

**MISSISSIPPI SPR-1(56), PART II**

**QUARTERLY PROGRESS REPORT**

**PERIOD: JULY, AUGUST, AND SEPTEMBER 2010**

**FEDERAL FY2010 4<sup>TH</sup> QUARTER**

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## State Study No. 144—Profilograph Specification Study

**Principal Investigator:** Jordan Whittington, EI

<b>.Funds Allocated:</b>	\$329,967.00	<b>Date Started:</b>	October 1, 2000
<b>Expended to Date:</b>	\$289,221.09	<b>Completion Date:</b>	September 30, 2010
<b>Current Work Program:</b>	\$ 29,967.00	<b>Time Remaining:</b>	0 months
<b>Current Work Program Expenditures:</b>	\$ 9,840.02		

**Research Agencies:** Research Division, Mississippi Department of Transportation

### Objective:

The current roughness specification utilized by the MDOT was developed over 10 years ago and there have been no significant changes since. The specification was developed based on the manual profilograph, which has since been replaced by the automatic unit. Also, unlike 10 years ago, industry is now utilizing high frequency rollers to compact their hot mix asphalt pavements. These rollers have a propensity for creating small scallops in the pavement surface, which due to blanking band requirements in most agency roughness specifications, are not taken into account when computing a profile index. However, these scallops are certainly felt by the traveling public and create a rougher ride quality. Based on this type of specification, industry is not being penalized for a rough ride quality and in some instances contractors are being rewarded with incentive pays for a rough final ride surface. Most states, including MDOT, have removed the blanking band from their roughness specification for this very reason. Many of the states have gone to the lightweight profiler for their QC/QA of ride quality. MDOT intends on utilizing the lightweight profiler, which instead of producing a profile index value measures the International Roughness Index (IRI). This transition will take some time with undoubtedly a period of time where a dual specification (lightweight profiler and profilograph) is in place. If MDOT is to ever successfully make this transition, the current profilograph specification must be “tightened up” and data must be gathered comparing profile index values to IRI for Mississippi pavements. Another task is to produce a method to determine areas of “localized roughness” utilizing inertial profilers.

### Progress:

More work was performed on final project report.

### Plans for Next Quarter:

This is the last quarterly report for this study.

## State Study No. 146--Updating Mississippi Flood Frequency Reports

**Principal Investigator:** K. Van Wilson  
**MDOT Project Monitor:** William Barstis, P.E.

**SP&R Funds Allocated:** \$ 80,000.00      **Date Started:** October 1, 2000  
**SP&R Expended to Date:** \$ 80,000.00      **Completion Date:** September 30, 2010  
**Non-SP&R Funds Allocated:** \$140,000.00      **Time Remaining:** 0 months  
**Non-SP&R Expended to Date:** \$140,000.00  
**Current Work Program:** \$0  
**Current Work Program Expenditures:** \$0

**Research Agencies:** United States Geological Survey and Research Division,  
Mississippi Department of Transportation

### **Objective:**

Knowledge of magnitude and frequency of floods is essential to the design of bridges, highway embankments, culverts, levees, dams, and other structures near streams. Effective flood-plain management and determination of flood insurance rates require accurate information on magnitude and frequency of floods.

The statewide flood-frequency reports by Landers and Wilson (1991) and Wilson and Landers (1991) provided estimates of magnitude and frequency of floods at gaging stations and provided techniques for estimating magnitudes and frequency of floods at ungaged sites in Mississippi. Observed annual peak-flow data collected through 1988 at 358 gaging stations were used in the analyses. Since the 1991 statewide flood-frequency reports, an additional 11 years of observed annual peak-flow data has become available and data have been collected on several large floods. Also, the 1991 regional flood-frequency equations were developed using generalized least-squares (GLS) regression (Stedinger and Tasker, 1985; and Tasker and Stedinger, 1989). GLS regression had and still has advantages over the ordinary least-squares and weighted least-squares regression, but since the 1991 reports, Tasker and Slade (1994) demonstrated that GLS regression coupled with a site-specific approach [referred to as "interactive" by Tasker and Slade (1994) and as "region-of-influence" by Hodge and Tasker (1995)] had smaller root-mean-square errors than the traditional geographic regional approach. Analyses of flood frequency using these additional data with a site-specific approach may substantially change and improve the accuracy of techniques for estimating magnitudes and frequencies of floods in Mississippi.

**Progress:**

Continued research of regional flood-frequency techniques and regression analyses.

**Plans for Next Quarter:**

Continue research of regional flood-frequency techniques and regression analyses.

