature profiles to be developed. The supplemental instrumentation used in section N9 is shown in Figure 2.5. Full details regarding instrumentation are provided in the following chapter.

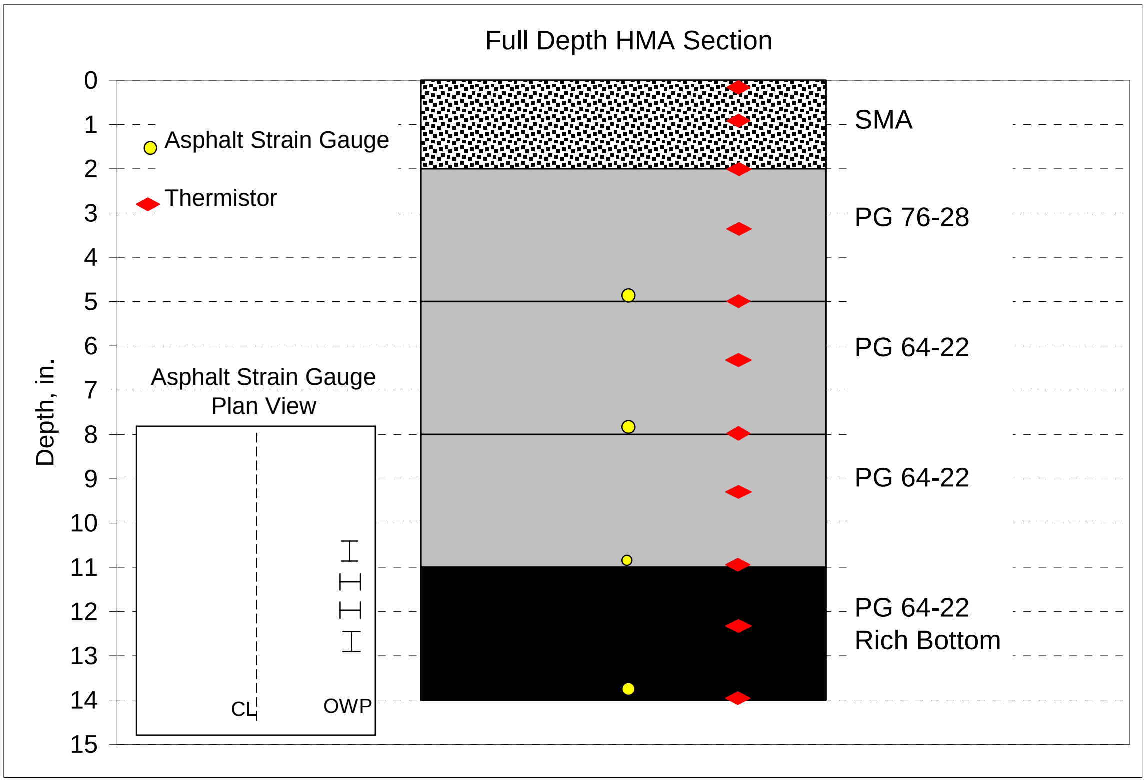


Figure 2.5. N9 Supplemental Instrumentation

Missouri: N10

The Missouri DOT has sponsored a structural section (N10) which was designed to address the broad needs of mechanistic-empirical pavement design. N10 features a Missouri Type 5 granular base material beneath eight inches of HMA which was intended to exhibit distress during the two-year traffic cycle.

Alabama DOT: S11

A new section was sponsored by ALDOT meant to build on previous work in the 2003 Test Track. In the 2003 structural sections, binder grade was held constant throughout the depth of the HMA to isolate the effect of the binder on performance. In reality, however, agencies will often use higher binder grades near the pavement surface where HMA rutting is more likely to occur and lower binder grades lower in the pavement where temperatures are not as extreme and rutting less likely to occur. Section S11 was built to more closely replicate actual pavement cross sections, in terms of material selection, used by ALDOT where the upper half is PG 76-22 and the lower half is PG 67-22.

CHAPTER 3 – INSTRUMENTATION

INSTRUMENTATION PLAN OVERVIEW

The instrumentation system developed and deployed for the 2003 structural study had proven itself to be reasonably robust and effective in gathering the requisite pavement response data needed for M-E investigations. Therefore, essentially the same system with a few exceptions, was used for the 2006 investigation. This also maintained continuity between the two research cycles in terms of equipment, data collection and data processing schemes.

Figure 3.1 illustrates the gauge arrangement used in the majority of the structural test sections (N1-N6, N8, N10 and S11), with corresponding gauge numbers italicized. In all, there were 14 structural response gauges. Gauges 1–12 were asphalt strain gauges (ASG) while 13 and 14 were earth pressure cells (EPC). Gauge 15 was a high speed laser measurement device to determine wheel placement relative to the embedded gauges. Gauges 1–15 were all recorded on the same high-speed data acquisition system, as will be described more fully later in this chapter. The temperature probe was part of a different, lower frequency, data acquisition system and therefore numbered separately.

The gauge array featured two earth pressure cells to measure vertical pressure in the center of the wheelpath at the HMA/granular base interface (gauge 13) and at the granular base/subgrade interface (gauge 14). These measurements were important toward the prediction of base and subgrade rutting in addition to assessing the effectiveness of the granular base layer in dissipating stresses.

The asphalt strain gauges measured both longitudinal (gauges 1–3 and 10–12) and transverse (gauges 4 – 9) strain. All the gauges were centered around the outside wheelpath, with gauges in the center and two feet on either side of the wheelpath. This gauge arrangement was devised so that the maximum strain could be measured despite the effects of natural wheel wander (*13*, *14*). Redundancy was built into the system by having the first six gauges replicated with the second set of six. For example, gauges 1 and 10 comprised a pair that measured longitudinal strain two feet to the left of the wheelpath center. In the event of gauge failure, paired gauges helped ensure that at least one measurement was made. When both gauges in a pair were operational, precision of the strain measurements could be established (*17*).

The laser system was deployed to accurately determine wheel placement relative to the gauges. Previous studies at the Test Track (*12*, *13*) with embedded axle sensing strips had shown wheel placement to be critical in determining pavement response.

Previous studies at the Track (*5*, *9*, *11*) had found strong correlations between temperatures in the asphalt and HMA modulus, asphalt strain, base pressure and subgrade pressure. Therefore, temperature probes were deemed critical and installed just outside the edge stripe in each section. It should be noted that section N7 had an additional set of earth pressure cells and asphalt strain gauges as shown in Figure 3.2. In the 2003 experiment, extra earth pressure cells (gauges 16 and 17) were installed in section N7 to examine wheelpath effects. No significant differences were observed between the inside and outside wheelpath. The extra set of asphalt strain gauges (18–21) were embedded along the center of the outside wheelpath, two inches higher in the structure than the bottom twelve gauges, in an effort to measure strain with depth. These gauges proved valuable in a slippage study that included both sections N7 and N8 during the 2003 experiment (15, 16).

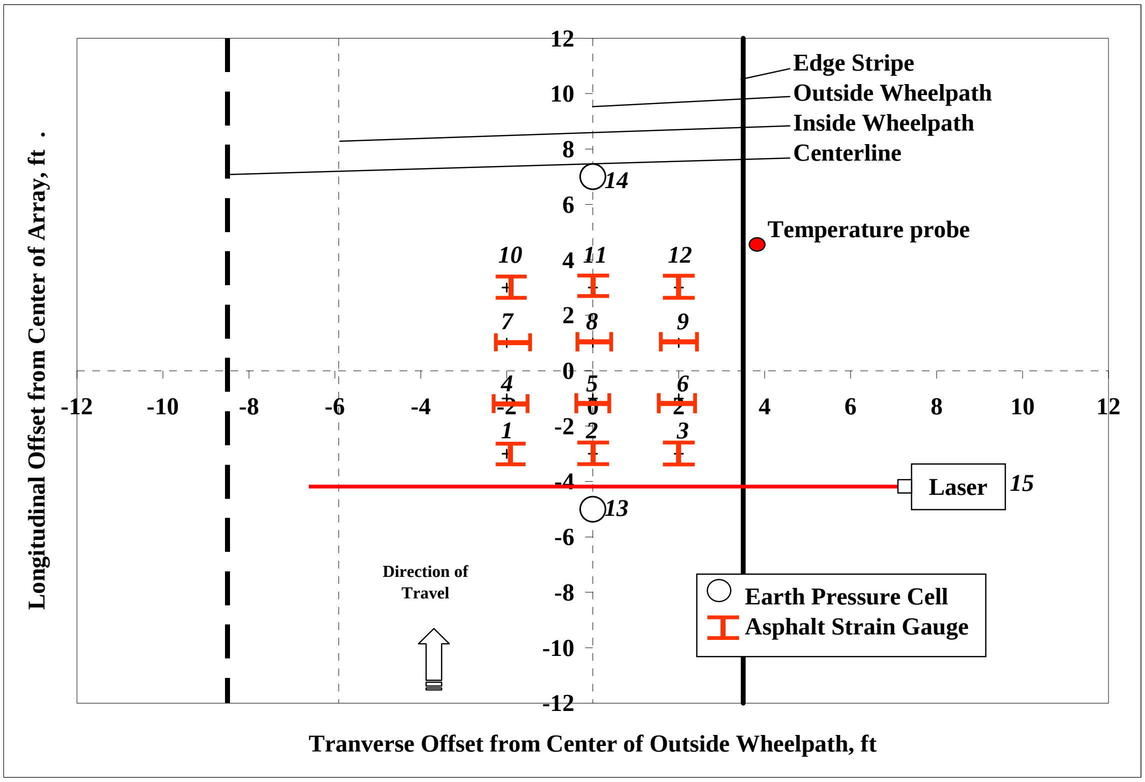


Figure 3.1. Gauge Arrangement for Sections N1-N6, N8, N10, S11

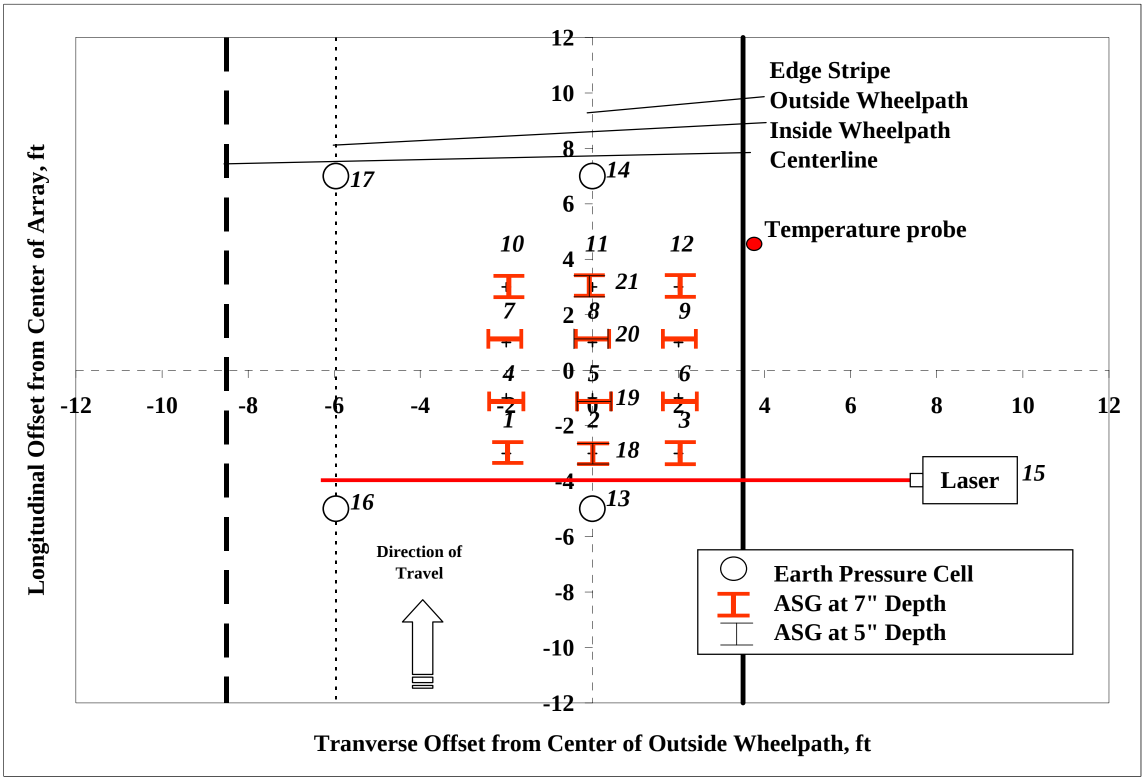


Figure 3.2. Gauge Arrangement for Section N7

In the previous chapter, it was noted that section N9 had asphalt strain gauges and temperature probes to measure thermal and strain gradients with depth. The strain gauge layout for section N9 is shown in Figure 3.3. The bottom twelve asphalt strain gauges were arranged as in all the other sections. The next twelve gauges were arranged in groups of four, placed on top of each previously paved HMA lift. As shown in Figure 3.3, gauges 16 – 19 were placed on top of the bottom HMA lift in the center of the outside wheelpath with two gauges in the longitudinal direction and two gauges in the transverse direction. Each successive group of four gauges was placed in similar manner on top of the preceding lift. The gauges were not stacked on top of each other to help minimize the disturbance to the overall structure.

ASPHALT STRAIN GAUGES

To maintain continuity and consistency with the existing structural test sections, the same asphalt strain gauges were used in the 2006 experiment. Purchased from Construction Technologies Laboratory, Inc. (CTL, Inc.), the gauge, with dimensions in inches, is shown in Figure 3.4. The sensor itself is a 350Ω Wheatstone Bridge mounted on a nylon 6/6 bar. There are four active strain gauges; two aligned with the maximum longitudinal strain and the other two with the transverse strain. The approximate stiffness of the nylon is 340,000 psi. Individual calibration sheets were provided with each gauge. It is also of note that the CTL gauges were designed and constructed to be applicable to most pavement cross-sections.The maximum range on the gauges is ±1,500 $\mu\varepsilon$ which is well within expected strain ranges for most flexible pavements.

Upon receipt of instrumentation from the vendor, each gauge was first checked for functionality. Specifically, the following checks were made:

- Gauge produced an output signal
- Baseline (unloaded) response was stable
- Gauge responded as expected to stimulus
- Gauge baseline (unloaded) signal was in acceptable range

To check the gauge functionality, each gauge was connected to the data acquisition system and a baseline reading was obtained. In addition to compiling tabular data, a small amount (i.e., a few seconds) of data were recorded for the baseline stability check. Figure 3.5 illustrates connecting asphalt strain gauges for functionality checks.

After the gauge was verified to produce an output signal and the baseline reading was recorded, an external load was applied to check that the gauge responded as expected. This was important since gauges could have been miswired by the manufacturer and produced a response opposite to what was expected when loaded. Figure 3.6 illustrates checking an asphalt strain gauge and verifying the response on the data acquisition software.

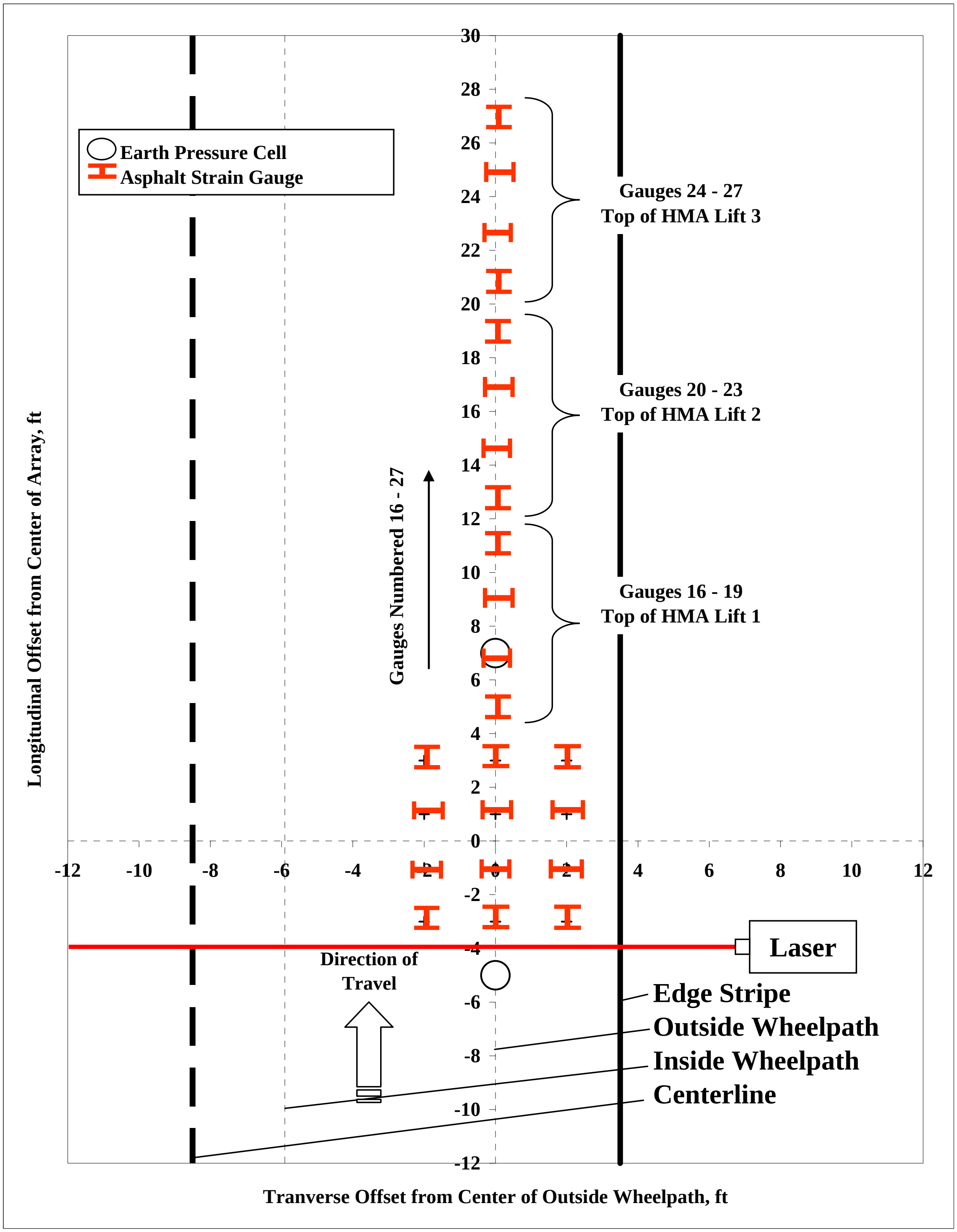


Figure 3.3. Gauge Arrangement for Section N9

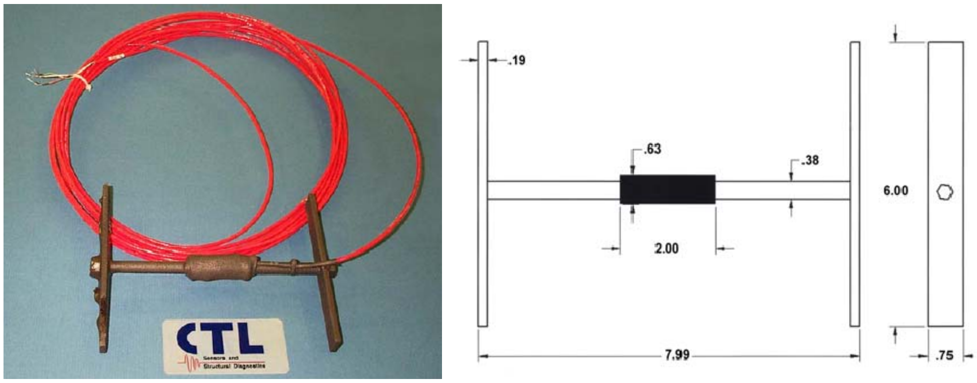


Figure 3.4. CTL Asphalt Strain Gauge

Figure 3.5. Connecting Asphalt Strain Gauges for Functionality Check

Figure 3.6. Gauge Response Check

The final functionality check ensured that the baseline signal was in an acceptable range. This was important since most gauges will drift with time and age and, although gauges can often be readjusted by adding resistance to the circuit, it is best to start an experiment with baseline readings near zero. Figure 3.7 illustrates this concept. In this example, four asphalt strain gauges were tested for functionality with a full-scale range of ±5 Volts. All four gauges have relatively stable baseline readings and produce the expected output (tension results in positive voltage change). However, gauges 1 and 2 have relatively high initial baselines with gauge 1 going offscale when put into tension. Though gauge 1 is functioning, it would be best to replace it with a gauge with an offset closer to zero.