## State Study No. 170--Implement The 2002 Design Guide For MDOT (Phase II)

**Principal Investigators:** Harold Von Quintus, Chetana Rao  
**MDOT Project Monitor:** William Barstis, P.E.

<b>SP&amp;R Funds Allocated:</b>	\$407,663.00	<b>Date Started:</b>	October 1, 2003
<b>SP&amp;R to Date:</b>	\$235,557.87	<b>Completion Date:</b>	December 31, 2010
<b>Non-SPR Allocated:</b>	\$500,000.00	<b>Time Remaining:</b>	3 months
<b>Non-SPR to Date:</b>	\$502,297.04		
<b>Current Work Program:</b>	\$150,000.00		
<b>Current Work Program Expenditures:</b>	\$ 49,776.13		

**Research Agencies:** Applied Research Associates, Inc.—Transportation Sector and Research Division, Mississippi Department of Transportation

### Objective:

Applied Research Associates, Inc.—Transportation Sector has finalized the development of the Mechanistic-Empirical Pavement Design Guide (MEPDG), previously referred to as the 2002 Pavement Design Guide, for design of new and rehabilitated structures through NCHRP Projects 1-37A and 1-40D. The MEPDG incorporates mechanistic-empirical based pavement design principles and allows highway agencies to develop cost-effective and reliable designs by systematically considering climate, material properties, construction variability, and traffic to predict pavement performance. This design process is a total departure from the process utilized in the current AASHTO design procedure, requiring the designer to make trial selection of materials and layer thicknesses and evaluating their performance under projected loadings over the design life of the pavement.

The objective of this study is to implement the MEPDG for Mississippi DOT. The following issues will be addressed in this study:

- Provide for training of MEPDG users and other stakeholders.
- Develop and execute a plan for securing the appropriate design input data on material and traffic characterization, and other design inputs.
- Conduct sensitivity analyses and make comparisons of MEPDG designs with Mississippi's current procedure.
- Develop and execute a plan for calibration of the MEPDG performance and distress models, defined as transfer functions.

**Progress:**

The project team primarily worked on task 7 and task 16 of the project during this quarter. There was little coordination with MDOT during this period, however. The project team provided further updates on the data collected and yet remaining to be received from MDOT. The PI also worked with NCAT to support their efforts with developing climate data for the local calibration. In addition, ARA provided a detailed field testing plan for stabilized materials.

**Plans for Next Quarter:**

The activities planned for next quarter include the following tasks:

- Task 7—The project team will continue to work with MDOT and assemble all relevant calibration data for flexible, semi-rigid, and rigid pavements. It is expected that MDOT will provide the “missing” information to complete the list of MEPDG input files.

**EEO and Title VI Information:**

Employment Data for ARA Research Staff

Total Staff	Male					Female				
	White	Black	Hispanic	Asian	Native Am	White	Black	Hispanic	Asian	Native Am
4	2			1					1	

## State Study No. 171--In-House Support To State Study No. 170 - Implement The 2002 Design Guide For MDOT (Phase II)

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**Principal Investigator:** William Barstis, P.E.

<b>Funds Allocated:</b>	\$350,000.00	<b>Date Started:</b>	October 1, 2003
<b>Expended to Date:</b>	\$252,280.48	<b>Completion Date:</b>	December 31, 2012
<b>Current Work Program:</b>	\$ 50,000.00	<b>Time Remaining:</b>	27 months
<b>Current Work Program Expenditures:</b> \$ 25,381.84			

**Research Agency:** Research Division, Mississippi Department of Transportation

### **Objective:**

This study will be conducted to support the State Study 170, "Implement the 2002 Design Guide for Mississippi DOT." The construction, traffic and materials data will be obtained for approximately 132 existing pavement sections. In addition to this data, pavement coring and FWD testing will be required for 24 of these pavement sections. Coordination between the six District Materials Engineers, the MDOT Central Laboratory and the private testing firm will be required to ensure that the requisite materials testing is conducted on representative samples of subgrade soils, crushed rock base course materials and chemically stabilized soil materials. Review the input/output data related to the customized 2002 Design Guide software as well as the developed training materials including courses, seminars and manuals that will be delivered to MDOT as a result of the referenced study.

### **Progress:**

MDOT continued to collect requisite data for calibration/validation of performance models. PM sections along with construction and material testing records were sent to ARA for calibration of transfer functions.

### **Plans for Next Quarter:**

Continue collecting requisite MDOT data for calibration of performance models for roadway sections.

## State Study No. 180--Evaluation Of Pavement Marking Materials

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**Principal Investigator:** Cindy Smith, P.E.

<b>Funds Allocated:</b>	\$ 90,000.00	<b>Date Started:</b>	October 1, 2005
<b>Expended to Date:</b>	\$ 70,836.21	<b>Completion Date:</b>	December 31, 2010
<b>Current Work Program:</b>	\$ 10,000.00	<b>Time Remaining:</b>	3 months
<b>Current Work Program Expenditures:</b> \$ 2,717.62			

**Research Agencies:** Research Division, Mississippi Department of Transportation

### **Objective:**

Current MDOT policy requires that products to be used on construction and maintenance projects come from the Departmental "Approved Products List". Additionally in order for the Department to obtain Federal participation on projects, all products must have an approved equal (i.e. no sole source products).

Safety has long been a priority for MDOT and with that in mind the Department is constantly exploring methods and products that will improve visibility for motorists both at night and during wet conditions. In order to evaluate new striping materials, MDOT has received formal experimental feature approval (in accordance with 23 CFR 635.411(a)(3)) from the Mississippi Division Office of FHWA on the following four projects to date:

1. MS 304 from US 61 to I-55 and Spur (MS 713), Desoto & Tunica Counties
2. US 49 from US 98 South to Black Creek, Forrest County
3. Interchange at US 61 and Liberty Road, Adams County
4. I-55 from Pearl Street to I-220, Hinds & Madison Counties

The performance of each of the experimental features incorporated in these projects (and any future approved pavement marking evaluations) will be separately documented and reported to interested agencies as well as the AASHTO Product Evaluation Listing (APEL) through technology transfer procedures already in place within MDOT's Research Division. This study will fund the collection and dissemination of data -resulting from these evaluations. Additionally should these evaluations prove to be successful it will enable the approval of more products for the Departmental "Approved Product List" and enable Federal participation on more projects utilizing these products.

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**Progress:**

No work was done during this quarter.

**Plans for Next Quarter:**

MDOT will conduct testing on the I-55 site in the fall of 2010.

## State Study No. 181--Structural Characterization Of Asphalt Drainage Course Layers

**Principal Investigator:** L. Allen Cooley, Jr.  
**MDOT Project Monitor:** William Barstis, P.E.

<b>Funds Allocated:</b>	\$100,000.00	<b>Date Started:</b>	October 1, 2005
<b>Expended to date:</b>	\$ 73,573.06	<b>Completion Date:</b>	December 31, 2011
<b>Current Work Program:</b>	\$ 26,324.00	<b>Time Remaining:</b>	15 months
<b>Current Work Program Expenditures:</b>	\$0		

**Research Agencies:** Burns Cooley & Dennis, Inc.

### Objective:

Asphalt Drainage Courses (ADCs) are generally required under all 4-lane facility flexible pavements in Mississippi. Within typical pavement sections, ADCs are placed over a stabilized granular soil base layer. MDOT is currently funding studies to implement the new Mechanistic-Empirical Pavement Design Guide (MEPDG). Within this new design guide all layers of the pavement structure are evaluated for fundamental engineering properties such as modulus and Poisson's Ratio. The proposed study includes three objectives:

1. Properly characterize the stiffness (modulus) of ADC materials.
2. Develop appropriate transfer functions for ADC materials. MDOT uses the Falling Weight Deflectometer (FWD) to characterize the structural capacity of in-place pavements that are scheduled for overlay. Data developed from FWD testing is input into ELMOD 5 for evaluating determining required thickness of overlay. To facilitate analysis using ELMOD 5 typical moduli values of ADC materials (objective 1) are required along with appropriate transfer functions.
3. The current MDOT flexible pavement design procedure does not assign a structural value (layer coefficient) to ADCs. The new MEPDG allows the contribution of the 4 inches of asphalt binder stabilized aggregates to the overall structural integrity of the pavement. Possible elimination of the underlying chemically stabilized soil base course could be realized if the drainage layer is shown to be structurally equivalent to the stabilized base layer, leading to a savings in pavement construction. The results from the first two objectives will be used in the MEPDG to perform this evaluation.

**Progress:**

During this quarter, six field projects were visited. At each of these field projects, Falling Weight Deflectometer testing was accomplished by MDOT personnel at three locations. The mid-depth HMA layer temperature was collect at each FWD test location. Each of the locations was also cored to identify/verify the pavement layers and collect layer thicknesses. The ADC layer from each was saved and is currently in cold storage.

**Plans for Next Quarter:**

During the next quarter Bob Briggs from Dynatest, Inc. will review and analyze the FWD data and provide guidance on lab testing of the collected ADC layers to develop a transfer function that relates field resilient modulus to laboratory tested resilient modulus. We anticipate that lab testing will also be initiated after Mr. Briggs reviews the FWD data.

**EEO and Title VI Information:**

<u>Employment Data for Research Staff</u>										
Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>
5	5									

## State Study No. 184--Long-Term Field Monitoring and Performance of Paving Fabric Interlayer Systems to Reduce Reflective Cracking

**Principal Investigator:** Farshad Amini

<b>Funds Allocated:</b>	\$218,224.00	<b>Date Started:</b>	October 1, 2005
<b>Expended to Date:</b>	\$ 66,128.40	<b>Completion Date:</b>	September 30, 2014
<b>Current Work Program:</b>	\$ 7,500.00	<b>Time Remaining:</b>	48 months
<b>Current Work Program Expenditures:</b>	\$ 3,277.85		

**Research Agency:** Jackson State University

### Objective:

The formation of reflective cracking of pavement overlays has confronted highway engineers for many years. Stress-relieving interlayers, such as paving fabrics, have been used in an attempt to reduce or delay reflective cracking. The primary objective of this project is to conduct a long-term monitoring of the paving fabric interlayer systems to evaluate its effectiveness and performance. A comprehensive testing, monitoring, and analysis program is planned, where twelve 500-ft pavement sections of a two-lane highway are constructed, and then monitored for seven years. Particular attention is directed towards investigating the influence of overlay thickness on long-term performance. A comparison between the performance of paving fabric treatment systems for milled and non-milled surfaces, as well as a comparison between the performance of paving fabrics on sealed and non-sealed surfaces are reported. In addition, a cost-benefit analysis is performed to develop total life cycle costs for each section.

### Progress:

During the last quarter, the third annual crack survey of the twelve paving fabric research sections was conducted to obtain the crack data to be used to evaluate the effectiveness of the paving fabric systems to reduce reflective cracking. The distress data collection was generally in accordance with the "Distress Identification Manual for the Long-Term Pavement Performance Project, SHRP-P-338" (SHRP, 1993). The test sections are surveyed annually following the construction.