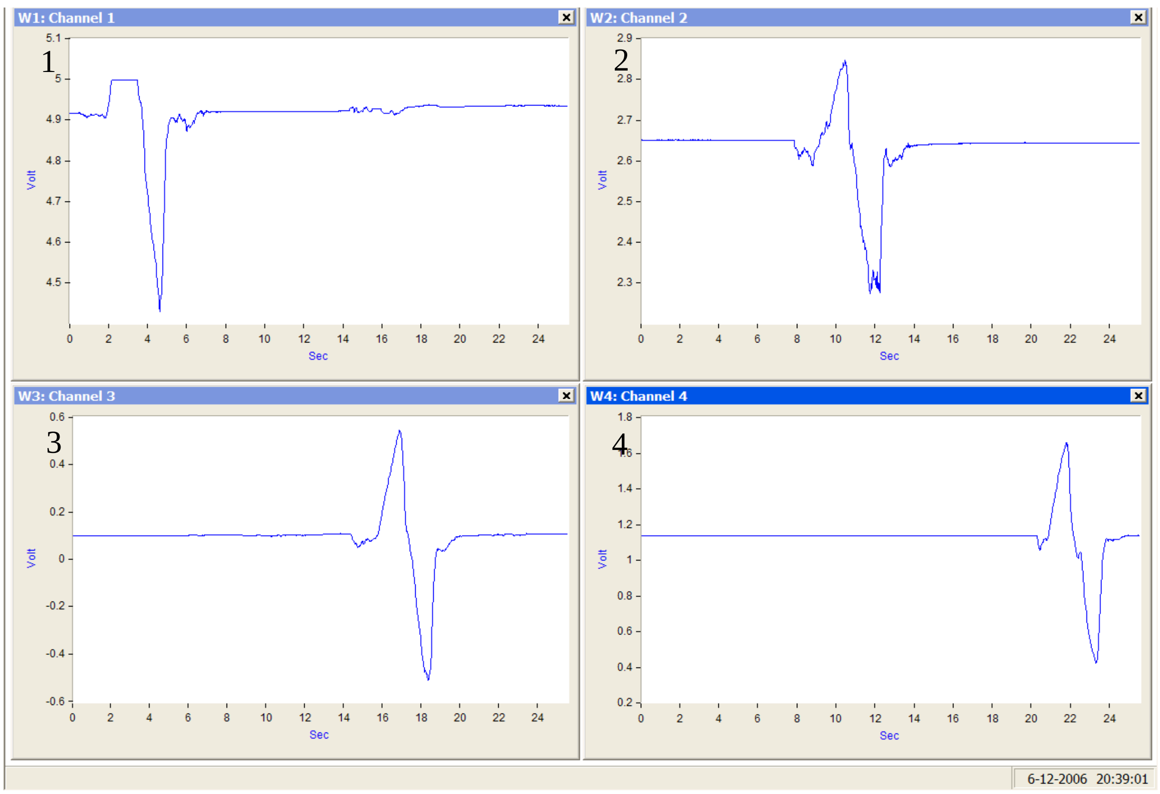


Figure 3.7. Asphalt Strain Gauge Signals

When deciding whether to replace gauges prior to construction, all of the gauges were considered together in the context of how many gauges were needed for initial construction. Of the 90 gauges purchased for the 2006 structural study, 18 were to be surplus that could be used in future rebuilds or in case of gauges failing the checks described above. All gauges passed the first three checks (gauge gives output signal, output signal is stable, gauge responds to stimulus). Therefore, it was possible to evaluate each gauge based upon its baseline voltage. Figure 3.8 illustrates a distribution of baseline voltages compiled from the 90 asphalt strain gauges. The data indicate that nearly 90% of the gauges were within ±2V of zero. Since there were enough surplus gauges, only gauges with an initial offset between ±2V were used. Had there been fewer gauges, the gauges with higher offsets would have been evenly distributed amongst the planned test sections such that one would not have an overrepresentation of high-offset gauges.

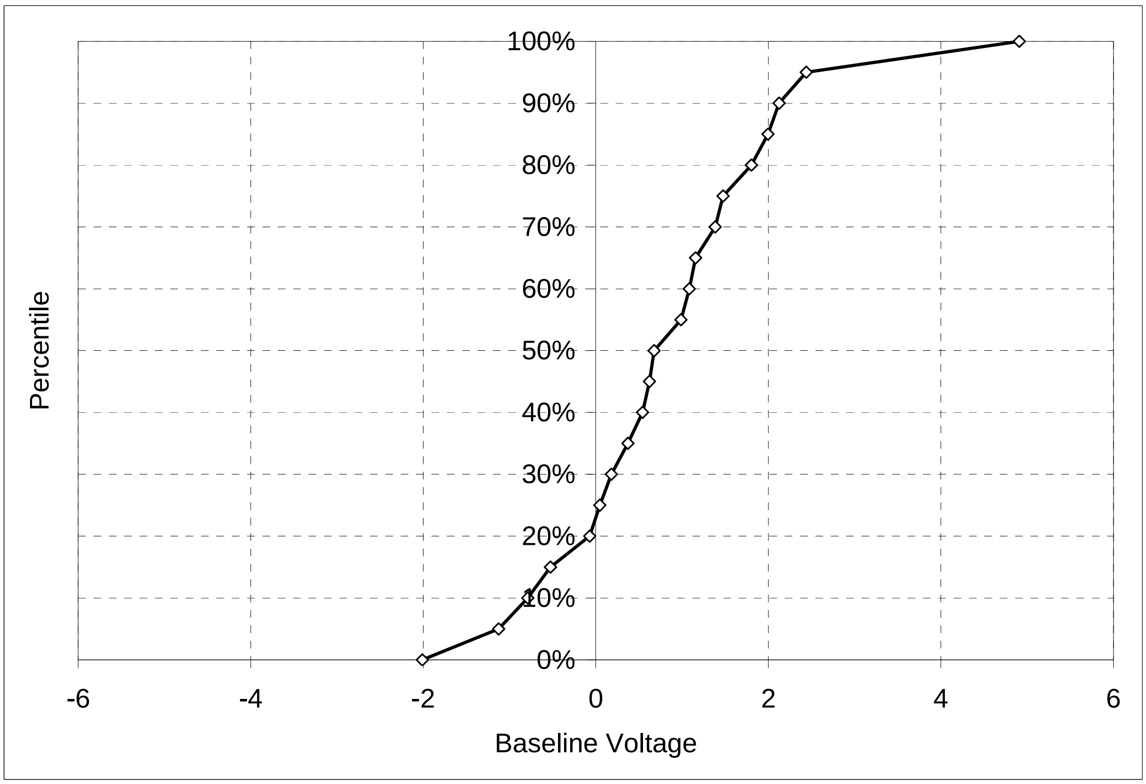


Figure 3.8. Baseline Voltage Statistical Summary

It is important to note that calibration of the asphalt strain gauges was not conducted at NCAT. Rather, each asphalt strain gauge was calibrated by the manufacturer (CTL, Inc.) and shipped with an individual calibration sheet. While it would be ideal to locally calibrate each individual gauge, the equipment, personnel and time required to perform such a calibration were not available. Further, a recent study by Hornyak et al. (2007) conducted extensive calibration studies of asphalt strain gauges. They concluded that their own calibration factors were in reasonable agreement with those provided by the manufacturer. A complete listing of individual gauges, and corresponding calibration factors (με/Volt) is given in Appendix A.

EARTH PRESSURE CELLS

The earth pressure cells used in the 2006 construction were the same make and model as used in the 2003 experiment. The Geokon model 3500 earth pressure cell with a full-scale capability of 36.3 psi (250 kPa) was used in all sections. Pictured in Figure 3.9, this device consists of two circular stainless steel plates welded together around their periphery and spaced apart by a narrow cavity filled with de-aired oil. Changing earth pressure squeezes the two plates together causing a corresponding increase of fluid pressure inside the cell. The semi-conductor transducer converts this pressure into an electrical signal which is transmitted as a voltage change via cable to the readout location. Figure 3.10 shows one test cell just after receipt at the test track in addition to the profile of the plate.

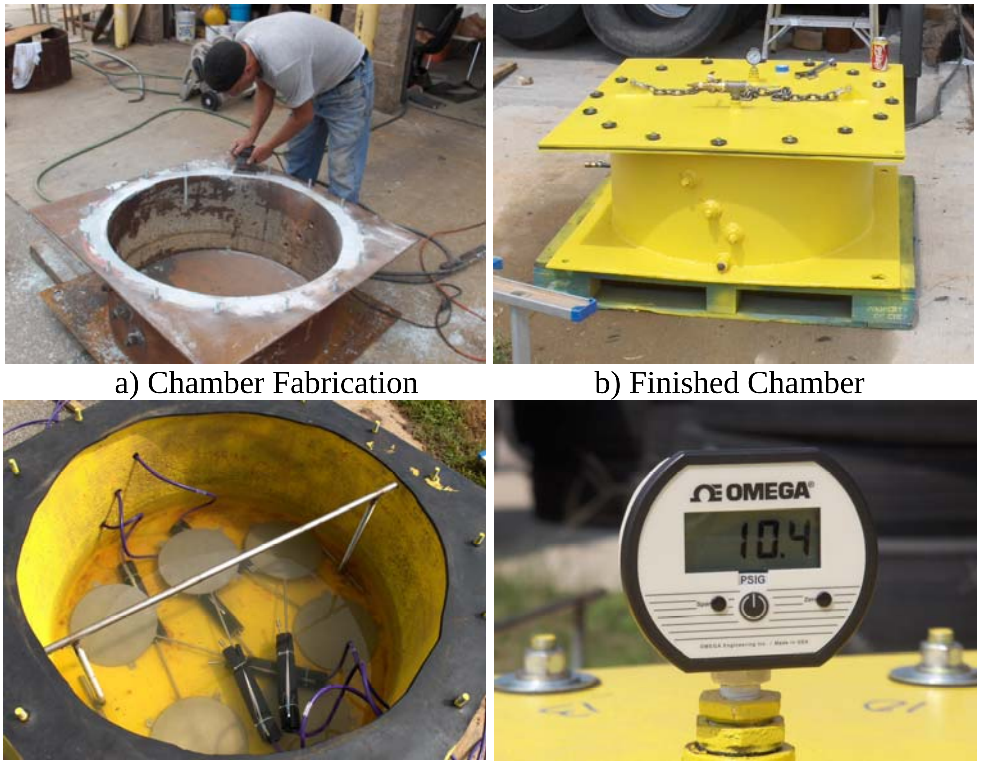
Figure 3.9. Geokon Earth Pressure Cell

Figure 3.10. Geokon Earth Pressure Cell at the Test Track

The earth pressure cells used in the 2003 experiment were put through a crude calibration procedure using the Auburn University Aquatic Center diving well (*14*). Though this calibration was deemed reasonably effective, it was decided that a more precise calibration, at reasonable cost, could be accomplished for the 2006 experiment. The following sub-sections describe the calibration chamber, procedure and results of the calibration process.

Calibration Chamber

Since the 2006 Test Track research effort utilized 18 new earth pressure cells, it was desirable to have a chamber capable of calibrating multiple gauges simultaneously. Given the materials on hand, the chamber was custom built to accommodate 6 gauges at one time as shown in Figure 3.11(c). Also pictured in Figure 3.11 was a rubber gasket (3.11(c)) and 17 bolts (3.11(b)) to seal the chamber during testing. External measurements were made by the Omega gauge (model #DPG1000B-100G) pictured in Figure 3.11(d) while internal measurements were obtained directly from the pressure plates connected to an external data acquisition system. The Omega gauge was capable of reading from 0–100 psi to the nearest 0.1 psi.



a) Chamber Fabrication b) Finished Chamber

c) Pressure Cells in Chamber d) Precision Pressure Gauge

Figure 3.11. NCAT Pressure Cell Calibration Chamber

Calibration Process and Results

The calibration process began by first carefully placing six earth pressure cells inside the calibration chamber. The cables were fed through access ports fitted with compression fittings to provide a nearly airtight chamber. The cables were then connected to the data acquisition system and the tank was filled with water until it was nearly full. The lid was placed on the tank and tightened into place after which an adjustable pressurized airline was connected so that pressures could be increased and decreased with the turn of a valve.

During calibration, readings were taken at approximately 5 psi increments, from 0 psi to near the full scale of the gauge at 30 psi. The pressure was increased and decreased, over the 30 psi range, three times for repeatability and to ensure that the gauges were reading the same way when either increasing or decreasing the pressure. Figure 3.12 illustrates the results for two pressure plates relative to the Geokon-provided calibration and it must be noted that these results are representative of all the pressure plates that were calibrated. Clearly, the local and manufacturer calibrations are very similar and one could argue that the local calibration was not needed. However, the local calibration does provide valuable information regarding the accuracy of the gauge prior to installation in addition to a slightly more precise, gauge specific, calibration. Table 3.1 lists the individual calibration coefficients obtained at NCAT and the manufacturer-provided coefficients for the cells used in 2003. The coefficients can be used to compute pressure according to the simple linear relationship:

$$Pressure = Slope * Output\ Voltage + Intercept \quad (3.1)$$

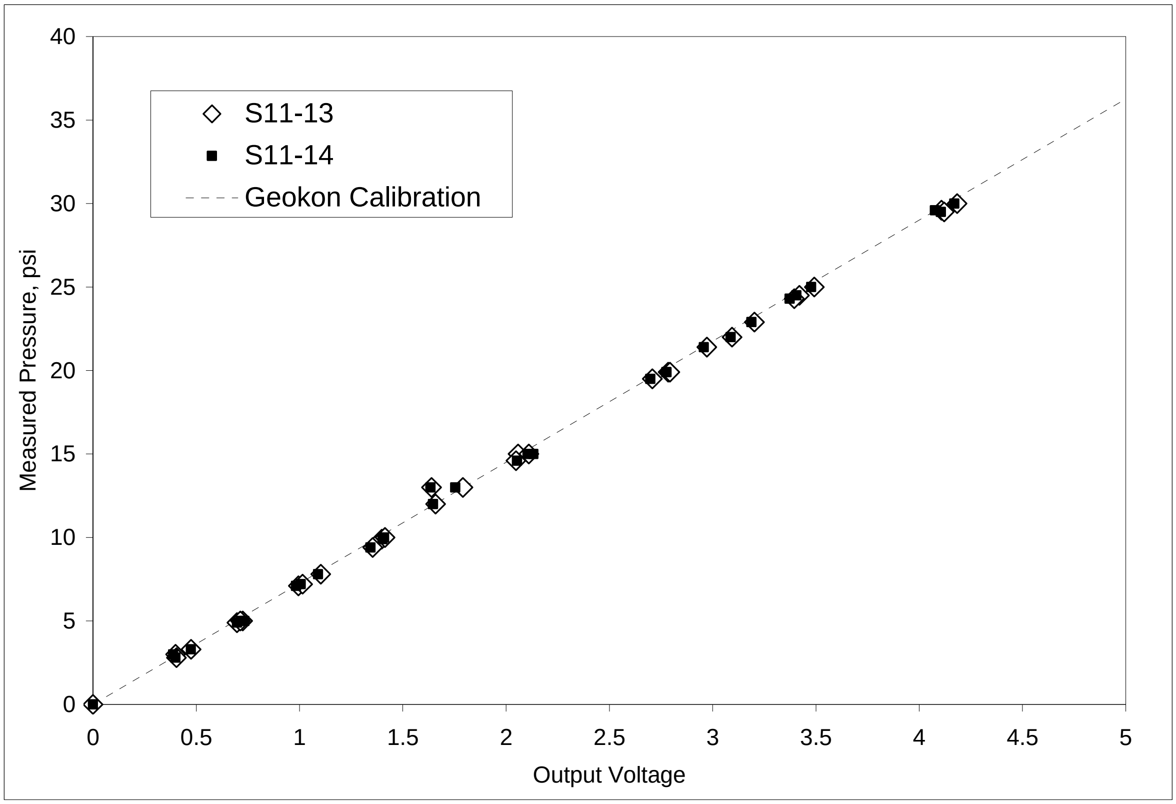


Figure 3.12. Pressure Plate Calibration Data

TEMPERATURE PROBES

The Campbell-Scientific model 108 thermistor temperature probes have proven themselves in the first two test cycles at the Test Track and were again selected for use in the 2006 study. Pictured in Figure 3.13, individual probes were bundled together so that thermal gradients with depth could be measured. The configuration shown in Figure 3.13 was used in the 2003 study and these probes were left in place in sections N3 through N7. Many of the investigations during the 2003 experiment, however, determined that HMA mid-depth temperature was strongly correlated to parameters such as asphalt strain and modulus. Therefore, for the new sections (N1, N2, N8, N9, N10 and S11), probes were custom built for each section to measure the top, middle and bottom of the HMA and three inches into the underlying aggregate base layer. The thicknesses were based on as-built HMA depths. Table 3.2 lists the thermal probe depths by test section.

As previously discussed, additional thermal sensors were used in section N9 to capture a more detailed thermal profile through the depth of the pavement. The probes were approximately set to match the top, middle and bottom of each HMA lift. These additional probe depths are listed in Table 3.3.