### Plans for Next Quarter:

During the next quarter, the third annual crack survey data will be analyzed.

**EEO and Title VI Information:  
Employment Data for Research Staff**

Total Staff	Male					Female			
	White	Black	Hispanic	Asian	Native Am	White	Black	Hispanic	Asian
1				1					

## **State Study No. 185--In-House Support To State Study No. 184 - Long-Term Field Monitoring And Performance Of Paving Fabric Interlayer Systems To Reduce Reflective Cracking**

**Principal Investigator:** Cindy Smith, P.E.

<b>Funds Allocated:</b>	\$ 30,000.00	<b>Date Started:</b>	October 1, 2005
<b>Expended to Date:</b>	\$ 14,752.30	<b>Completion Date:</b>	September 30, 2014
<b>Current Work Program:</b>	\$ 10,000.00	<b>Time Remaining:</b>	48 months
<b>Current Work Program Expenditures:</b>	\$0		

**Research Agency:** Research Division, Mississippi Department of Transportation

### **Objective:**

This study will be conducted to support the proposed study “Long-Term Field Monitoring and Performance of Paving Fabric Interlayer Systems to Reduce Reflective Cracking.”

The required tasks include:

- FWD field testing and evaluation of requisite overlay of proposed pavement for inclusion in Phase II study.
- Operation of the MDOT profiler to obtain video images of the pavement surface one time prior to construction of the twelve test sections and nine times subsequent to construction.
- Mapping of cracks on the video logs for submission to Jackson State University.
- Traffic control will be required to facilitate FWD testing by MDOT and pavement coring operations by Burns, Cooley, & Dennis, Inc.
- Review of one construction report, three progress reports, and one final report.

### **Progress:**

Data collection was done in September of 2010.

### **Plans for Next Quarter:**

No work is planned for next quarter.

## State Study No. 186--Consultant Support To State Study No. 184 – Long – Term Field Monitoring And Performance Of Paving Fabric Interlayer Systems To Reduce Reflective Cracking

**Principal Investigator:** Randy Ahlrich, P.E.

**MDOT Project Monitor:** Cindy Smith, P.E.

<b>Funds Allocated:</b>	\$ 20,400.00	<b>Date Started:</b>	October 1, 2005
<b>Expended to date:</b>	\$ 19,251.00	<b>Completion Date:</b>	September 30, 2014
<b>Current Work Program:</b>	\$ 0	<b>Time Remaining:</b>	48 months
<b>Current Work Program Expenditures:</b> \$ 0			

**Research Agencies:** Burns, Cooley & Dennis, Inc.  
Research Division, Mississippi Department of Transportation

### Objective:

This project will provide consultant support to the proposed study “Long-Term Field Monitoring and Performance of Paving Fabric Interlayer Systems to Reduce Reflective Cracking.” The required tasks include:

- Provide guidance on selection of paving fabric.
- Provide guidance regarding paving fabric construction for inclusion in construction bid documents.
- Monitor construction of test sections.
- Perform requisite coring of pavement test sections.
- Review the construction report, three progress reports and the final report.

### Progress:

No work performed this quarter.

### Plans for Next Quarter:

None

### EEO and Title VI Information:

Employment Data for Burns Cooley & Dennis, Inc. Research Staff

Total	Male					Female				
Staff	White	Black	Hispanic	Asian	Native Am	White	Black	Hispanic	Asian	NativeAm
0										

## State Study No. 195--Evaluation Of Load-Deflection Behavior In Drilled, Cast-In-Place Concrete Shafts In Mississippi

**Principal Investigator:** Chris Saucier  
**MDOT Project Monitor:** Sean Ferguson

<b>Funds Allocated:</b>	\$171,000.00	<b>Date Started:</b>	October 1, 2007*
<b>Expended to Date:</b>	\$116,914.86	<b>Completion Date:</b>	December 31, 2010
<b>Current Work Program:</b>	\$ 70,000.00	<b>Time Remaining:</b>	3 months
<b>Current Work Program Expenditures:</b>	\$ 25,789.66		

\* Funding cycle initiated in January 2008, date shown is authorization date.

\*\*Excludes \$5,370.00 remaining from Second Year work program.

**Research Agencies:** Mississippi State University  
Materials Division, Mississippi Department of Transportation

### Objective:

Over the past decade, the Mississippi Department of Transportation (MDOT) has performed approximately sixty load tests on straight-sided, drilled, cast-in-place concrete shafts (drilled shafts). Each of these load tests was well instrumented and included an Osterberg load cell and several strain gauges at critical locations along the shaft length.

Data in the MDOT drilled shaft load test database is currently employed in a qualitative form to support engineering judgment of the behavior of new shafts being completed in proximity to a project where an instrumented load test exists. To date, however, the data has not been integrated into a quantitative procedure that could readily be employed in design. The objective of this study is to develop the necessary correlations between design strength parameters and model soil response using the existing MDOT database of load tests on drilled shafts. These correlations would form the basis of a new method of design of drilled shafts for locations other than those constructed to date, reduce the amount of conservatism relative to that employed in the current design method, and result in a reduction of construction costs.