Table 3.1. Earth Pressure Cell Calibration Coefficients

Section	Gauge	Location	Slope	Intercept	R^2
N1	13	Base	7.295	-0.267	1.000
N1	14	Subgrade	7.382	-0.38	0.999
N2	13	Base	7.309	-0.297	0.997
N2	14	Subgrade	7.302	-0.246	0.999
N3	13	Base	7.260	0.000	**
N3	14	Subgrade	2.900	0.000	**
N4	13	Base	7.260	0.000	**
N4	14	Subgrade	2.900	0.000	**
N5	13	Base	7.260	0.000	**
N5	14	Subgrade	2.900	0.000	**
N6	13	Base	7.260	0.000	**
N6	14	Subgrade	2.900	0.000	**
N7	13	Base	7.260	0.000	**
N7	14	Subgrade	2.900	0.000	**
N7	16	Base	7.260	0.000	**
N7	17	Subgrade	2.900	0.000	**
N8	13	Base	7.197	0.042	0.997
N8	14	Subgrade	7.173	0.069	0.998
N9	13	Base	7.177	0.068	0.998
N9	14	Subgrade	7.188	0.084	0.997
N10	13	Base	7.247	-0.24	0.999
N10	14	Subgrade	7.324	-0.306	1.000
S11	13	Base	7.181	-0.023	0.999
S11	14	Subgrade	7.211	-0.032	0.999

**Existing gauge from 2003 experiment. Used manufacturer-provided calibration.

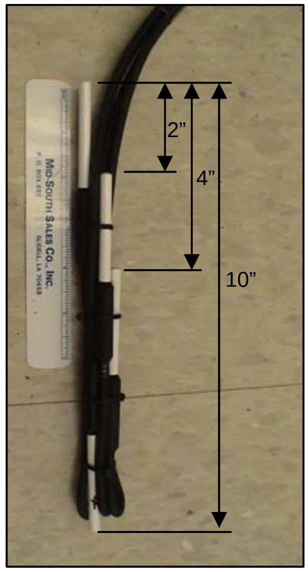


Figure 3.13. Temperature Probe Array Used in Sections N3 – N7

Table 3.2. Temperature Probe Depths

	Depth of Probe, inches			
Section	T1	T2	T3	T4
N1	0.0	3.7	7.4	10.4
N2	0.0	3.5	7.0	10.0
N3	0.0	2.0	4.0	10.0
N4	0.0	2.0	4.0	10.0
N5	0.0	2.0	4.0	10.0
N6	0.0	2.0	4.0	10.0
N7	0.0	2.0	4.0	10.0
N8	0.0	5.0	10.0	13.0
N9	0.0	7.2	14.4	17.4
N10	0.0	3.9	7.7	10.7
S11	0.0	3.8	7.6	10.6

Table 3.3. Section N9 – Additional Temperature Probe Depths

Sensor	Depth, in.
T5	0.0
T6	1.0
T7	2.0
T8	3.7
T9	5.4
T10	6.9
T11	8.4
T12	9.6
T13	10.8
T14	12.4
T15	14.1
T16	17.1

As mentioned above, the model 108 thermistors had been used extensively at the Test Track with good success. Based on this experience, it was deemed that a local calibration was unnecessary. However, for the new probes used in the 2006 study, each thermistor was submerged in an ice bath to check its zero reading prior to "accepting" it for use in the project. All thermistors passed this simple test.

LASERS

Wheel wander was measured during the 2003 Test Track using embedded axle sensing strips in Section N4 (*12*, *13*). Pictured in Figure 3.14, these strips were useful in characterizing the wheel wander pattern for one location in the structural experiment. However, they did have a number of limitations. First, they required cutting 1.5 inches by 1.5 inches by 7 foot slots in the pavement surface. While they have performed well in the section in which they were placed (N4 – 9 inches of HMA), it was thought that placing them in thinner sections could be problematic and cause premature distress. The second problem was that they could not be placed directly over a sub-surface gauge array for fear of confounding readings made by the asphalt strain gauges and pressure plates below. Therefore, they were placed upstream of the embedded instrumentation in N4 and one-to-one correlations between wheel placement and measured response were not possible. To address these two major issues, a non-contact method of measuring wheel placement was sought for the 2006 experiment. The solution, as described in the following paragraphs, was to use a high-speed laser measuring device.

Figure 3.14. Axle Sensing Strips for Measuring Wheel Wander

An extensive search of existing technologies was conducted to find a distance measuring device capable of capturing a truck tire moving past it at 45 mph. The result of the search was the AccuRange 4000, also called the AR4000. Manufactured by Acuity Research Incorporated, there are a number of AR4000 models available. The model selected for the Test Track was the AR4000-LIR (Figure 3.15) which is a Class IIIb laser that uses near infrared light (780 nm wavelength) with an effective range up to 50 ft and an accuracy of ±0.1 inch. Another feature of the AR4000-LIR was that it could be seamlessly integrated into the data acquisition system used for the subsurface instrumentation. This feature was key in being able to directly correlate subsurface response measurements to wheel placement. As shown in Figures 3.1 and 3.2, the laser was assigned to channel 15 for each section's data acquisition system.

Figure 3.15. AR4000-LIR Distance Measuring Unit

While extensive testing was conducted in the laboratory and with a small test vehicle (pickup truck) to gain familiarity with the sensor, calibration of each gauge did not occur until it was installed in the field. This was because each test section had a unique set of conditions that could be accounted for in the calibration process. Full details regarding installation of the laser sensors and subsequent calibration are provided in the next chapter.

DATA ACQUISITION

The 2003 Test Track utilized a combination of wireless data transmission for temperature and moisture measurements while the pavement response measurements were made with a hard-connection with personnel alongside the Test Track during testing (*14*). While this was an effective means of gathering data, wireless technology had advanced sufficiently by the start of the 2006 Test Track to utilize primarily wireless data transmission for both the environmental and pavement response measurements. This change had several important advantages. First, data could be collected under any weather conditions since roadside boxes did not have to be opened to make the connection. Second, the data collection process was more efficient since personnel were not having to physically move from section to section. Third, and most importantly, the wireless system kept personnel off the track during testing. The obvious advantage of this was moving personnel out of a potentially hazardous work environment. A short description of the wireless system is provided below.

Figure 3.16 shows the roadside instrumentation enclosures erected for the 2006 Test Track. The arrangement of enclosures was designed to make use of the existing enclosure (small box on upper left) that was erected for the 2003 experiment. Aside from the myriad parts needed to assemble this configuration, the two main components of the data acquisition system were the Campbell-Scientific CR10X datalogger used to record in situ temperatures and the Dataq DI-760 datalogger used to make readings of the laser, earth pressure cells and asphalt strain gauges.

The CR10X datalogger (Figure 3.17), manufactured by Campbell-Scientific, Inc. had been used extensively at the Test Track dating back to the first experiment in 2000. Its primary function in the 2006 study was to make minute-by-minute thermistor readings (so-called “slow speed” readings) from which hourly summaries (i.e., minimum, maximum and average hourly temperatures) were archived. The second function of the CR10X was to utilize its built-in programmable features to remotely power on and off the DI-760 unit and laser. This enabled data collection activities to be conducted entirely remotely.

The DI-760 data acquisition unit (Figure 3.18) was supplied by DATAQ Instruments, Inc. The DI-760’s main function was to collect strain, pressure and laser measurements at relatively high frequencies (so-called “high-speed” readings) on the order of 1,000 to 2,000 Hz/channel. The system was very similar to the portable DI-510-32 unit that was used in the 2003 experiment (*14*) with some important exceptions. First, the DI-760 was designed to be ethernet-ready. This was a key feature since it was to be integrated to the wireless network at the Test Track. Second, it was designed to be a fixed, non-portable unit. An individual DI-760, and signal conditioning modules, was installed in each test section. While this was certainly more expensive than using a single unit moved between sections, the benefits in terms of data collection efficiency and safety warranted the transition.

Figure 3.16. Roadside Data Acquisition Enclosures and Equipment

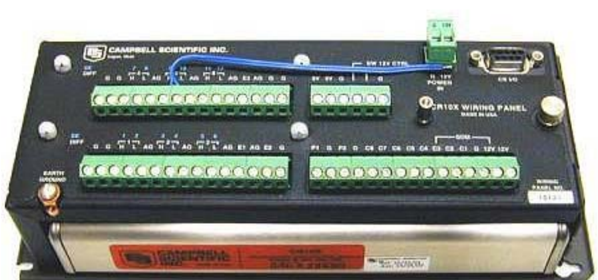


Figure 3.17. CR10X Datalogger

Figure 3.18. DI-760 Data Acquisition Unit

The CR10X and the DI-760 were integrated in a newly deployed wireless network mesh at the Test Track. Personnel from the Auburn University College of Engineering Network Services office were responsible for the customized development, construction and maintenance of the mesh. The mesh provided high-speed wireless internet access from anywhere on the Test Track or in the lab buildings. Therefore, the dataloggers could be accessed remotely to download environmental data or to make a wireless connection when making high-speed pavement response measurements.

CHAPTER 4 –
SECTION CONSTRUCTION AND GAUGE INSTALLATION

INTRODUCTION

This chapter describes the construction and installation of gauges in the new test sections in the 2006 structural study. Details regarding the existing test sections have been documented previously (*14*). The chapter generally follows the order of construction, beginning with removal of existing test sections followed by construction of individual pavement layers. Descriptions of gauge installation are also provided.

SECTION REMOVAL

As mentioned in previous chapters, sections N1, N2, N8, N9, N10 and S11 required full-depth removal of the existing pavement to facilitate construction of the new test sections. Figure 4.1 shows the milling operation in section N8 which required full depth removal of the existing pavement (7 inches HMA, 6 inches aggregate base) in addition to removing 45 inches of the existing embankment to allow for the Oklahoma embankment to be constructed. Figure 4.2 shows sections N8 at the conclusion of the milling operation. It should be noted, from both Figures 4.1 and 4.2, that the inside lane was left in place which proved to be a valuable work platform both during removal and the paving operation. The shoulder was also left in place due to the large amount of material that would have to be removed and replaced. Though drainage outlets were cut to help remove rainwater, there was still significant water pooling as shown in Figure 4.3. Figure 4.4 summarizes the depth of milling for each of the structural test sections.

Figure 4.1. Milling Operation in Section N8 (8/18/2006)

Figure 4.2. Section N8 at Conclusion of Pavement Removal (8/24/2006)

Figure 4.3. Section N9 After a Rain Event (8/24/2006)

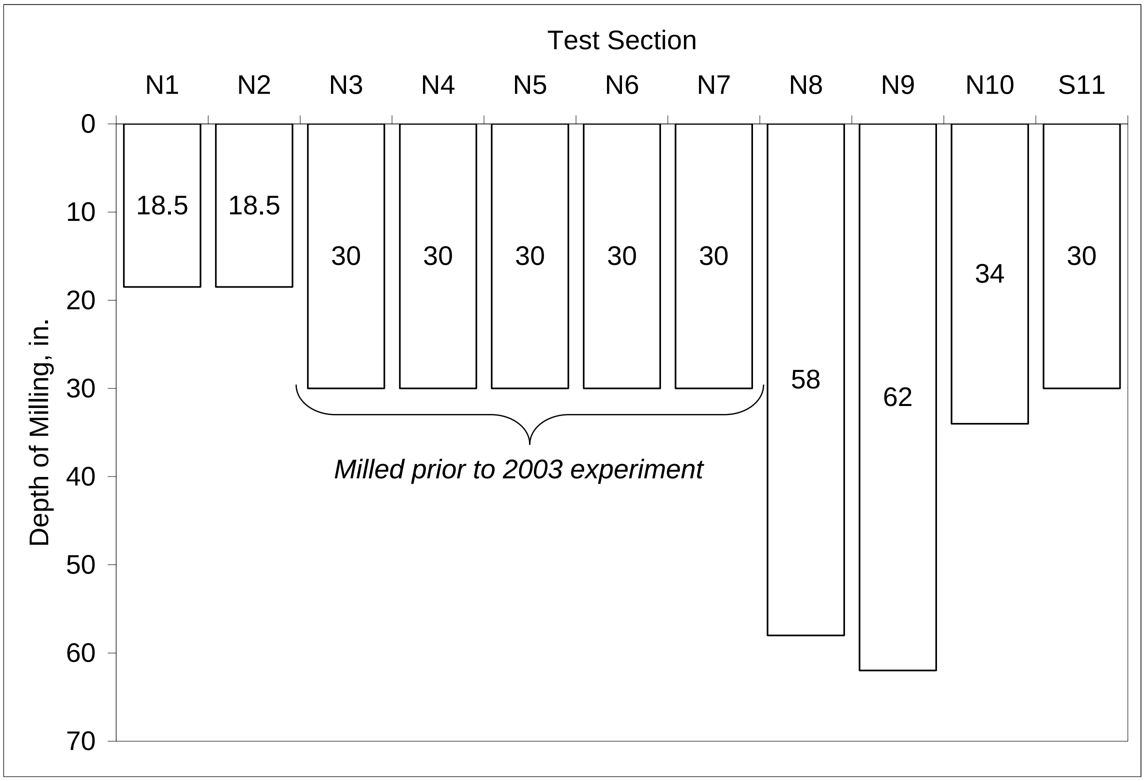


Figure 4.4. Depth of Milling

UNBOUND MATERIALS AND GRADATIONS

A variety of unbound materials were used as sublayers in both the 2003 and 2006 structural sections. They included materials excavated on site, locally available but off site materials and materials brought in from other states. Figure 4.5 illustrates the unbound material gradations with a table inset indicating where the materials were used within the experiment. Further discussion of the materials and their relevant as-built properties are provided in the following sections.

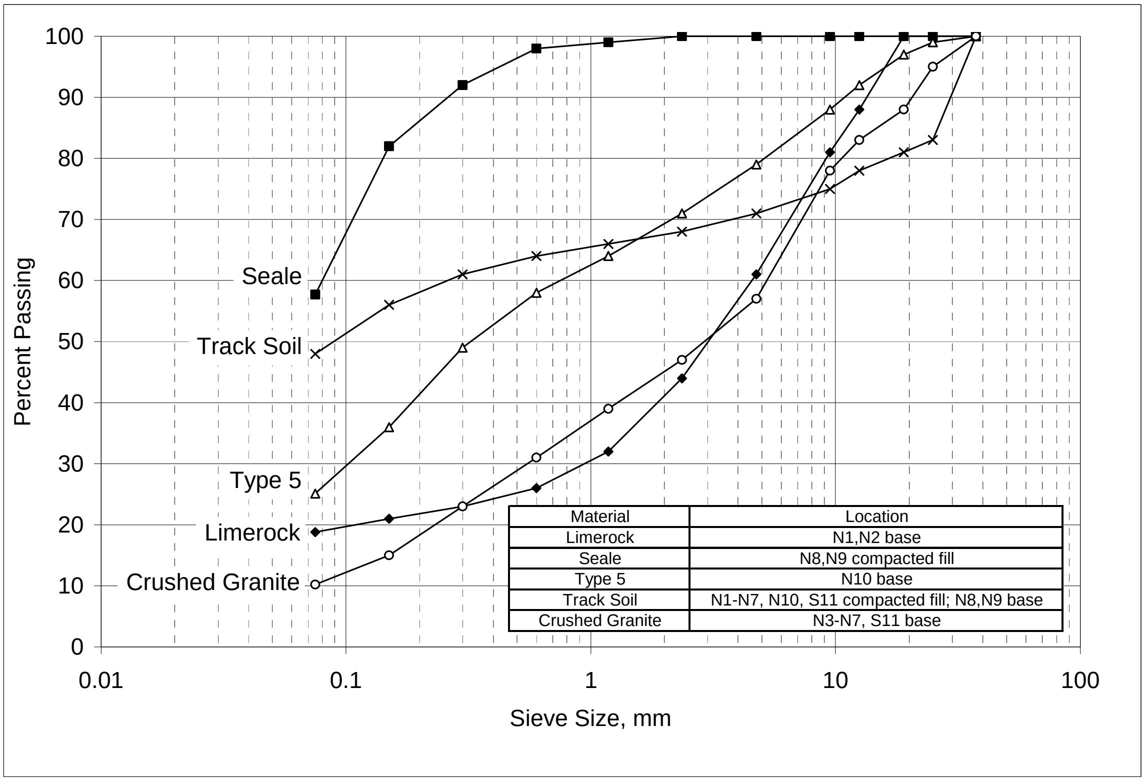


Figure 4.5. Unbound Material Gradations and Use in Structural Study

COMPACTED FILL CONSTRUCTION

After each of the new test sections had been milled to the requisite depth, fill material was placed and compacted. The amount and type of fill was dependent upon the test section. The process is described on a section-by-section basis below.

Sections N1 and N2

As noted in Figure 4.4, 18.5 inches of the existing pavement was removed. Since the new pavement was to consist of approximately 7 inches of HMA with 10 inches of limerock base, approximately 1.5 inches of additional leveling fill material was placed and compacted to a target density of 123.8 pcf which was consistent with the target density in the 2003 test sections. Actual in place thickness, determined by survey, and density and moisture contents, determined by nuclear density gauge, are listed in Table 4.1. It should be noted that these are section-wide average values and the unit weights represent total unit weight (including moisture). As done in previous research cycles at the Test Track (*11*), the fill material was taken from a borrow pit located in the west curve. The material, referred to as Track Soil, was classified as an AASHTO A-4(0) soil and contained many large stones and cobbles that broke down under compaction.

Table 4.1. N1 and N2 Average In-Place Compacted Fill Properties

Section	Thickness, in.	Unit Weight, pcf	Moisture Content, %
N1	1.1	132.2	9.8
N2	1.5	132.6	8.3

Sections N3 – N7

Though sections N3 through N7 were left in place for the 2006 experiment, it is worth noting their respective fill thicknesses, in-place densities and moisture contents at the time of construction. Table 4.2 summarizes section-wide averages and it should be noted that the fill material (Track Soil) was obtained from the same pit located in the west curve of the Test Track.

Table 4.2. N3 – N7 Average In-Place Compacted Fill Properties

Section	Thickness, in.	Unit Weight, pcf	Moisture Content, %
N3	14.9	127.6	8.7
N4	15.3	125.6	8.0
N5	17.1	129.3	7.8
N6	16.8	132.7	9.7
N7	16.7	130.2	9.1

Sections N8 and N9

ODOT requested a soft soil, similar to what they frequently encountered in Oklahoma, be used in their test sections. A local source from Seale, AL (approximately 30 miles south of the Test Track) was identified for use in N8 and N9 and was classified as an AASHTO A-7-6(13) soil.

Approximately 40 inches of the Seale material was placed in both sections N8 and N9. This depth was placed and compacted in approximately equal lifts in each test section. Section N8 was constructed in 4 lifts while N9 was constructed in 3 lifts. Table 4.3 summarizes the average fill thickness, in place densities and moisture contents for each section.