### Progress:

There was no progress during the July-September 2010 reporting period. During the previous reporting period, April-June 2010, the research assistant working on the project elected to take an M. S. degree and pursue an employment opportunity. Also,

the P.I. has changed employment status. Progress on the project halted. In that the original contract period was scheduled to expire September 30, the situation was discussed with MDOT Research Division. The research product was considered to be a priority and a decision was made to let the current contract expire and complete the work under a new contract and with a new P.I.

**Plans for Next Quarter:**

Work accomplished on the project and literature collected will be reviewed. Work will begin on a new proposal to complete the project.

**EEO and Title VI Information:**

Employment Data for Mississippi State University Research Staff

Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>
1	1									

## State Study No. 198--Quality Verification Of PQI301 Asphalt Density Device

**Principal Investigators:** Paula Wiles, P.E., and Jordan Whittington, E.I.

<b>Funds Allocated:</b>	\$ 45,000.00	<b>Date Started:</b>	October 1, 2006
<b>Expended to Date:</b>	\$ 19,825.82	<b>Completion Date:</b>	September, 2010
<b>Current Work Program:</b>	\$10,000.00	<b>Time Remaining:</b>	0 months
<b>Current Work Program Expenditures:</b> \$ 2,771.49			

**Research Agencies:** 6<sup>th</sup> District, Mississippi Department of Transportation  
Research Division, Mississippi Department of Transportation

### **Objective:**

Nuclear density gages are currently used by the Mississippi Department of Transportation (MDOT) to determine the in-situ density of hot mix asphalt (HMA) layers. These devices include radioactive sources which require:

- MDOT must have a special license and follow regulatory controls
- Each user must be specially trained and certified
- Each user must wear a badge which is periodically tested to ensure that the employee has not been exposed to an excessive amount of radiation
- Designated special storage areas

The 6<sup>th</sup> District will purchase a PQI 301 Pavement Quality Indicator. This device is advertised to provide accurate density measurements of HMA while eliminating every negative aspect of the use of the nuclear density gage. The Gulfport Project Office will use this device in conjunction with the nuclear density gage on upcoming projects to provide comparison test results. These results will be evaluated to determine if the PQI 301 can be used in lieu of the nuclear density gage.

### **Progress:**

Finalized project.

### **Plans for Next Quarter:**

No plans as this project is finished.

## State Study No. 206--Performance Specification For Chemically Stabilized Pavement Layers

**Principal Investigator:** Isaac Howard  
**MDOT Project Monitor:** William Barstis, P.E.

**Funds Allocated:** \$239,703.00    **Date Started:** October 1, 2007  
**Expended to Date:** \$ 2,681.64    **Completion Date:** December 31, 2011 (ext)  
**Current Work Program:** \$ 30,000    **Time Remaining:** 15 months  
**Current Work Program Expenditures:** \$ 2,681.64

**Research Agencies:** Mississippi State University  
Research Division, Mississippi Department of Transportation

### Objective:

The proposed project will develop a performance specification for chemically treated pavement layers (lime, fly ash, and cement). A significant amount of laboratory testing of stabilized soils will be utilized, including previous stabilization research performed for MDOT. Numerical analysis will be performed using the finite element method to determine thresholds for the performance specification. MEPDG software will also be used to perform a sensitivity analysis.

### Progress:

Calorimetry testing continued in this quarter to a limited extent. The majority of the effort expended this quarter was in identifying suitable materials to conduct the study and in writing a draft of the proposed research plan modifications. This plan was submitted to MDOT for review in September. One of the candidate soils was identified and obtained during the quarter. Drying and processing of this material has commenced. Additionally, one cement source and one slag source were identified and obtained.

### Plans for Next Quarter:

Work with MDOT Research Division to finalize revised research plan for the study. Attempt to obtain additional material sources, and continue calorimetry. PI was granted a year's no-cost time extension.

**Employment Data for Mississippi State University Research Staff**

Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>
2	2									

## State Study No. 207--Open Graded Friction Course For HMA Pavements

**Principal Investigator:** Tom White

**MDOT Project Monitor:** Jordan Whittington, E.I.

<b>Funds Allocated:</b>	\$ 135,000.00	<b>Date Started:</b>	September 30, 2008
<b>Expended to Date:</b>	\$ 48,654.05	<b>Completion Date:</b>	June 30, 2011
<b>Current Work Program:</b>	\$ 51,000.00	<b>Time Remaining:</b>	9 months
<b>Current Work Program Expenditures:</b>	\$ 26,107.44		

**Research Agencies:** Mississippi State University  
Research Division, Mississippi Department of Transportation

### Objective:

Open Graded Friction Courses (OGFC) decrease hydroplaning potential, spray, noise and underlying pavement temperature. Because of relatively high annual rainfall in the state, use of OGFC would significantly reduce hydroplaning potential, which is a major safety issue in Mississippi. Additional beneficial functions are reduction in spray, noise and underlying pavement temperature.

Research is proposed that will provide comprehensive tests, data, material evaluation, and performance results for OGFC. As a result, MDOT will be in a position to make decisions on broad application of OGFC throughout the state with respect to allowing materials, verification of mix design criteria, safety (hydroplaning and spray), noise and contribution to pavement structural capacity. Testing will be conducted in both the laboratory and the field. Field testing is proposed for test sections strategically located as to site and materials representative throughout Mississippi.