Table 4.3. N8 and N9 Average In-Place Compacted Fill Properties

Section	Thickness, in.	Unit Weight, pcf	Moisture Content, %
N8	41.7	126.2	18.0
N9	39.2	126.9	17.2

Sections N10 and S11

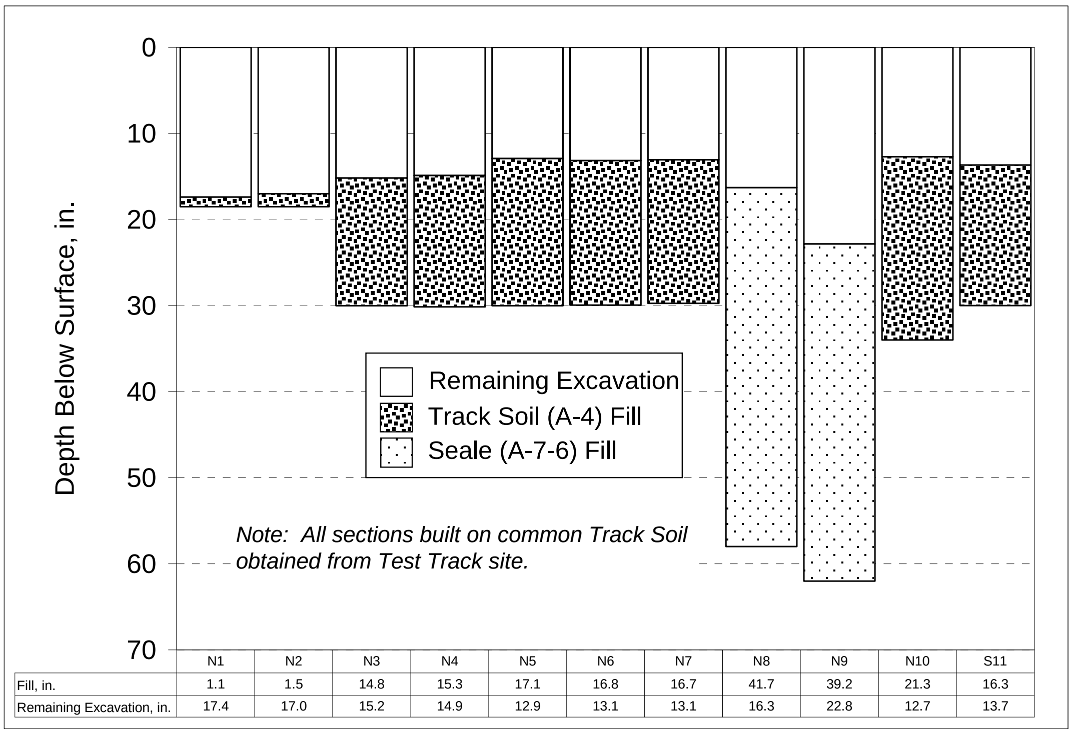
The fill material employed in N10 and S11 was similar to that used in N1 – N7. An interesting point regarding N10 and S11, as shown in Table 4.4, was the large difference in as-built moisture content between the two test sections needed to achieve approximately the same in-place unit weight.

Table 4.4. N10 and S11 Average In-Place Compacted Fill Properties

Section	Thickness, in.	Unit Weight, pcf	Moisture Content, %
N10	21.3	135.3	9.0
S11	16.3	133.8	12.8

Comparison of All Sections – Fill

For the sake of comparison, Figures 4.6 and 4.7 summarize all the data presented in the subsections above. The most notable comparison is between the Seale fill sections (N8 and N9) that had much higher moisture contents and relatively lower unit weights in comparison to the other sections utilizing the Track Soil fill material.



	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	S11
Fill, in.	1.1	1.5	14.8	15.3	17.1	16.8	16.7	41.7	39.2	21.3	16.3
Remaining Excavation, in.	17.4	17.0	15.2	14.9	12.9	13.1	13.1	16.3	22.8	12.7	13.7

Figure 4.6. Summary of Compacted Fill Depths

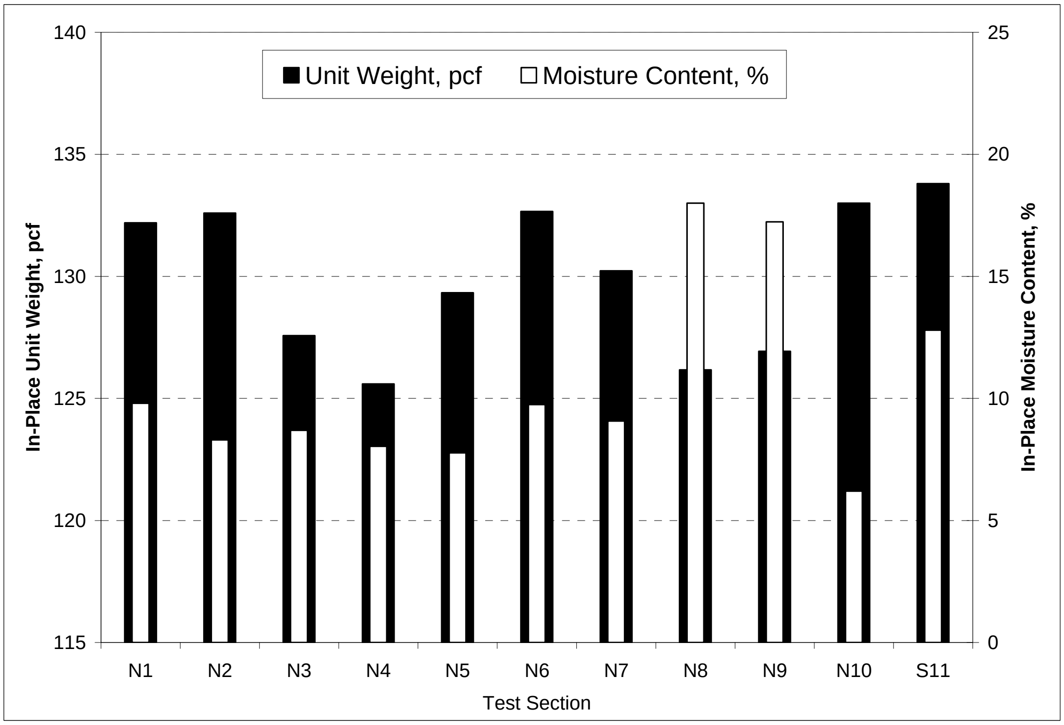


Figure 4.7. Summary of Compacted Fill Moisture Contents and Unit Weights

FILL PRESSURE GAUGE INSTALLATION AND BASE CONSTRUCTION

Once the fill had been prepared, work commenced on installing the earth pressure cell at the top of the fill. The installation procedure was nearly identical to that used during the 2003 installation. Interested readers can consult NCAT Report 04-01 (*14*) for detailed descriptions regarding pressure cell installation. Only the main steps, and differences during the 2006 installation, are described below.

To install the earth pressure cell, a shallow cavity and cable trench was first dug as illustrated in Figure 4.8. The shallow cavity was made level and filled first with a layer of -#8 material followed by a thin layer of -#16 material. The sieved material was taken locally from each section (i.e., sections N8 and N9 used sieved Seale material while all the others used the Track Soil material). After leveling the gauge (shown in Figure 4.9), a thin layer of -#8 material was placed on top of the gauge, followed by a thicker layer of -#16 material. The soil was compacted by hand. These layers of sieved material enveloped the pressure cell and ensured that no large stones would come in direct contact with the flat part of the gauge. The rest of the gauge utilized -#8 as backfill and cover over the transducer. It was believed that this component was more rugged and less susceptible to puncture from larger stones and therefore -#8 soil was deemed suitable. This material was also hand compacted. A nearly complete installation in shown in Figure 4.9.

During the 2003 installation, sieved material was also used to backfill and cover the cabling running from the transducer to the roadside conduit. Though this worked well in terms of gauge survivability, there was a desire to used unsieved material for backfill and cover to minimize the effect of having the gauge present in the structure. Therefore, in 2006, the cables were threaded through a 3/8 inch flexible aluminum conduit that did not require the use of sieved material. The flexible conduit is shown in Figure 4.8 It was simply laid in the trench and backfilled with unsieved soil. This was then compacted using a Marshall hammer as shown in Figure 4.10. It should be noted that this technique was first used during the installation of gauges at the Marquette Interchange project in Milwaukee, WI (4).

Figure 4.8. Preparation of Pressure Cell Cavity and Trench in N1

After the fill pressure cell had been installed, the aggregate base layer was constructed. A relatively small amount of aggregate base material was first carefully placed in a mound (Figure 4.11), and compacted by hand, over the fill pressure cell to give it some protection prior to commencing full-scale aggregate base construction. However, once the gauge was covered, construction proceeded in the usual fashion achieving the target density and moisture content for the respective materials in each test section. It should be noted that the earth pressure cells were monitored during construction of the aggregate base to ensure there was not gauge failure during construction. Had there been gauge failure, it would have been possible to excavate down to the gauge and replace it prior to paving the HMA. However, 100% of the gauges survived the construction of the aggregate base and excavation was not needed. The following sub-sections document the aggregate base construction for each section.

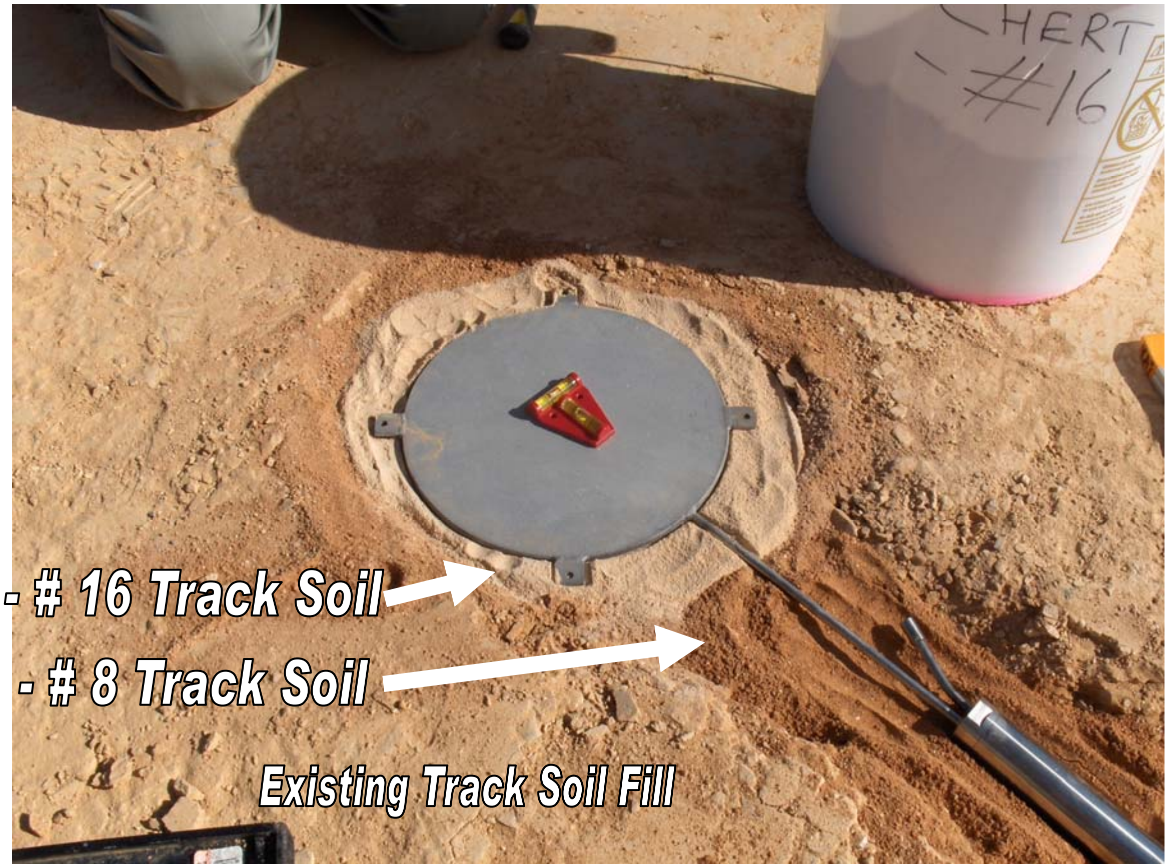


Figure 4.9. Installation of Fill Pressure Cell in Section S11

Figure 4.10. Compaction of Cable Trench for Fill Pressure Cell in Section N8

Figure 4.11 Placing Aggregate Base in Section S11.

Sections N1 and N2

The aggregate base in sections N1 and N2 was a limerock material often used by the Florida DOT. The limerock base was relatively fine with nearly 20% passing the #200 sieve. Table 4.5 summarizes the sectional average thickness, unit-weight and moisture contents.

Table 4.5. N1 and N2 Average In-Place Aggregate Base Properties

Section	Thickness, in.	Unit Weight, pcf	Moisture Content, %
N1	10.0	127.4	11.9
N2	10.0	129.6	13.0

Sections N3 – N7

As noted previously N3 through N7 were left in place for the 2006 experiment, and the as-built aggregate properties are included here for completeness. Table 4.6 summarizes section-wide averages for the aggregate base which was a dense-graded crushed granite material (~10% passing #200) often used by the Alabama DOT in the southeastern part of the state.

Table 4.6. N3 – N7 Average In-Place Aggregate Base

Section	Thickness, in.	Unit Weight, pcf	Moisture Content, %
N3	6.0	146.5	6.2
N4	6.0	145.9	5.8
N5	6.0	146.1	6.2
N6	6.0	146.5	6.5
N7	6.0	146.8	6.6

Sections N8 and N9

ODOT utilizes lime treatment in many projects to improve the upper portion of the subgrade and to provide a stable work platform. Upon reviewing the locally-available Track Soil, ODOT engineers opted to use this material to represent their treated soil. Table 4.7 summarizes the section-specific average as-built properties.

Table 4.7. N8 and N9 Average In-Place Aggregate Base Properties

Section	Thickness, in.	Unit Weight, pcf	Moisture Content, %
N8	6.4	133.4	10.8
N9	8.4	133.8	12.9

Section N10

A material commonly used for aggregate base in Missouri (Type 5) was utilized in section N10. As noted in Figure 4.5, this material was generally finer-graded than either the limerock or granite base materials. It was also the thinnest aggregate base placed within the structural experiment as noted in Table 4.8.

Table 4.8. N10 Average In-Place Aggregate Base Properties

Section	Thickness, in.	Unit Weight, pcf	Moisture Content, %
N10	5.0	138.6	4.7

Section S11

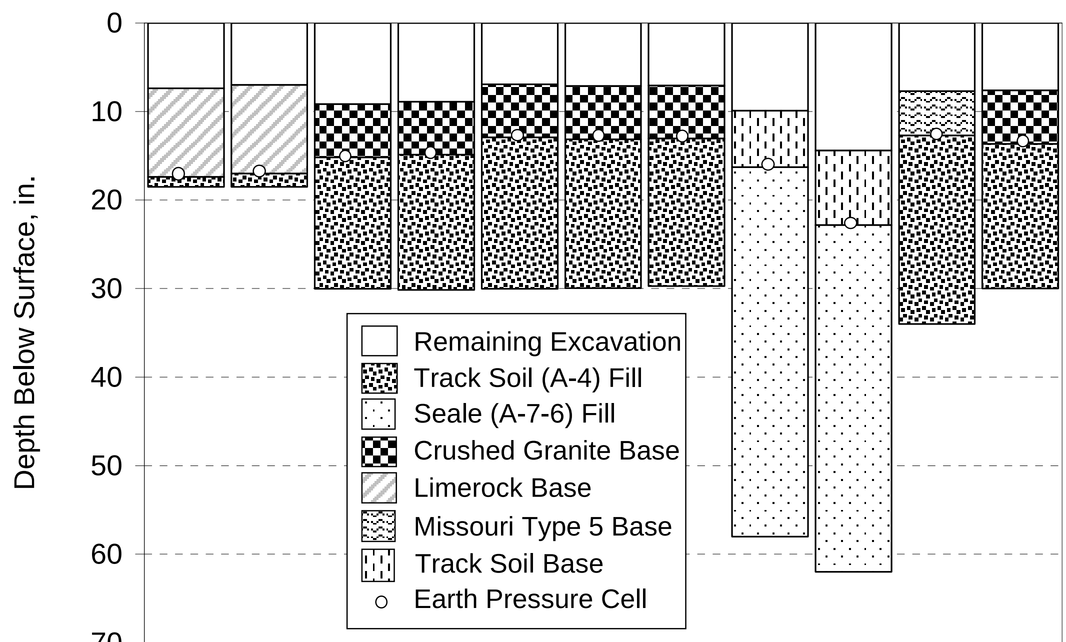
The aggregate base in S11 was similar to the base layers previously constructed in sections N3 – N7. The as-built properties are listed in Table 4.9.

Table 4.9. S11 Average In-Place Aggregate Base Properties

Section	Thickness, in.	Unit Weight, pcf	Moisture Content, %
S11	6.1	145.5	3.4

Comparison of All Sections – Aggregate Base

Figure 4.12 summarizes the thickness data presented in the tables above for the eleven structural test sections. The figure also indicates the location of the earth pressure cells at the compacted fill/aggregate base interface. Figure 4.13 summarizes the in-place unit weights and moisture contents for each section. It is interesting to note that the aggregate base in S11 needed much less water (about 50% less) to achieve nearly the same unit weight as similar materials placed in sections N3 – N7 in the 2003 construction cycle.