### Progress:

In the previous quarter a compactive effort of 17 revolutions was identified to compact an OGFC cap on an existing compacted dense core for the falling head permeability test. This effort was compared with the 50 revolutions to compact a 115mm thick core. Continued evaluation of the specimen preparation and test indicates thickness and compactive effort needs additional study. This will be done within the context of other work.

In review of the specifications for the asphalt-rubber OGFC some questions surfaced about criteria and testing practice. These questions were posed to MDOT Materials Division; however, the history of the requirements was not clear. Subsequent review of

standards appears to have answered the questions. Clarifications have been made in the specification.

Students have been trained for conducting physical tests on OGFC to include indirect tension and dynamic modulus tests.

**Plans for Next Quarter:**

During the next quarter indirect tension tests will be completed along with moisture sensitivity tests. Dynamic modulus tests will be initiated.

Earlier in the year an inquiry was made about the possibility of OGFC test sections. However, at this point test sections are unlikely this construction season. It is hoped a project for early next construction season can be identified. In any case the project may need to be extended.

Employment Data for Mississippi State University Research Staff

Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>
4	4									

## State Study No. 208--Effect Of Coarse Aggregate Cleanliness And Moisture Content On Stripping Susceptibility & Long Term Performance Of HMA

**Principal Investigator (MSU):** Dr. Isaac Howard

**Principal Investigator (BCD):** L. Allen Cooley, Jr., P.E.

**MDOT Project Monitor:** James Watkins, P.E.

<b>Funds Allocated:</b>	\$275,000.00	<b>Date Started:</b>	October 1, 2007
<b>Expended to Date:</b>	\$ 35,422.84	<b>Completion Date:</b>	December 31, 2010
<b>Current Work Program:</b>	\$150,000	<b>Time Remaining:</b>	3 months
<b>Current Work Program Expenditures:</b> \$ 18,599.20			

**Research Agencies:** Mississippi State University  
Burns, Cooley & Dennis, Inc.  
Research Division, Mississippi Department of Transportation

### Objective:

There are two issues that are related to the use of absorptive, dirty aggregates. The first issue is the potential for moisture damage. Dirty coatings left on aggregate surfaces can prevent the asphalt binder from properly adhering to the aggregates, leading to an increased potential for moisture damage. This is especially true when clayey fines coat the aggregates. Additionally, all of the moisture from highly absorptive aggregates may not be removed during the production process. Moisture remaining within the aggregates will increase the potential for moisture damage. The second issue is that of compactibility of the HMA in the field. Moisture remaining within the aggregates will try to escape the asphalt binder coated aggregates in the form of water vapor. The water vapor acts to extend the asphalt binder making the HMA act like it is over asphalted. When this occurs, the mixture can act very tender under the roller and be difficult to compact.

In order to evaluate the effect of absorptive, dirty aggregates, field projects will be visited. Aggregates from project will be sampled and evaluated for cleanliness using a number of tests to determine the number of adhered fines as well as the activity of those fines. Mixture will be sampled and tested for moisture content and susceptibility to moisture damage. Additionally, the mixtures will be evaluated during compaction to determine the influence of aggregate moisture content on compactability.

**Progress:**

Burns Cooley Dennis, Inc. completed three field projects during the fourth quarter. To date, eight of the twelve proposed field projects have been completed. The field projects completed in the fourth quarter included paving projects on Old Brandon Road in the city of Flowood, I-55 in Yazoo County, and MS Highway 8 in Chickasaw County. Aggregate samples were obtained from stockpiles and the cold feed belt. Samples of the asphalt mixture were obtained from haul trucks at the plant and from the asphalt paver. All material samples were transported to the Burns Cooley Dennis laboratory for subsequent testing.

Temperature and density was monitored during compaction. Temperature was recorded during the compaction process at three locations of varying depth within the asphalt pavement and on the pavement surface. Change in density was recorded behind the paver and after each roller pass. Cores were obtained to determine in-place density and mixture properties.

Laboratory testing was initiated on materials obtained on the three projects. Laboratory testing is approximately 75 percent complete for materials obtained from the eight field projects thus far.

**Plans for Next Quarter:**

At least three field projects have been identified for the upcoming quarter. These include one project in Oktibbeha County and I-20 in Hinds County. It is the intent of the researchers to complete the remaining field projects in the next quarter. Laboratory testing and data analysis will also continue during the next quarter.