	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	S11
Fill, in.	1.1	1.5	14.8	15.3	17.1	16.8	16.7	41.7	39.2	21.3	16.3
Aggregate Base, in.	10.0	10.0	6.0	6.0	6.0	6.0	6.0	6.4	8.4	5.0	6.1
Remaining Excavation, in.	7.4	7.0	9.2	8.9	6.9	7.1	7.1	9.9	14.4	7.7	7.6

Figure 4.12. Summary of Compacted Fill and Aggregate Base Depths

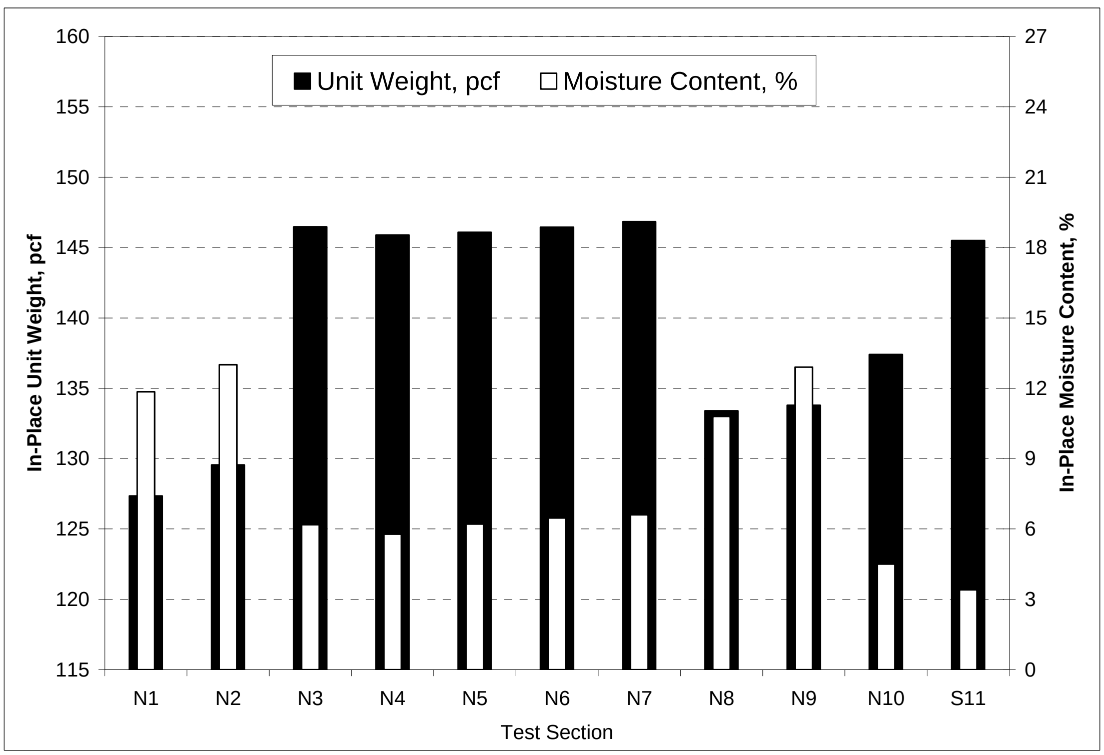


Figure 4.13. Summary of Aggregate Base Moisture Contents and Unit Weights

BASE PRESSURE CELL, ASPHALT STRAIN GAUGE INSTALLATION AND HMA CONSTRUCTION

The installation of the earth pressure cell on top of the aggregate base layer followed the same procedure as that described above for the first set of pressure plates installed. The sieved material used to fill the cell cavity and cover the gauge was taken locally from each section (e.g., section N1 used limerock, section S11 used granite, etc.).

The installation of the asphalt strain gauges was nearly identical to that used during the 2003 installation. Interested readers can consult NCAT Report 04-01 (*14*) for detailed descriptions. Only the main steps, and key differences during the 2006 installation, are described below.

After the aggregate base layer in each section had met the density and moisture requirements, work commenced on installing the earth pressure cells and asphalt strain gauges. The first step was to establish the gauge locations for 13-sensor array. The surveyor, using a total station, established the location of the edge stripe, from which the center of the wheelpath was determined. Gauge locations were then marked and a grid was painted on the aggregate base to aid in the gauge placement and trench digging process. Figure 4.14 illustrates a completed grid with gauges laid out prior to cutting into the aggregate base.

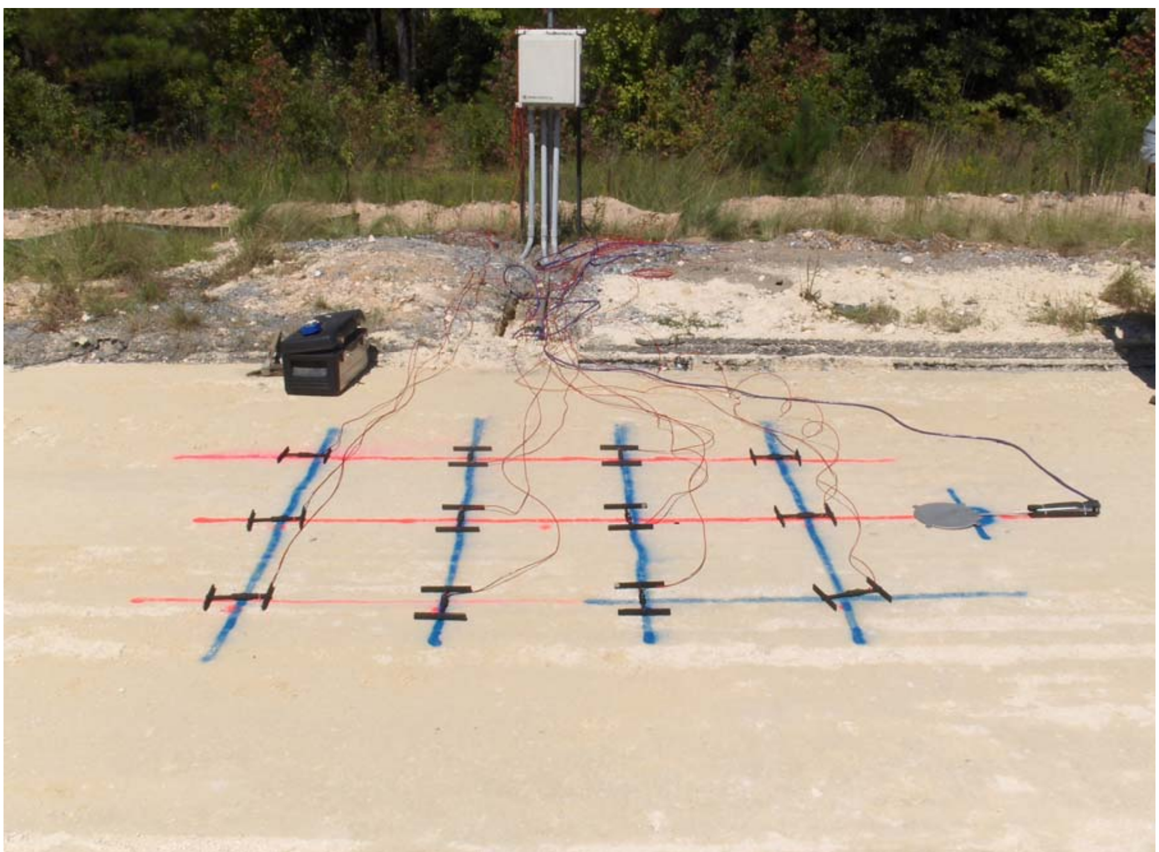


Figure 4.14. Completed Gauge Layout in Section N1

The next step was to thread the cabling of each gauge through the flexible steel conduit to help protect the cable from sharp stones when buried in the aggregate base. This was not done in the

2003 installation process, but was described previously regarding the installation of the first set of pressure cells. The ASG cables were threaded through a 1/2 inch conduit while the EPC cables were threaded through a 3/8 inch conduit. Figure 4.15 illustrates an ASG with conduit and plastic grommet to protect the cable from the sharp edge of the cut conduit. Also of note are the three cable ties that securely anchor the cable to the axis of the strain gauge, the flange of the gauge and the conduit to the gauge, respectively.

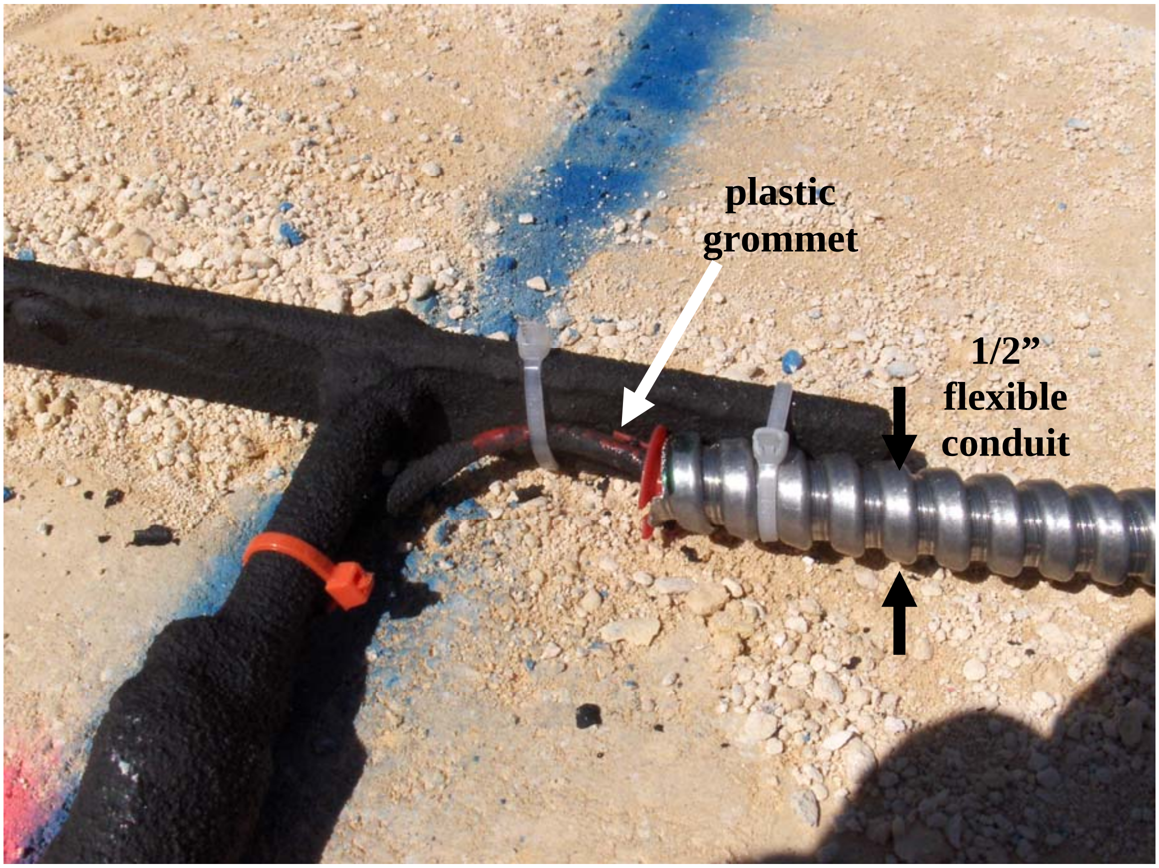


Figure 4.15. Asphalt Strain Gauge with Cable Threaded through Conduit

Once the gauges had been threaded with conduit and were ready for placement, small trenches were cut into the aggregate base by hand in which to bury the cables (Figure 4.16). The trenches were then backfilled, compacted with a Marshall hammer and the area was carefully swept clean to minimize any additional dust that would absorb asphalt during construction. Figure 4.17 illustrates a completed gauge array (S11) just prior to paving. Of note in the figure are the flexible conduit sections that extend just a few inches from each gauge before entering the cable trench as shown in the figure inset.

Figure 4.16. Preparing Trenches for Cables in Aggregate Base

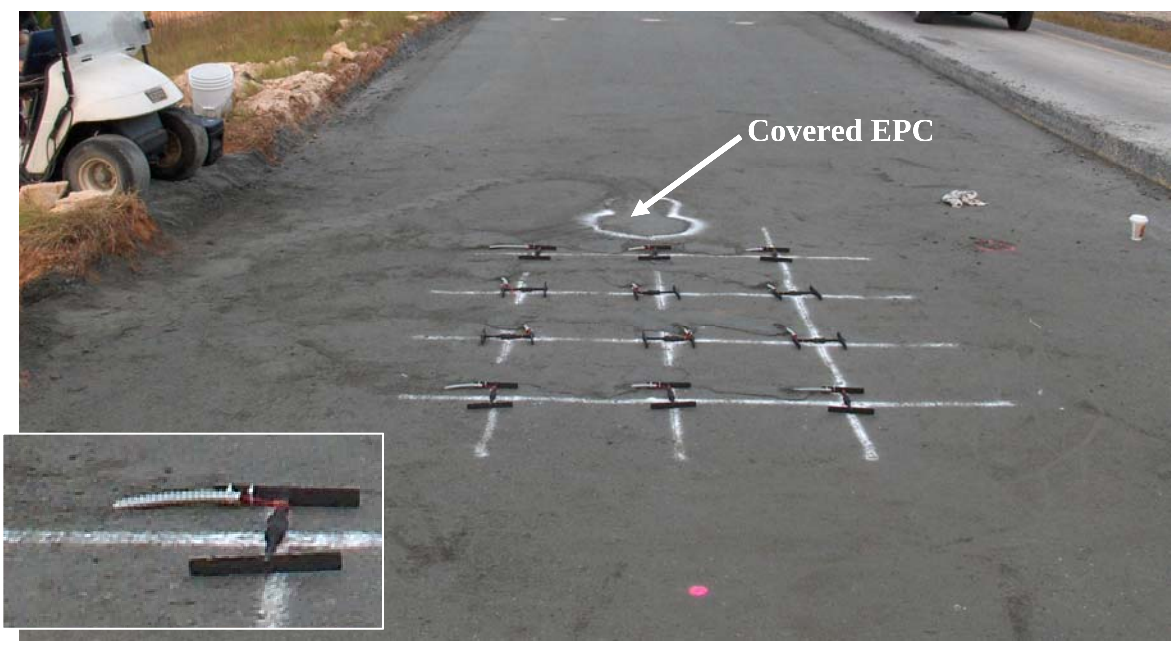


Figure 4.17. Completed Gauge Array (S11) Just Prior to Paving

When the contractor began paving the first lift of a given section, the ASGs were tacked into place using a sand-asphalt mixture prepared with the asphalt being used for that lift and a clean sand. A small patch of this mixture, in the shape of the ASG, was placed beneath each sensor (Figure 4.18). While the ASG's were being tacked, mix was taken from the hopper and screened through a #4 sieve to remove large particles. The -#4 material was then used to hand compact a small amount of cover material over each ASG and earth pressure cell (Figure 4.19). As seen in Figure 4.19, a 1 ft x 1 ft steel tamping plate was used to provide final compaction of the cover material prior to the paver passing over. Only constant pressure and rocking motion, not impact force, was used to provide this final compaction.

Figure 4.18. Tacking ASGs into Place (N10)

Figure 4.19. Placing Cover Mix (N10)

Once the gauges were covered, the paving train proceeded forward and care was taken so that the paver tracks did not run over any of the gauges (Figure 4.20). The gauges were monitored throughout the construction process so that changes to future construction processes could be made if widespread gauge failures were observed during paving. Fortunately, this did not occur.

Figure 4.20. Paver Approaching Gauge Array (S11)

After the first lift was placed, paving continued within a given section until all lifts had been placed. When possible, gauges were monitored during paving of each lift. It should be noted that additional gauges were placed in subsequent lifts in section N9 as described in Chapter 3. Figure

4.21 illustrates key points in this process. Flexible conduit was not used with these cables because it was believed it would cause too great a discontinuity in the HMA layers. The following subsections provide details regarding the mixtures and as-built properties placed in each of the test sections.

a. Gauges Laid Out with Sand Asphalt Tack under Gauges and Covering cables.

b. Gauges Covered with -#4 Mix Prior to Paving.

c. Paver Crossing Over Gauge Cables.

Figure 4.21. Laying ASGs Between HMA Lifts

Sections N1 and N2

As noted in Chapter 2, FDOT was interested in validating the fracture energy ratio concept for predicting the occurrence of top-down cracking. Therefore, section N2 was designed to have the upper lifts with approximately twice the fracture energy relative to the upper lifts in section N1. This was achieved through using a higher-grade binder (PG 76-22) in the upper two lifts of section N2. Both sections were paved in three lifts with summary mixture information noted in Table 4.10. Appendix B contains detailed laboratory and as-built data for each mixture. Figure 4.22 illustrates these sections relative to all the other sections within the structural study with gauge depths noted in the figure.

Sections N3 – N7

As noted previously, sections N3 through N7 were left in place from the 2003 structural study. Summary data are again provided in Table 4.10 with details provided in Appendix B. It is important to recall that surface lift in section N5 was replaced at the beginning of the 2006 research cycle due to extensive surface cracking in this section.

Sections N8 and N9

The mixtures placed in sections N8 and N9 were designed by ODOT and were intended to provide a perpetual pavement. As shown in Table 4.10, the bottom lift in each section (N8-4 and N8-5, respectively) was designed in the laboratory for 2% air voids rather than the standard 4% for typical Superpave mixtures. This resulted in relatively higher asphalt contents on the order of 7% for the rich bottom mixtures in both test sections. The other main factor in the N8/N9 experiment was that N8 was approximately 4 inches thinner than N9 which will allow for evaluation of differing strain levels in the context of perpetual pavement analyses. Details regarding these mixtures are in Appendix B.

Section N10

Section N10 is representative of a typical cross-section used on state routes in Missouri. The upper two lifts of the section featured PG 70-22, while the bottom lift used a lower binder grade (Table 4.10, Appendix B).

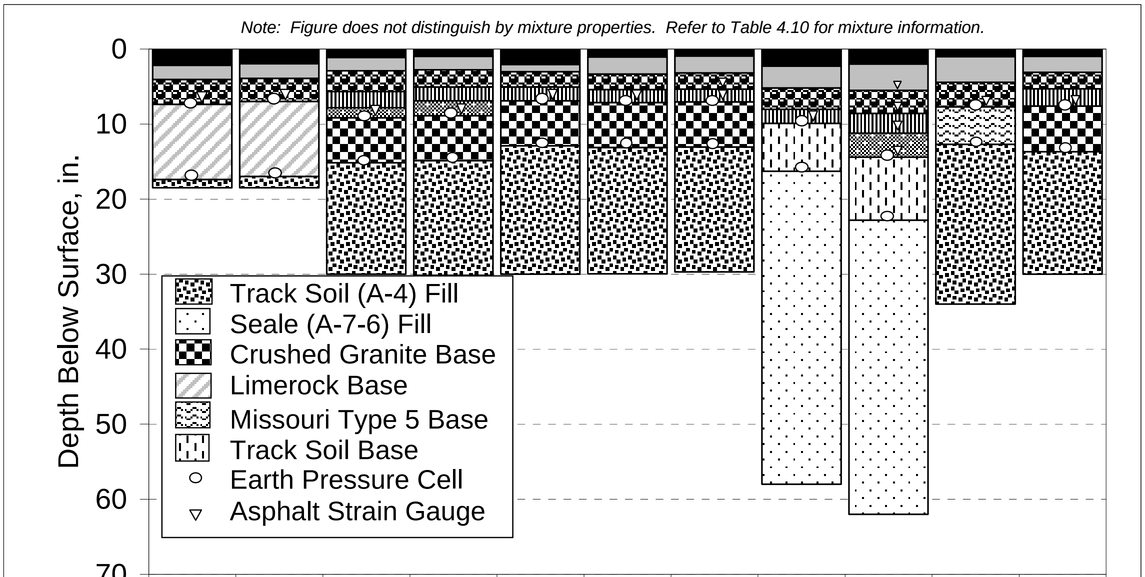
Section S11

Section S11 was intended to build on previous findings from the 2003 Test Track by replicating section N6 but with a higher grade binder in the upper two asphalt lifts as seen in Table 4.10 and Appendix B.