**Employment Data for Mississippi State University Research Staff**

Total Staff	Male					Female				
	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>
2	2	0	0	0	0	0	0	0	0	0

**Employment Data for Burns, Cooley & Dennis, Inc. Research Staff**

Total Staff	Male					Female				
	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>
2	2	0	0	0	0	1	0	0	0	0

## State Study No. 210--Emergency Evacuation Study For The Greater Jackson Area (DYNASMART-P Deployment)

**Principal Investigator:** Feng Wang, P.E.  
**MDOT Project Monitor:** Acey Roberts, E.I.T.

<b>Funds Allocated:</b>	\$55,158.00	<b>Date Started:</b>	October 1, 2008
<b>Expended to Date:</b>	\$14,680.09	<b>Completion Date:</b>	June 30, 2011
<b>Current Work Program:</b>	\$ 55,158.00	<b>Time Remaining:</b>	9 months
<b>Current Work Program Expenditures:</b>	\$ 8,175.14		

**Research Agencies:** Jackson State University  
Traffic Engineering Division, Mississippi Department of  
Transportation

### Objective:

The proposed research will address the possible emergency evacuation needs for the greater Jackson area of Mississippi. This research will study the feasibility of applying the new generation dynamic traffic assignment (DTA) based traffic-network planning and simulation model, DYNASMART-P, in developing and evaluating emergency evacuation strategies to assist implementation of intelligent transportation system (ITS) functionalities. These functionalities will improve emergency preparedness, mitigation, response and recovery capabilities for this area of Mississippi. This study will also enable MDOT to verify viable emergency traffic control strategies and facilitate the implementation of ITS technologies in major highway corridors in the state.

### Progress:

In the past months, the research team has achieved the following major progress: (1) Resolved the computational efficiency problem using a 64-bit DynusT (Dynamic Urban Systems in Transportation) which is a FHWA sponsored Dynamic Traffic Assignment (DTA) simulation software developed by Dr. Yi-Chang Chiu at University of Arizona. (2) Test alternative software packages such as DTALite which is an open-source dynamic traffic assignment model developed by Dr. Xuesong Zhou at University of Uath. (3) Compared the performance of Dynasmart-P, DTALite, and DynusT in different number of simulation scenarios (Gas spill) and justified the superiority of either DTALite or DynusT in this project on computers with the same configurations. (4) Coded and edited network input files for optimal DMS deployment to implement contra-flow strategy for simulation runs.

**Plan for Next Quarter:**

- (1) Receive approval from the Project Director and the Traffic Division on the selection of DTA simulation package DynusT for the simulation study of the Gas Spill scenario.
- (2) Continue to run simulations using the DynusT to address the objectives: identify the vulnerable points or segments in the network; quantify the system-wide impacts of the applied congestion mitigation strategies such as ITS (DMS) and contra-flow on the network capacity improvements; find the minimum amount of time needed to evacuate the population in the affected area using optimized traffic management strategies.
- (3) Pilot-test on how to model VMS in a more realistic way and find the cost-effective setting of the number of VMS and their locations considering the constraints of operational budget and evacuation efficiency.
- (4) Finish all the simulation runs and output analysis in DynusT, develop research results and analyses, and start the final report drafting.

**EEO and Title VI Information:**

Employment Data for Jackson State University Research Staff

Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>
3				2			1			

## **State Study No. 211--Laboratory Testing And Evaluation Of Near Surface Properties Of Flexible Pavements Due To Bituminous Surface Treatments**

**Principal Investigator:** Isaac Howard  
**MDOT Project Monitor:** William Barstis, P.E.

<b>Funds Allocated:</b>	\$330,000.00	<b>Date Started:</b>	October 1, 2008
<b>Expended to Date:</b>	\$ 43,826.68	<b>Completion Date:</b>	March 31, 2013
<b>Current Work Program:</b>	\$ 125,000.00	<b>Time Remaining:</b>	30 months
<b>Current Work Program Expenditures:</b> \$ 38,051.84			
<b>Research Agencies:</b>	Mississippi State University Research and Materials Divisions, Mississippi Department of Transportation		

### **Objective:**

The project will test all emulsions that at present can be delivered into Mississippi for sealing activities. The end product will be a draft performance/material acceptance specification for chip and scrub seal activities. The project will also investigate the benefits of fog seals via wheel tracking of pavement slabs treated with fog seals.

### **Progress:**

Over 500 BBR tests were conducted on near surface mixtures both with and without emulsion treatment. A project (HWY 366) was identified for the long term performance test of seal treatments. The section was sealed in September. Cores were obtained from three different areas of the pavement for use in development of the long term performance test. Cores were taken before and after sealing. Moisture loss analysis was performed using sweep and frosted marble test data that indicated a strong relationship between moisture loss and strength gain. The data also has revealed other relative performance data that could be implemented in a chip seal performance oriented specification.

### **Plans for Next Quarter:**

Continue to test and analyze BBR data. A considerable amount of indirect tensile testing of near surface asphalt is also planned for the next quarter. Additional developments related to the long term performance test are also envisioned depending on the progress of BBR testing.

**EEO and Title VI Information:**

Employment Data for Mississippi State University Research Staff

<u>Total</u>	<u>Male</u>					<u>Female</u>				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>
5	4	0	1	0	0	0	0	0	0	0

## State Study No. 212--Utilization Of RAP In Construction (Phase II--High Rap Surface Course)

**Principal Investigator:** Isaac Howard  
**MDOT Project Monitor:** James C. Watkins, P.E.

**Funds Allocated:** \$115,000.00      **Date Started:** October 1, 2008  
**Expended to Date:** \$ 80,827.18      **Completion Date:** December 31, 2010  
**Current Work Program:** \$ 70,000.00      **Time Remaining:** 3 months  
**Current Work Program Expenditures:** \$ 60,419.81

**Research Agencies:** Mississippi State University  
 Research and Materials Divisions, Mississippi Department of  
 Transportation

### Objective:

The project will focus on laboratory investigation of high RAP content warm mixed asphalt for use as an overlay material. Material characterization will be the focus of the research, and will include determination of a variety of properties needed for mix design (e.g. stiffness), as well as attempt to modify properties expected to be problematic (e.g. durability and cracking). The project will also attempt to leverage the information obtained from MDOT SS 200.