Table 4.10. HMA Properties

Section-Lift	Binder Grade	Gradation Type	Nominal Maximum Aggregate Size, mm	QC Asphalt Content, %	QC Air Voids, %	As-built Density, %Gmm	Depth, in.
N1-3	67-22	Dense	19.0	4.6	5.9	92.1	3.3
N1-2	67-22	Dense	12.5	4.9	4.2	92.2	1.9
N1-1	67-22	Dense	12.5	4.9	2.7	94.6	2.2
N2-3	67-22	Dense	19.0	4.7	5.6	94.9	3.1
N2-2	76-22	Dense	12.5	5.0	3.7	94.2	2.0
N2-1	76-22	Dense	12.5	4.8	2.8	95.0	2.0
N3-5	67-22	Dense	19.0	4.6	4.0	94.6	1.3
N3-4	67-22	Dense	19.0	4.3	5.1	93.0	2.2
N3-3	67-22	Dense	19.0	4.5	3.1	93.7	2.8
N3-2	67-22	Dense	19.0	4.3	4.7	93.3	1.8
N3-1	67-22	Dense	9.5	6.1	5.7	92.8	1.1
N4-5	76-22	Dense	19.0	4.4	4.5	92.7	2.0
N4-4	76-22	Dense	19.0	4.7	3.0	92.8	1.8
N4-3	76-22	Dense	19.0	4.4	3.3	93.2	2.3
N4-2	76-22	Dense	19.0	4.3	4.7	92.9	1.8
N4-1	76-22	Dense	9.5	6.1	5.5	93.4	1.0
N5-4	76-22	Dense	12.5	4.7	3.3	93.2	1.8
N5-3	76-22	Dense	12.5	4.4	3.0	92.8	2.0
N5-2	76-22	Dense	12.5	4.3	4.3	92.9	1.0
N5-1	67-22	Dense	12.5	5.9	2.9	94.8	2.1
N6-4	67-22	Dense	19.0	5.0	2.9	96.0	1.7
N6-3	67-22	Dense	19.0	4.5	3.1	93.4	2.1
N6-2	67-22	Dense	19.0	4.6	4.9	94.1	2.3
N6-1	67-22	Dense	9.5	6.2	5.0	93.7	1.1
N7-4	67-22	Dense	19.0	5.0	2.9	95.0	1.7
N7-3	67-22	Dense	19.0	4.5	3.1	93.3	2.1
N7-2	67-22	Dense	19.0	4.6	4.6	94.3	2.2
N7-1	76-22	SMA	9.5	6.2	7.3	93.1	0.9
N8-4	64-22	Dense	12.5	7.1	2.1	97.2	1.9
N8-3	64-22	Dense	19.0	4.9	4.4	92.9	2.8
N8-2	76-28	Dense	19.0	5.2	2.8	93.6	2.9
N8-1	76-28	SMA	12.5	6.9	5.0	91.8	2.3
N9-5	64-22	Dense	12.5	7.0	1.7	94.4	3.2
N9-4	64-22	Dense	19.0	4.6	3.8	93.9	2.6
N9-3	64-22	Dense	19.0	5.0	3.4	95.1	3.1
N9-2	76-28	Dense	19.0	5.1	3.0	92.9	3.5
N9-1	76-28	SMA	12.5	7.0	4.9	93.0	2.0
N10-3	64-22	Dense	19.0	5.2	4.1	93.3	3.3
N10-2	70-22	Dense	19.0	4.7	4.4	92.5	3.4
N10-1	70-22	Dense	12.5	5.6	5.6	91.3	1.0
S11-4	67-22	Dense	19.0	4.9	5.2	91.8	2.3
S11-3	67-22	Dense	19.0	5.0	4.9	92.6	2.2
S11-2	76-22	Dense	19.0	5.4	4.6	94.2	2.1
S11-1	76-22	Dense	9.5	6.9	3.4	93.2	1.0

Note: Lift 1 = surface lift



	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	S11
Fill, in.	1.1	1.5	14.8	15.3	17.1	16.8	16.7	41.7	39.2	21.3	16.3
Aggregate Base, in.	10.0	10.0	6.0	6.0	6.0	6.0	6.0	6.4	8.4	5.0	6.1
Lift 5			1.3	2.0					3.2		
Lift 4			2.2	1.8	1.8	1.7	1.7	1.9	2.6		2.3
Lift 3	3.3	3.1	2.8	2.3	2.0	2.1	2.1	2.8	3.1	3.3	2.2
Lift 2	1.9	2.0	1.8	1.8	1.0	2.3	2.2	2.9	3.5	3.4	2.1
Lift 1	2.2	2.0	1.1	1.0	2.1	1.1	0.9	2.3	2.0	1.0	1.0

Figure 4.22. 2006 Structural Study Cross Sections and Gauge Depths

GAUGE SURVIVABILITY

Immediately following construction, inventory was taken of functioning vs. non-functioning gauges. Within the newly constructed sections, all the earth pressure cells were fully functional. This was also experienced in the 2003 installation where the pressure cells had a 100% survivability rate. Table 4.11 summarizes the asphalt strain gauge functionality of the newly-placed sections. Table 4.12 summarizes both the survivability immediately following construction in 2003 and gauges still functioning at the beginning of the 2006 experiment. The survival rates were much higher in 2006 (86.9%) compared to 2003 (62.5%). This may be attributed to the use of additional cable ties, flexible conduit and simply having more experience in using the gauges. It is also interesting to note the gauge loss during the 2003 experiment. Some sections did not lose any gauges after construction (N3 and N4) while other sections (N5-N7) lost around half the gauges that were functioning after construction.

Table 4.11 2006 Asphalt Strain Gauge Survivability

Section	Total Gauges	Functional Gauges	% Survival
N1	12	12	100.0%
N2	12	12	100.0%
N8	12	11	91.7%
N9	24	18	75.0%
N10	12	9	75.0%
S11	12	11	91.7%
Total	84	73	86.9%

Table 4.12. 2003 Asphalt Strain Gauge Survivability and Functionality

		Start of 2003 Experiment		Start of 2006 Experiment		
Section	Total Gauges	Functional Gauges	%Survival	Functional Gauges	%Survival	%Change Survivability
N3	12	3	25.0%	3	25.0%	0.0%
N4	12	7	58.3%	7	58.3%	0.0%
N5	12	6	50.0%	3	25.0%	-50.0%
N6	12	11	91.7%	6	50.0%	-45.5%
N7	16	13	81.3%	6	37.5%	-53.8%
Total	64	40	62.5%	25	39.1%	-37.5%

TEMPERATURE PROBE INSTALLATION

After paving was complete, temperature probes consisting of a bundled set of thermistors were installed in the test sections. Following the procedure from the 2003 installation (*14*), a vertical hole was drilled just outside the edgestripe, approximately two feet from the edge of the finished pavement. The bundled array of thermistors was then coated with roofing cement and inserted into the hole. A discussion of the probe depths was provided in Chapter 3.

LASER INSTALLATION AND CALIBRATION

As presented in Chapter 3, a laser-based system was used to measure transverse wheel placement during testing. While each gauge was identical to the next, the installation in each section was unique due to variances in laser height, orientation and distance from the travel lane. Therefore, once the gauge was installed in the roadside cabinet, a local calibration was required.

Each laser was mounted on top of a steel plate inside a road-side box as shown in Figure 4.23. The plate had four bolts with springs to allow for easy-adjustment and leveling of the laser once it was mounted inside the box. Though the roadside boxes were manufactured with a clear window, it was found that it sufficiently distorted the laser so that the door had to be open during calibration and testing.

Calibration consisted of placing a flat cardboard target at various offsets from the laser and correlating the voltage output to the physical distance measurement. A local zero reference point was selected outside of the travel lane and all distances were measured from this point. Figure 4.24 shows the calibration curves developed for each test section. All were found to be highly linear with extremely high R^2 (i.e., > 0.99) in all cases. It is interesting to note that the gauge in section N10 had notably different behavior. Though it was highly linear, it had a much lower zero-offset voltage than any of the other gauges. The reason for this was not fully explored but may be due to a setting on that specific gauge. However, since calibration could be completed on this section, no further investigation was undertaken.

While it is useful to make absolute measurements for a local zero point, all the other instrumentation is referenced to the center of the gauge array which is centered in the outside wheelpath. Therefore, it was necessary to establish the distance from the local zero point to the center of the outside wheelpath for future computations. Table 4.13 lists these measurements.

Figure 4.23. Laser Installation

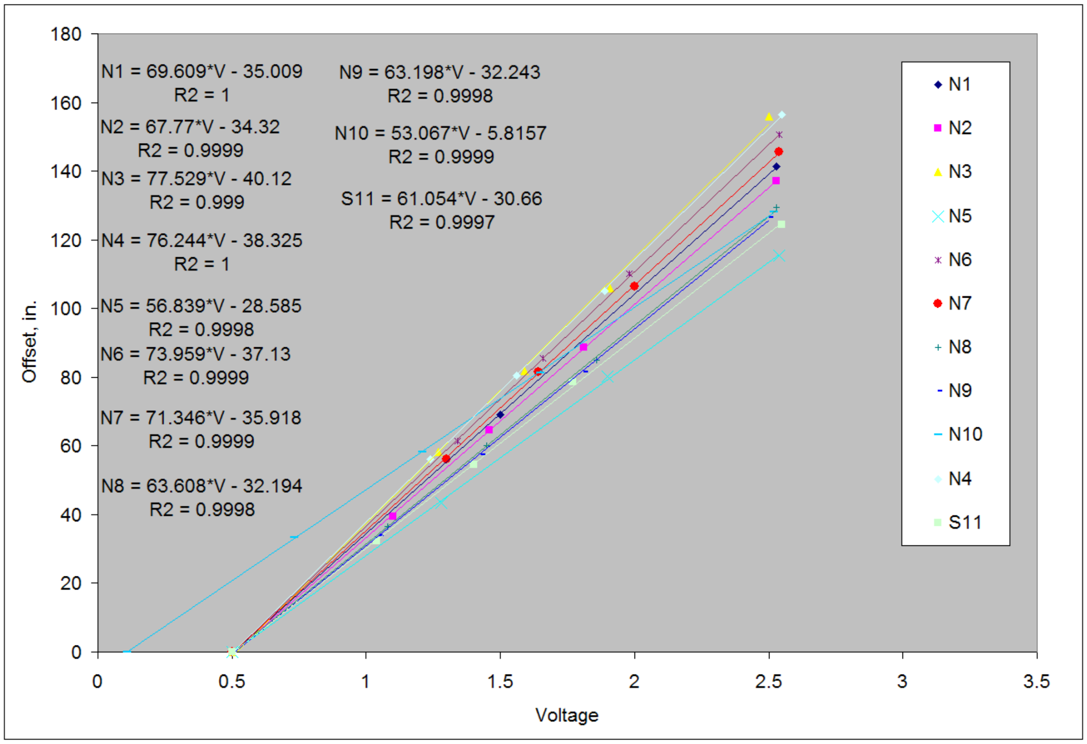


Figure 4.24. Laser Calibration Data

Table 4.13. Distance from Laser Zero Point to Center of Gauge Array

Section	Wheelpath Offset from Laser Zero Point, in.
N1	72.3
N2	64.6
N3	81.7
N4	80.6
N5	80.2
N6	85.5
N7	81.5
N8	60.0
N9	57.5
N10	58.3
S11	54.4

SUMMARY

This chapter detailed the installation of gauges and construction of the new structural sections in the 2006 Test Track. Overall, these two activities were deemed successful with a notable improvement in gauge survivability between the 2003 and 2006 experiments.

From the standpoint of data collection using the embedded sensors, the collection efforts can be divided into slow-speed and high-speed categories. The slow speed pertains to the temperature probes. Readings will be made on a minute-by-minute basis from which hourly summaries (minimum, average and maximum) can be tabulated.

High-speed measurements (asphalt strain gauges, earth pressure cells and lasers) will be made on a weekly basis. Three passes of each truck, deemed sufficient in previous research (Priest and Timm, 2006) will be made at the test speed, 45 mph. Temperature readings will also be made at the time of testing so that correlations between temperature and strain can be made.

Other laboratory testing will be conducted to meet the objectives stipulated in Chapter 1. The suite of tests includes, but is not limited to: dynamic modulus of the HMA, beam fatigue of select HMA materials and triaxial resilient modulus of the unbound materials.

Performance measurement, of course, is a critical component of any M-E investigation. To that end, rut depth and cracking measurements will be made throughout the experiment so that correlations between performance and mechanistic pavement response can be established. Furthermore, forensic investigation (coring and trenches) will be undertaken as needed to help explain the origin and progression of pavement distress.

CHAPTER 5 – SUMMARY

This report was intended to serve as a basic reference document for the construction and installation of instrumentation in the 2006 Test Track structural study. While no specific conclusions can be made from this report with respect to M-E design, a few observations related to full-scale pavement testing and instrumentation are warranted.

1. The addition of flexible steel conduit to aid in cable protection appeared to significantly improve gauge survivability. It is recommended that this practice be continued in the future, especially when placing gauges on or in coarse aggregate materials.
2. Placing asphalt strain gauges between lifts of HMA can be done, with sufficient sand asphalt and cover material, however gauge failure is more likely to occur so redundancy is very important.
3. Consideration should be made regarding the depth of milling and the likelihood that the resulting trench will fill with water. Sufficient drainage points should be provided to allow for natural drainage of rainwater after milling but before paving.
4. Laser measurement appears to be a viable non-contact method for wheel-offset measurement.
5. On site calibration of the earth pressure cells resulted in very similar calibration coefficients as those provided by the manufacturer. This finding was consistent with previous findings (3).

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APPENDIX A-
ASPHALT STRAIN GAUGE CALIBRATION FACTORS

Table A.1 Section N1 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	368.73
2	376.38
3	349.52
4	363.72
5	385.96
6	362.51
7	366.52
8	381.70
9	358.50
10	379.33
11	362.06
12	376.25

Table A.2 Section N2 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	360.21
2	357.74
3	378.95
4	369.70
5	378.64
6	390.05
7	394.68
8	392.52
9	386.35
10	360.14
11	355.52
12	357.37

Table A.3 Section N3 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	389.45
2	400.71
3	370.64
4	398.28
5	380.43
6	402.98
7	406.44
8	405.70
9	400.90
10	394.87
11	385.20
12	438.85

Table A.4 Section N4 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	343.50
2	386.69
3	339.93
4	314.10
5	314.70
6	397.09
7	410.73
8	396.78
9	421.64
10	404.58
11	407.95
12	384.90

Table A.5 Section N5 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	361.54
2	322.88
3	340.13
4	355.25
5	384.57
6	348.93
7	367.05
8	391.82
9	407.92
10	381.63
11	341.98
12	342.28

Table A.6 Section N6 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	333.75
2	397.18
3	360.62
4	360.02
5	382.23
6	337.81
7	319.26
8	326.20
9	402.64
10	360.02
11	390.39
12	344.76

Table A.7 Section N7 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	333.75
2	322.88
3	383.67
4	380.65
5	367.43
6	397.04
7	394.32
8	399.76
9	345.84
10	379.66
11	382.68
12	387.22
18	394.21
19	387.60
20	366.72
21	416.49

Table A.8 Section N8 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	367.78
2	379.18
3	387.51
4	374.07
5	380.11
6	360.62
7	368.63
8	369.86
9	375.10
10	380.65
11	368.94
12	359.38

Table A.9 Section N9 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	381.27
2	372.02
3	368.01
4	370.26
5	367.18
6	375.81
7	379.81
8	389.98
9	354.18
10	360.03
11	345.55
12	360.34
16	401.45
17	391.91
18	356.34
19	393.14
20	369.33
21	352.02
22	368.71
23	380.45
24	382.56
25	359.47
26	346.50
27	386.27

Table A.10 Section N10 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	368.82
2	386.11
3	381.17
4	355.10
5	369.58
6	350.17
7	366.83
8	381.51
9	391.67
10	366.42
11	377.20
12	376.20

Table A.11 Section S11 Asphalt Strain Gauge Calibration Factors

Gauge	Calibration Factor (με/Volt)
1	367.45
2	369.94
3	387.75
4	386.51
5	371.66
6	382.36
7	339.66
8	381.64
9	365.07
10	356.13
11	381.72
12	357.67

APPENDIX B-
ASPHALT MIXTURE DESIGN
AND CONSTRUCTION PROPERTIES

Note: Asphalt lifts were referenced differently in the 2003 and 2006 Test Sections. If built in 2003, the lifts were referenced by location (i.e., surface, upper binder, lower binder, etc.). If built in 2006 they were referenced by number (i.e., 1 = surface, 2 = upper binder, etc.).

Quadrant: N
Section: 1
Sublot: 1

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	100 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Grn/Lms
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	100
1/2":	97	97
3/8":	82	82
No. 4:	60	59
No. 8:	50	49
No. 16:	38	39
No. 30:	28	30
No. 50:	19	22
No. 100:	12	14
No. 200:	7.0	8.8
Asphalt Content:	4.8	4.9
Pill Bulk Gravity:	2.413	2.431
TMD (Rice):	2.514	2.499
Avg Air Voids:	4.0	2.7
Avg VMA:	14.4	13.3

Construction Diary

Relevant Conditions for Construction

Completion Date:	September 29, 2006
24 Hour High Temperature (F):	73
24 Hour Low Temperature (F):	48
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.7
78 LaGrange Granite	45.0
M10 Columbus Granite	45.0
8910 Opelika Limestone Screenings	10.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.1
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	305
Avg Section Compaction:	94.6%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 1
Sublot: 2

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	100 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Grn/Lms
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	100
1/2":	97	97
3/8":	82	85
No. 4:	60	61
No. 8:	50	51
No. 16:	38	39
No. 30:	28	31
No. 50:	19	22
No. 100:	12	14
No. 200:	7.0	8.7
Asphalt Content:	4.8	4.9
Pill Bulk Gravity:	2.413	2.384
TMD (Rice):	2.514	2.488
Avg Air Voids:	4.0	4.2
Avg VMA:	14.4	15.0

Construction Diary

Relevant Conditions for Construction

Completion Date:	September 28, 2006
24 Hour High Temperature (F):	84
24 Hour Low Temperature (F):	63
24 Hour Rainfall (in):	0.02
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.8
78 LaGrange Granite	43.0
M10 Columbus Granite	47.0
8910 Opelika Limestone Screenings	10.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.9
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	300
Avg Section Compaction:	92.2%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 1
Sublot: 3

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	60 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	94	96
1/2":	84	85
3/8":	72	74
No. 4:	53	53
No. 8:	45	43
No. 16:	36	36
No. 30:	28	26
No. 50:	15	14
No. 100:	8	8
No. 200:	5.0	5.4
Asphalt Content:	4.5	4.6
Pill Bulk Gravity:	2.468	2.415
TMD (Rice):	2.571	2.567
Avg Air Voids:	4.0	5.9
Avg VMA:	14.2	15.8

Construction Diary

Relevant Conditions for Construction

Completion Date:	September 27, 2006
24 Hour High Temperature (F):	81
24 Hour Low Temperature (F):	52
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	3.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.6
78 Opelika Limestone	33.0
57 Opelika Limestone	20.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	22.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	NA
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	315
Avg Section Compaction:	92.1%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 2
Sublot: 1

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	100 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Grn/Lms
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	100
1/2":	97	97
3/8":	82	85
No. 4:	60	61
No. 8:	50	50
No. 16:	38	39
No. 30:	28	31
No. 50:	19	23
No. 100:	12	15
No. 200:	7.0	9.6
Asphalt Content:	4.8	4.8
Pill Bulk Gravity:	2.413	2.429
TMD (Rice):	2.514	2.499
Avg Air Voids:	4.0	2.8
Avg VMA:	14.4	13.3

Construction Diary

Relevant Conditions for Construction

Completion Date:	September 29, 2006
24 Hour High Temperature (F):	73
24 Hour Low Temperature (F):	48
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.7
78 LaGrange Granite	45.0
M10 Columbus Granite	45.0
8910 Opelika Limestone Screenings	10.0
Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.0
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	315
Avg Section Compaction:	95.0%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 2
Sublot: 2

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	100 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Grn/Lms
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	100
1/2":	97	91
3/8":	82	82
No. 4:	60	62
No. 8:	50	50
No. 16:	38	41
No. 30:	28	29
No. 50:	19	16
No. 100:	12	10
No. 200:	7.0	6.6
Asphalt Content:	4.8	5.0
Pill Bulk Gravity:	2.413	2.384
TMD (Rice):	2.514	2.475
Avg Air Voids:	4.0	3.7
Avg VMA:	14.4	15.1

Construction Diary

Relevant Conditions for Construction

Completion Date:	September 28, 2006
24 Hour High Temperature (F):	84
24 Hour Low Temperature (F):	63
24 Hour Rainfall (in):	0.02
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.8
78 LaGrange Granite	43.0
M10 Columbus Granite	47.0
8910 Opelika Limestone Screenings	10.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.0
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	310
Avg Section Compaction:	94.2%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 2
Sublot: 3

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	60 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	94	96
1/2":	84	86
3/8":	72	75
No. 4:	53	54
No. 8:	45	45
No. 16:	36	36
No. 30:	28	26
No. 50:	15	14
No. 100:	8	9
No. 200:	5.0	5.6
Asphalt Content:	4.5	4.7
Pill Bulk Gravity:	2.468	2.424
TMD (Rice):	2.571	2.567
Avg Air Voids:	4.0	5.6
Avg VMA:	14.2	15.5

Construction Diary

Relevant Conditions for Construction

Completion Date:	September 27, 2006
24 Hour High Temperature (F):	81
24 Hour Low Temperature (F):	52
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	3.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.6
78 Opelika Limestone	33.0
57 Opelika Limestone	20.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	22.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	3.1
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	310
Avg Section Compaction:	94.9%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

Quadrant:	**N**
Section:	**3**
Sublot:	**Surface**

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Grn/Lms/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	100	100
1/2":	100	100
3/8"	99	100
No. 4	83	80
No. 8	62	63
No. 16	47	51
No. 30	34	38
No. 50	19	21
No. 100	11	12
No. 200	5.0	6.6
Asphalt Content	6.3	6.1
Pill Bulk Gravity:		2.347
TMD (Rice):		2.488
Avg Air Voids		5.7
Avg VMA:		17

Construction Diary

Relevant Conditions for Construction

Completion Date:	Thursday, July 24, 2003
24 Hour High Temperature (F):	86
24 Hour Low Temperature (F):	62
24 Hour Rainfall (in):	0
Lift type:	Surface
Planned Mill / Lift Thickness (in):	1.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	6.2
89 Columbus Granite	24.0
8910 Opelika Limestone	27.0
M10 Columbus Granite	30.0
Shorter Coarse Sand	19.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.2
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	325
Avg Section Compaction:	92.8

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 3
Sublot: Upper Binder

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	92
1/2":	84	82
3/8"	72	72
No. 4	53	51
No. 8	45	43
No. 16	36	37
No. 30	28	29
No. 50	15	16
No. 100	8	9
No. 200	5.0	5.6
Asphalt Content	4.5	4.3
Pill Bulk Gravity:		2.469
TMD (Rice):		2.590
Avg Air Voids		4.7
Avg VMA:		14

Construction Diary

Relevant Conditions for Construction

Completion Date:	Tuesday, July 22, 2003
24 Hour High Temperature (F):	89
24 Hour Low Temperature (F):	69
24 Hour Rainfall (in):	0.12
Lift type:	Upper Binder
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.3
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.8
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	320
Avg Section Compaction:	93.3

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 3
Sublot: Lower Binder

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	93
1/2":	84	84
3/8"	72	74
No. 4	53	53
No. 8	45	43
No. 16	36	35
No. 30	28	24
No. 50	15	14
No. 100	8	9
No. 200	5.0	5.5
Asphalt Content	4.5	4.5
Pill Bulk Gravity:		2.496
TMD (Rice):		2.575
Avg Air Voids		3.1
Avg VMA:		13

Construction Diary

Relevant Conditions for Construction

Completion Date:	Monday, July 21, 2003
24 Hour High Temperature (F):	90
24 Hour Low Temperature (F):	66
24 Hour Rainfall (in):	0
Lift type:	Lower Binder
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.4
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.7
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	329
Avg Section Compaction:	93.7

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 3
Sublot: Upper Base

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	100
1/2":	84	84
3/8"	72	75
No. 4	53	57
No. 8	45	48
No. 16	36	42
No. 30	28	33
No. 50	15	20
No. 100	8	11
No. 200	5.0	6.7
Asphalt Content	4.5	4.3
Pill Bulk Gravity:		2.441
TMD (Rice):		2.571
Avg Air Voids		5.1
Avg VMA:		16

Construction Diary

Relevant Conditions for Construction

Completion Date:	Thursday, July 17, 2003
24 Hour High Temperature (F):	91
24 Hour Low Temperature (F):	71
24 Hour Rainfall (in):	0.01
Lift type:	Upper Base
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.5
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.1
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	346
Avg Section Compaction:	93.0

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 3
Sublot: Lower Base

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	90
1/2":	84	79
3/8"	72	68
No. 4	53	50
No. 8	45	44
No. 16	36	39
No. 30	28	30
No. 50	15	16
No. 100	8	9
No. 200	5.0	5.6
Asphalt Content	4.5	4.6
Pill Bulk Gravity:		2.450
TMD (Rice):		2.553
Avg Air Voids		4.0
Avg VMA:		15

Construction Diary

Relevant Conditions for Construction

Completion Date:	Wednesday, July 16, 2003
24 Hour High Temperature (F):	91
24 Hour Low Temperature (F):	65
24 Hour Rainfall (in):	0
Lift type:	Lower Base
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.5
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.3
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	326
Avg Section Compaction:	94.6

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 4
Sublot: Surface

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Grn/Lms/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	100	100
1/2":	100	100
3/8"	99	100
No. 4	83	81
No. 8	62	61
No. 16	47	49
No. 30	34	37
No. 50	19	21
No. 100	11	12
No. 200	5.0	6.7
Asphalt Content	6.3	6.1
Pill Bulk Gravity:		2.356
TMD (Rice):		2.494
Avg Air Voids		5.5
Avg VMA:		19

Construction Diary

Relevant Conditions for Construction

Completion Date:	Monday, July 28, 2003
24 Hour High Temperature (F):	90
24 Hour Low Temperature (F):	69
24 Hour Rainfall (in):	0
Lift type:	Surface
Planned Mill / Lift Thickness (in):	1.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	6.2
89 Columbus Granite	24.0
8910 Opelika Limestone	27.0
M10 Columbus Granite	30.0
Shorter Coarse Sand	19.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.0
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	347
Avg Section Compaction:	93.4

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 4
Sublot: Upper Binder

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	92
1/2":	84	82
3/8"	72	72
No. 4	53	52
No. 8	45	44
No. 16	36	37
No. 30	28	28
No. 50	15	15
No. 100	8	9
No. 200	5.0	5.5
Asphalt Content	4.5	4.3
Pill Bulk Gravity:		2.451
TMD (Rice):		2.571
Avg Air Voids		4.7
Avg VMA:		15

Construction Diary

Relevant Conditions for Construction

Completion Date:	Tuesday, July 22, 2003
24 Hour High Temperature (F):	89
24 Hour Low Temperature (F):	69
24 Hour Rainfall (in):	0.12
Lift type:	Upper Binder
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.3
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.7
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	304
Avg Section Compaction:	92.9

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 4
Sublot: Lower Binder

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	92
1/2":	84	82
3/8"	72	71
No. 4	53	51
No. 8	45	42
No. 16	36	34
No. 30	28	24
No. 50	15	13
No. 100	8	7
No. 200	5.0	5.1
Asphalt Content	4.5	4.4
Pill Bulk Gravity:		2.482
TMD (Rice):		2.568
Avg Air Voids		3.3
Avg VMA:		14

Construction Diary

Relevant Conditions for Construction

Completion Date:	Monday, July 21, 2003
24 Hour High Temperature (F):	90
24 Hour Low Temperature (F):	66
24 Hour Rainfall (in):	0
Lift type:	Lower Binder
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.4
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.3
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	326
Avg Section Compaction:	93.2

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 4
Sublot: Upper Base

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	92
1/2":	84	79
3/8"	72	66
No. 4	53	49
No. 8	45	43
No. 16	36	36
No. 30	28	26
No. 50	15	14
No. 100	8	8
No. 200	5.0	5.5
Asphalt Content	4.5	4.7
Pill Bulk Gravity:		2.480
TMD (Rice):		2.557
Avg Air Voids		3.0
Avg VMA:		14

Construction Diary

Relevant Conditions for Construction

Completion Date:	Thursday, July 17, 2003
24 Hour High Temperature (F):	91
24 Hour Low Temperature (F):	71
24 Hour Rainfall (in):	0.01
Lift type:	Upper Base
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.6
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.8
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	340
Avg Section Compaction:	92.8

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 4
Sublot: Lower Base

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	88
1/2":	84	77
3/8"	72	66
No. 4	53	49
No. 8	45	42
No. 16	36	36
No. 30	28	28
No. 50	15	16
No. 100	8	9
No. 200	5.0	5.5
Asphalt Content	4.5	4.4
Pill Bulk Gravity:		2.456
TMD (Rice):		2.571
Avg Air Voids		4.5
Avg VMA:		15

Construction Diary

Relevant Conditions for Construction

Completion Date:	Wednesday, July 16, 2003
24 Hour High Temperature (F):	91
24 Hour Low Temperature (F):	65
24 Hour Rainfall (in):	0
Lift type:	Lower Base
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.5
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.0
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	336
Avg Section Compaction:	92.7

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

4/4/2007

Quadrant: N
Section: 5
Sublot: 1

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	60 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Grn/Lms/Snd
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	100
1/2":	97	97
3/8":	86	85
No. 4:	64	65
No. 8:	51	54
No. 16:	40	42
No. 30:	29	31
No. 50:	17	17
No. 100:	11	11
No. 200:	7.4	6.8
Asphalt Content:	5.8	5.9
Pill Bulk Gravity:	2.379	2.393
TMD (Rice):	2.478	2.465
Avg Air Voids:	4.0	2.9
Avg VMA:	16.6	15.9

Construction Diary

Relevant Conditions for Construction

Completion Date:	September 27, 2006
24 Hour High Temperature (F):	81
24 Hour Low Temperature (F):	52
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	5.8
78 LaGrange Granite	35.0
M10 Columbus Granite	15.0
Shorter Coarse Sand	20.0
8910 Opelika Limestone Screenings	30.0
Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.1
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	310
Avg Section Compaction:	94.8%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

Quadrant: N
Section: 5
Sublot: Upper Binder

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	92
1/2":	84	82
3/8"	72	72
No. 4	53	52
No. 8	45	44
No. 16	36	37
No. 30	28	28
No. 50	15	15
No. 100	8	9
No. 200	5.0	5.5
Asphalt Content	4.5	4.3
Pill Bulk Gravity:		2.461
TMD (Rice):		2.571
Avg Air Voids		4.3
Avg VMA:		15

Construction Diary

Relevant Conditions for Construction

Completion Date:	Tuesday, July 22, 2003
24 Hour High Temperature (F):	89
24 Hour Low Temperature (F):	69
24 Hour Rainfall (in):	0.12
Lift type:	Upper Binder
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.3
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.2
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	306
Avg Section Compaction:	92.9

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N

Section: 5

Sublot: Lower Binder

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	92
1/2":	84	82
3/8"	72	71
No. 4	53	51
No. 8	45	42
No. 16	36	34
No. 30	28	24
No. 50	15	13
No. 100	8	7
No. 200	5.0	5.1
Asphalt Content	4.5	4.4
Pill Bulk Gravity:		2.490
TMD (Rice):		2.568
Avg Air Voids		3.0
Avg VMA:		14

Construction Diary

Relevant Conditions for Construction

Completion Date:	Monday, July 21, 2003
24 Hour High Temperature (F):	90
24 Hour Low Temperature (F):	66
24 Hour Rainfall (in):	0
Lift type:	Lower Binder
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.4
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.0
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	324
Avg Section Compaction:	92.8

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 6
Sublot: Surface

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Grn/Lms/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	100	100
1/2":	100	100
3/8"	99	100
No. 4	83	81
No. 8	62	62
No. 16	47	50
No. 30	34	37
No. 50	19	21
No. 100	11	12
No. 200	5.0	6.8
Asphalt Content	6.3	6.2
Pill Bulk Gravity:		2.356
TMD (Rice):		2.480
Avg Air Voids		5.0
Avg VMA:		19

Construction Diary

Relevant Conditions for Construction

Completion Date:	Tuesday, July 29, 2003
24 Hour High Temperature (F):	91
24 Hour Low Temperature (F):	70
24 Hour Rainfall (in):	0
Lift type:	Surface
Planned Mill / Lift Thickness (in):	1.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	6.2
89 Columbus Granite	24.0
8910 Opelika Limestone	27.0
M10 Columbus Granite	30.0
Shorter Coarse Sand	19.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.1
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	317
Avg Section Compaction:	93.7

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 6
Sublot: Upper Binder

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	93
1/2":	84	82
3/8"	72	71
No. 4	53	52
No. 8	45	45
No. 16	36	39
No. 30	28	30
No. 50	15	16
No. 100	8	9
No. 200	5.0	5.7
Asphalt Content	4.5	4.6
Pill Bulk Gravity:		2.451
TMD (Rice):		2.577
Avg Air Voids		4.9
Avg VMA:		15

Construction Diary

Relevant Conditions for Construction

Completion Date:	Thursday, July 24, 2003
24 Hour High Temperature (F):	86
24 Hour Low Temperature (F):	62
24 Hour Rainfall (in):	0
Lift type:	Upper Binder
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.3
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.3
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	318
Avg Section Compaction:	94.1

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 6
Sublot: Lower Binder

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	96
1/2":	84	85
3/8"	72	74
No. 4	53	52
No. 8	45	43
No. 16	36	35
No. 30	28	24
No. 50	15	14
No. 100	8	9
No. 200	5.0	5.6
Asphalt Content	4.5	4.5
Pill Bulk Gravity:		2.481
TMD (Rice):		2.561
Avg Air Voids		3.1
Avg VMA:		14

Construction Diary

Relevant Conditions for Construction

Completion Date:	Tuesday, July 22, 2003
24 Hour High Temperature (F):	89
24 Hour Low Temperature (F):	69
24 Hour Rainfall (in):	0.12
Lift type:	Lower Binder
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.3
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.2
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	318
Avg Section Compaction:	93.4

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 6
Sublot: Base

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	90
1/2":	84	78
3/8"	72	71
No. 4	53	53
No. 8	45	44
No. 16	36	36
No. 30	28	27
No. 50	15	15
No. 100	8	9
No. 200	5.0	5.7
Asphalt Content	4.5	5.0
Pill Bulk Gravity:		2.483
TMD (Rice):		2.558
Avg Air Voids		2.9
Avg VMA:		14

Construction Diary

Relevant Conditions for Construction

Completion Date:	Friday, July 18, 2003
24 Hour High Temperature (F):	89
24 Hour Low Temperature (F):	67
24 Hour Rainfall (in):	0
Lift type:	Base
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.5
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.6
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	325
Avg Section Compaction:	96.0

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 7
Sublot: Surface

Laboratory Diary

General Description of Mix and Materials

Design Method:	SMA
Compactive Effort:	50 blows
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Granite
Gradation Type:	SMA

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	100	100
1/2":	100	100
3/8"	99	100
No. 4	53	49
No. 8	25	24
No. 16	19	20
No. 30	16	17
No. 50	14	14
No. 100	11	12
No. 200	9.0	9.2
Asphalt Content	6.1	6.2
Pill Bulk Gravity:		2.261
TMD (Rice):		2.438
Avg Air Voids		7.3
Avg VMA:		21

Construction Diary

Relevant Conditions for Construction

Completion Date:	Wednesday, July 30, 2003
24 Hour High Temperature (F):	86
24 Hour Low Temperature (F):	69
24 Hour Rainfall (in):	0
Lift type:	Surface
Planned Mill / Lift Thickness (in):	1.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	6.0
89 Columbus Granite	77.0
M10 Columbus Granite	17.0
Boral Flyash	6.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.0
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	337
Avg Section Compaction:	93.1

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 7
Sublot: Upper Binder

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	93
1/2":	84	82
3/8"	72	71
No. 4	53	52
No. 8	45	45
No. 16	36	39
No. 30	28	30
No. 50	15	16
No. 100	8	9
No. 200	5.0	5.7
Asphalt Content	4.5	4.6
Pill Bulk Gravity:		2.459
TMD (Rice):		2.577
Avg Air Voids		4.6
Avg VMA:		15

Construction Diary

Relevant Conditions for Construction

Completion Date:	Thursday, July 24, 2003
24 Hour High Temperature (F):	86
24 Hour Low Temperature (F):	62
24 Hour Rainfall (in):	0
Lift type:	Upper Binder
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.3
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.3
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	326
Avg Section Compaction:	94.3

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 7
Sublot: Lower Binder

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	96
1/2":	84	85
3/8"	72	74
No. 4	53	52
No. 8	45	43
No. 16	36	35
No. 30	28	24
No. 50	15	14
No. 100	8	9
No. 200	5.0	5.6
Asphalt Content	4.5	4.5
Pill Bulk Gravity:		2.482
TMD (Rice):		2.561
Avg Air Voids		3.1
Avg VMA:		14

Construction Diary

Relevant Conditions for Construction

Completion Date:	Tuesday, July 22, 2003
24 Hour High Temperature (F):	89
24 Hour Low Temperature (F):	69
24 Hour Rainfall (in):	0.12
Lift type:	Lower Binder
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.3
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.1
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	310
Avg Section Compaction:	93.3

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

Quadrant: N
Section: 7
Sublot: Base

Laboratory Diary

General Description of Mix and Materials

Design Method:	Superpave
Compactive Effort:	80 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Gradation Type:	ARZ

Avg. Lab Properties of Plant Produced Mix

Sieve Size:	Design	QC:
1":	100	100
3/4":	94	90
1/2":	84	78
3/8"	72	71
No. 4	53	83
No. 8	45	44
No. 16	36	36
No. 30	28	27
No. 50	15	15
No. 100	8	9
No. 200	5.0	5.7
Asphalt Content	4.5	5.0
Pill Bulk Gravity:		2.485
TMD (Rice):		2.558
Avg Air Voids		2.9
Avg VMA:		14

Construction Diary

Relevant Conditions for Construction

Completion Date:	Friday, July 18, 2003
24 Hour High Temperature (F):	89
24 Hour Low Temperature (F):	67
24 Hour Rainfall (in):	0
Lift type:	Base
Planned Mill / Lift Thickness (in):	2.0

Plant Configuration and Placement Details

Component:	% Setting:
Asphalt Content (Plant Setting)	4.5
78 Opelika Limestone	33.0
57 Opelika Limestone	22.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	20.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.7
Type of Tack Coat Utilized:	PG67-22
Target Tack Application Rate (gal/sy):	0.03
Avg Temperature In Truck (F):	328
Avg Section Compaction:	95.0

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot;
2) Sections are listed in the order they appear on the Track beginning with E2 and continuing counterclockwise to E1;
3) The total research thickness of all rutting study sections ranges from 3/4 to 4 inches by design;
4) The total HMA thickness of all structural study sections (N1 through N8) ranges from 5 to 9 inches by design;
5) ARZ, TRZ, and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
6) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively.

4/4/2007

Quadrant: N
Section: 8
Sublot: 1

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	SMA
Compactive Effort:	50 gyrations
Binder Performance Grade:	76-28
Modifier Type:	SBS
Aggregate Type:	Granite
Design Gradation Type:	SMA

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	100
1/2":	97	93
3/8":	78	71
No. 4:	29	31
No. 8:	23	22
No. 16:	19	17
No. 30:	16	15
No. 50:	15	13
No. 100:	14	12
No. 200:	12.3	10.5
Asphalt Content:	6.8	6.9
Pill Bulk Gravity:	2.319	2.276
TMD (Rice):	2.414	2.397
Avg Air Voids:	3.9	5.0
Avg VMA:	17.9	15.6

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 18, 2006
24 Hour High Temperature (F):	84
24 Hour Low Temperature (F):	70
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	6.1
Hanson 5/8 Chips	71.0
Hanson Screenings	14.0
GMI Sand	10.0
Flyash	5.0
Cellulose	0.3
Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.3
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	350
Avg Section Compaction:	91.8%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 8
Sublot: 2

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	S3
Compactive Effort:	100 gyrations
Binder Performance Grade:	76-28
Modifier Type:	SBS
Aggregate Type:	Granite
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	95	95
1/2":	81	83
3/8":	72	79
No. 4:	64	64
No. 8:	44	43
No. 16:	30	31
No. 30:	22	24
No. 50:	15	17
No. 100:	8	10
No. 200:	5.4	6.7
Asphalt Content:	4.3	5.2
Pill Bulk Gravity:	2.415	2.426
TMD (Rice):	2.498	2.496
Avg Air Voids:	3.3	2.8
Avg VMA:	13.5	10.4

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 18, 2006
24 Hour High Temperature (F):	84
24 Hour Low Temperature (F):	70
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	3.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.1
Hanson 1 Chips	30.0
Hanson Screenings	25.0
Dolese Screenings	8.0
Martin Marietta Stone Sand	27.0
GMI Sand	10.0
Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	3.0
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	340
Avg Section Compaction:	93.6%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 8
Sublot: 3

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	S3
Compactive Effort:	100 gyrations
Binder Performance Grade:	64-22
Modifier Type:	NA
Aggregate Type:	Granite
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	95	95
1/2":	81	85
3/8":	72	80
No. 4:	64	64
No. 8:	44	43
No. 16:	30	31
No. 30:	22	24
No. 50:	15	17
No. 100:	8	10
No. 200:	5.4	7.0
Asphalt Content:	4.3	4.9
Pill Bulk Gravity:	2.415	2.393
TMD (Rice):	2.498	2.503
Avg Air Voids:	3.3	4.4
Avg VMA:	13.5	11.3

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 16, 2006
24 Hour High Temperature (F):	64
24 Hour Low Temperature (F):	55
24 Hour Rainfall (in):	0.01
Planned Mill / Lift Thickness (in):	3.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.3
Hanson 1 Chips	30.0
Hanson Screenings	25.0
Dolese Screenings	10.0
Martin Marietta Stone Sand	25.0
GMI Sand	10.0

Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	2.9
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	345
Avg Section Compaction:	92.9%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 8
Sublot: 4

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	RBL
Compactive Effort:	50 gyrations
Binder Performance Grade:	64-22
Modifier Type:	NA
Aggregate Type:	Granite
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	100
1/2":	99	97
3/8":	88	87
No. 4:	58	61
No. 8:	39	39
No. 16:	25	26
No. 30:	18	19
No. 50:	13	15
No. 100:	10	12
No. 200:	8.1	10.5
Asphalt Content:	6.0	7.1
Pill Bulk Gravity:	2.400	2.374
TMD (Rice):	2.452	2.424
Avg Air Voids:	2.0	2.1
Avg VMA:	14.6	12.6

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 13, 2006
24 Hour High Temperature (F):	66
24 Hour Low Temperature (F):	48
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	6.2
Hanson 5/8 Chips	35.0
Hanson Screenings	20.0
Dolese Screenings	45.0
Approximate Length (ft):	200
Survey Mill / Lift Thickness (in):	1.9
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	345
Avg Section Compaction:	97.2%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 9
Sublot: 1

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	SMA
Compactive Effort:	50 gyrations
Binder Performance Grade:	76-28
Modifier Type:	SBS
Aggregate Type:	Granite
Design Gradation Type:	SMA

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	100
1/2":	97	94
3/8":	78	72
No. 4:	29	32
No. 8:	23	23
No. 16:	19	18
No. 30:	16	15
No. 50:	15	13
No. 100:	14	12
No. 200:	12.3	10.9
Asphalt Content:	6.8	7.0
Pill Bulk Gravity:	2.319	2.279
TMD (Rice):	2.414	2.397
Avg Air Voids:	3.9	4.9
Avg VMA:	17.9	15.5

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 18, 2006
24 Hour High Temperature (F):	84
24 Hour Low Temperature (F):	70
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	6.1
Hanson 5/8 Chips	71.0
Hanson Screenings	14.0
GMI Sand	10.0
Flyash	5.0
Cellulose	0.3
Approximate Length (ft):	197
Survey Mill / Lift Thickness (in):	2.0
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	350
Avg Section Compaction:	93.0%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 9
Sublot: 2

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	S3
Compactive Effort:	100 gyrations
Binder Performance Grade:	76-28
Modifier Type:	SBS
Aggregate Type:	Granite
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	99
3/4":	95	96
1/2":	81	86
3/8":	72	82
No. 4:	64	67
No. 8:	44	45
No. 16:	30	32
No. 30:	22	25
No. 50:	15	17
No. 100:	8	10
No. 200:	5.4	7.0
Asphalt Content:	4.3	5.1
Pill Bulk Gravity:	2.415	2.422
TMD (Rice):	2.498	2.496
Avg Air Voids:	3.3	3.0
Avg VMA:	13.5	10.5

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 18, 2006
24 Hour High Temperature (F):	84
24 Hour Low Temperature (F):	70
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	3.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.1
Hanson 1 Chips	30.0
Hanson Screenings	25.0
Dolese Screenings	8.0
Martin Marietta Stone Sand	27.0
GMI Sand	10.0

Approximate Length (ft):	197
Survey Mill / Lift Thickness (in):	3.5
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	340
Avg Section Compaction:	92.9%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 9
Sublot: 3

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	S3
Compactive Effort:	100 gyrations
Binder Performance Grade:	64-22
Modifier Type:	NA
Aggregate Type:	Granite
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	95	96
1/2":	81	84
3/8":	72	80
No. 4:	64	66
No. 8:	44	45
No. 16:	30	32
No. 30:	22	24
No. 50:	15	17
No. 100:	8	10
No. 200:	5.4	6.5
Asphalt Content:	4.3	5.0
Pill Bulk Gravity:	2.415	2.419
TMD (Rice):	2.498	2.503
Avg Air Voids:	3.3	3.4
Avg VMA:	13.5	10.4

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 16, 2006
24 Hour High Temperature (F):	64
24 Hour Low Temperature (F):	55
24 Hour Rainfall (in):	0.01
Planned Mill / Lift Thickness (in):	3.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.3
Hanson 1 Chips	30.0
Hanson Screenings	25.0
Dolese Screenings	10.0
Martin Marietta Stone Sand	25.0
GMI Sand	10.0

Approximate Length (ft):	197
Survey Mill / Lift Thickness (in):	3.1
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	345
Avg Section Compaction:	95.1%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 9
Sublot: 4

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	S3
Compactive Effort:	100 gyrations
Binder Performance Grade:	64-22
Modifier Type:	NA
Aggregate Type:	Granite
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	95	93
1/2":	81	81
3/8":	72	76
No. 4:	63	61
No. 8:	43	42
No. 16:	29	30
No. 30:	22	23
No. 50:	15	17
No. 100:	7	10
No. 200:	4.9	7.2
Asphalt Content:	4.3	4.6
Pill Bulk Gravity:	2.415	2.411
TMD (Rice):	2.498	2.507
Avg Air Voids:	3.3	3.8
Avg VMA:	13.5	10.4

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 16, 2006
24 Hour High Temperature (F):	64
24 Hour Low Temperature (F):	55
24 Hour Rainfall (in):	0.01
Planned Mill / Lift Thickness (in):	3.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.0
Hanson 1 Chips	30.0
Hanson Screenings	25.0
Dolese Screenings	10.0
Martin Marietta Stone Sand	25.0
GMI Sand	10.0
Approximate Length (ft):	197
Survey Mill / Lift Thickness (in):	2.6
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	350
Avg Section Compaction:	93.9%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 9
Sublot: 5

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	RBL
Compactive Effort:	50 gyrations
Binder Performance Grade:	64-22
Modifier Type:	NA
Aggregate Type:	Granite
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	100
1/2":	99	96
3/8":	88	85
No. 4:	58	59
No. 8:	39	38
No. 16:	25	26
No. 30:	18	19
No. 50:	13	15
No. 100:	10	13
No. 200:	8.1	10.5
Asphalt Content:	6.0	7.0
Pill Bulk Gravity:	2.400	2.384
TMD (Rice):	2.452	2.424
Avg Air Voids:	2.0	1.7
Avg VMA:	14.6	12.2

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 13, 2006
24 Hour High Temperature (F):	66
24 Hour Low Temperature (F):	48
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	3.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	6.2
Hanson 5/8 Chips	35.0
Hanson Screenings	20.0
Dolese Screenings	45.0
Approximate Length (ft):	197
Survey Mill / Lift Thickness (in):	3.2
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	345
Avg Section Compaction:	94.4%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 10
Sublot: 1

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	125 gyrations
Binder Performance Grade:	70-22
Modifier Type:	SBS
Aggregate Type:	St Louis/Porph
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	99
1/2":	97	96
3/8":	82	83
No. 4:	52	52
No. 8:	30	33
No. 16:	17	21
No. 30:	11	14
No. 50:	8	9
No. 100:	6	7
No. 200:	5.1	5.4
Asphalt Content:	5.6	5.6
Pill Bulk Gravity:	2.358	2.318
TMD (Rice):	2.456	2.456
Avg Air Voids:	4.0	5.6
Avg VMA:	14.4	16.9

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 12, 2006
24 Hour High Temperature (F):	75
24 Hour Low Temperature (F):	54
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	1.75
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	5.6
Iron Mountain, MO Porphyry 3/4"	36.0
Maryland Heights, MO 3/4"	21.0
Maryland Heights, MO 3/8"	15.0
Maryland Heights, MO Man Sand	11.0
Iron Mountain, MO Porphyry Man Sand	16.0
Hyd Lime	1.0
Approximate Length (ft):	206
Survey Mill / Lift Thickness (in):	1.0
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	345
Avg Section Compaction:	91.3%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 10
Sublot: 2

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	125 gyrations
Binder Performance Grade:	70-22
Modifier Type:	SBS
Aggregate Type:	St Louis/Porph
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	98	97
1/2":	84	83
3/8":	69	68
No. 4:	45	41
No. 8:	26	26
No. 16:	15	17
No. 30:	9	12
No. 50:	6	8
No. 100:	5	7
No. 200:	4.2	5.6
Asphalt Content:	4.9	4.7
Pill Bulk Gravity:	2.377	2.383
TMD (Rice):	2.476	2.493
Avg Air Voids:	4.0	4.4
Avg VMA:	13.7	13.7

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 11, 2006
24 Hour High Temperature (F):	82
24 Hour Low Temperature (F):	64
24 Hour Rainfall (in):	0.12
Planned Mill / Lift Thickness (in):	3.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.9
Maryland Heights, MO 1"	14.0
Maryland Heights, MO 3/4"	30.0
Maryland Heights, MO 3/8"	20.0
Maryland Heights, MO Man Sand	19.0
Iron Mountain, MO Porphyry Man Sand	16.0
Hyd Lime	1.0
Approximate Length (ft):	206
Survey Mill / Lift Thickness (in):	3.4
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	350
Avg Section Compaction:	92.5%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: N
Section: 10
Sublot: 3

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	125 gyrations
Binder Performance Grade:	64-22
Modifier Type:	NA
Aggregate Type:	St Louis/Porph
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	98	98
1/2":	84	88
3/8":	69	74
No. 4:	45	48
No. 8:	26	30
No. 16:	15	19
No. 30:	9	12
No. 50:	6	9
No. 100:	5	7
No. 200:	4.2	6.3
Asphalt Content:	4.9	5.2
Pill Bulk Gravity:	2.377	2.383
TMD (Rice):	2.476	2.486
Avg Air Voids:	4.0	4.1
Avg VMA:	13.7	14.2

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 10, 2006
24 Hour High Temperature (F):	82
24 Hour Low Temperature (F):	57
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	3.25
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.9
Maryland Heights, MO 1"	14.0
Maryland Heights, MO 3/4"	30.0
Maryland Heights, MO 3/8"	20.0
Maryland Heights, MO Man Sand	19.0
Iron Mountain, MO Porphyry Man Sand	16.0
Hyd Lime	1.0
Approximate Length (ft):	206
Survey Mill / Lift Thickness (in):	3.3
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	335
Avg Section Compaction:	93.3%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: S
Section: 11
Sublot: 1

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	60 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Grn/Lms/Snd
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	100	100
1/2":	100	100
3/8":	99	100
No. 4:	83	86
No. 8:	62	67
No. 16:	47	52
No. 30:	34	37
No. 50:	19	21
No. 100:	11	13
No. 200:	5.4	8.6
Asphalt Content:	6.3	6.9
Pill Bulk Gravity:	2.375	2.380
TMD (Rice):	2.474	2.464
Avg Air Voids:	4.0	3.4
Avg VMA:	18.1	18.0

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 13, 2006
24 Hour High Temperature (F):	66
24 Hour Low Temperature (F):	48
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	1.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	6.2
89 Columbus Granite	24.0
8910 Opelika Limestone Screenings	27.0
M10 Columbus Granite	30.0
Shorter Coarse Sand	19.0

Approximate Length (ft):	202
Survey Mill / Lift Thickness (in):	1.0
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	340
Avg Section Compaction:	93.2%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: S
Section: 11
Sublot: 2

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	60 gyrations
Binder Performance Grade:	76-22
Modifier Type:	SBS
Aggregate Type:	Lms/Grn/Snd
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	94	97
1/2":	84	89
3/8":	72	79
No. 4:	53	60
No. 8:	45	49
No. 16:	36	39
No. 30:	28	27
No. 50:	15	15
No. 100:	8	9
No. 200:	5.0	5.7
Asphalt Content:	4.5	5.4
Pill Bulk Gravity:	2.468	2.441
TMD (Rice):	2.571	2.558
Avg Air Voids:	4.0	4.6
Avg VMA:	14.2	15.6

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 12, 2006
24 Hour High Temperature (F):	75
24 Hour Low Temperature (F):	54
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.8
78 Opelika Limestone	33.0
57 Opelika Limestone	20.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	22.0

Approximate Length (ft):	202
Survey Mill / Lift Thickness (in):	2.1
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	350
Avg Section Compaction:	94.2%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: S
Section: 11
Sublot: 3

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	60 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	94	96
1/2":	84	85
3/8":	72	74
No. 4:	53	54
No. 8:	45	44
No. 16:	36	35
No. 30:	28	25
No. 50:	15	13
No. 100:	8	8
No. 200:	5.0	5.4
Asphalt Content:	4.5	5.0
Pill Bulk Gravity:	2.468	2.442
TMD (Rice):	2.571	2.569
Avg Air Voids:	4.0	4.9
Avg VMA:	14.2	15.1

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 12, 2006
24 Hour High Temperature (F):	75
24 Hour Low Temperature (F):	54
24 Hour Rainfall (in):	0.00
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.8
78 Opelika Limestone	33.0
57 Opelika Limestone	20.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	22.0
Approximate Length (ft):	202
Survey Mill / Lift Thickness (in):	2.2
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	340
Avg Section Compaction:	92.6%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).

4/4/2007

Quadrant: S
Section: 11
Sublot: 4

Laboratory Diary

General Desccription of Mix and Materials

Design Method:	Super
Compactive Effort:	60 gyrations
Binder Performance Grade:	67-22
Modifier Type:	NA
Aggregate Type:	Lms/Grn/Snd
Design Gradation Type:	Dense

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
1":	100	100
3/4":	94	97
1/2":	84	88
3/8":	72	76
No. 4:	53	56
No. 8:	45	46
No. 16:	36	37
No. 30:	28	26
No. 50:	15	14
No. 100:	8	8
No. 200:	5.0	5.5
Asphalt Content:	4.5	4.9
Pill Bulk Gravity:	2.468	2.437
TMD (Rice):	2.571	2.572
Avg Air Voids:	4.0	5.2
Avg VMA:	14.2	15.3

Construction Diary

Relevant Conditions for Construction

Completion Date:	October 11, 2006
24 Hour High Temperature (F):	82
24 Hour Low Temperature (F):	64
24 Hour Rainfall (in):	0.12
Planned Mill / Lift Thickness (in):	2.00
Paving Machine:	Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	4.7
78 Opelika Limestone	33.0
57 Opelika Limestone	20.0
M10 Columbus Granite	25.0
Shorter Coarse Sand	22.0

Approximate Length (ft):	202
Survey Mill / Lift Thickness (in):	2.3
Type of Tack Coat Utilized:	67-22
Target Tack Application Rate (gal/sy):	0.05
Avg Temperature at Plant (F):	350
Avg Section Compaction:	91.8%

General Notes:

1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section number (sequential) and sublot (top=1);
2) The total research thickness of all mix performance sections ranges from 3/4 to 4 inches by design;
3) The total HMA thickness of all structural study sections (N1 through N10) ranges from 7 to 14 inches by design;
4) ARZ, TRZ and BRZ refer to gradations intended to pass above, through and below the restricted zone, respectively;
5) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
6) VMA values computed from QC volumetrics are based on design values of Gsb (stockpile gravity testing is ongoing).