### Progress:

With exception of a minor amount of moisture damage, durability, and dynamic modulus testing all other testing is complete pending analysis. Less than 10% of the testing for the project is left to perform. Analysis has commenced alongside writing of the final report. The progress on this project is coming along well and is on schedule for completion at the end of the year.

### Plans for Next Quarter:

Complete all activities and submit the final report.

### EEO and Title VI Information:

#### Employment Data for Mississippi State University Research Staff

Total Staff	Male					Female				
	White	Black	Hispanic	Asian	Native Am	White	Black	Hispanic	Asian	Native Am
13	9	0	0	0	0	4	0	0	0	0

## State Study No. 213--Performance Evaluation Of Roundabouts For Traffic Delay And Crash Reduction In Oxford, MS

**Principal Investigator:** Waheed Uddin  
**MDOT Project Monitor:** James Sullivan, P.E.

<b>Funds Allocated:</b>	\$70,920.00	<b>Date Started:</b>	May 28, 2009
<b>Expended to Date:</b>	\$40,949.23	<b>Completion Date:</b>	December 31, 2010
<b>Current Work Program:</b>	\$ 46,000	<b>Time Remaining:</b>	3 months
<b>Current Work Program Expenditures:</b> \$ 40,949.23			

**Research Agencies:** Department of Civil Engineering/Center for Advanced Infrastructure Technology, University of Mississippi  
Traffic Engineering Division, Mississippi Department of Transportation

### Objective:

This study will evaluate the effectiveness of the roundabout traffic control method for improved traffic flow, reductions of traffic delays and crashes, and enhanced air quality. The project research team will collect post-roundabout traffic volume, delay, and crash data for comparison with the pre-roundabout data. The pre- and post-construction data will be analyzed using plots, trends, and statistical tests of significance. Benefit and cost analysis will be conducted and results will be presented in GIS visualization and spatial maps.

### Progress:

1) Final simulations of the S. Lamar overpass including both junctions were run for pre- and post- construction of roundabouts for the highest peak hour volume of manually collected data during the week of October 12, 2009 show evidence of improved performance after roundabout construction: contact points reduced (25 contact points reduced to 7 on South Roundabout), with respect to 17% reduction in average delay per vehicle, 77% reduction in average idling time per vehicle during queues, 50% increase in mean speed, and 77% reduced emissions. Fuel consumption reduced resulting in lesser greenhouse gas emission. 2) Crash data for Oxford, acquired from the Department of Public Safety for 2005-2009, show statistically significant reduction in post-roundabout period. Number of crashes reduced 34% and 57% reduction was noted in injury crashes. Comprehensive economic cost reduced 54% from crashes. 3) The interim report was submitted to MDOT.

**Plans for Next Quarter:**

- 1) Public opinion survey form for online survey, university approval for human subject research.
- 2) Compilation of draft final project. Due to delay in public opinion survey the final report submission for MDOT's review and comments will be delayed.
- 3) A no-cost extension of up to 6 months will be requested from MDOT.

**EEO and Title VI Information:**

Employment Data for University of Mississippi Research Staff

Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>
3	1			1			1			

## State Study No. 214-- MDOT Implementation Plan For GPS Technology In Planning, Design And Construction Delivery

**Principal Investigator:** John Hannon  
**MDOT Project Monitor:** Cindy Smith, P.E.

<b>Funds Allocated:</b>	\$172,988.00	<b>Date Started:</b>	October 1, 2008
<b>Expended to Date:</b>	\$ 36,586.38	<b>Completion Date:</b>	March 31, 2011
<b>Current Work Program:</b>	\$ 172,988.00	<b>Time Remaining:</b>	6 months
<b>Current Work Program Expenditures:</b>	\$ 36,586.38		

**Research Agencies:** The University of Southern Mississippi  
Transportation Information Division, Mississippi Department of  
Transportation

### **Objective:**

Global Positioning System (GPS) technology offers advantages to transportation agencies in the planning, design and construction stages of project delivery. This research study will develop a guide for MDOT implementation of GPS technology, both internally and externally, assisting the agency in the areas of construction specifications, quality control, business policies and procedures, and cost budgeting. This study will result in the delivery of a report that includes recommendations for specification language regarding contractor use of GPS for automated machine grading and the sharing of MDOT electronic data. This report will include a suggested plan for implementation of GPS technology in the MDOT corresponding functional areas. Workshops will be delivered with the participation of MDOT personnel and construction company representatives centered on the GPS Guidance Specification and Implementation Plan to facilitate their adoption.

### **Progress:**

Completed draft of final report and submitted to MDOT for review. Revised draft and then submitted final version of report. All project deliverables have been received for this study. This is the final quarterly progress report.

### **Plans for Next Quarter:**

None. Study is completed. This will be the final progress report.

**EEO and Title VI Information:**

Employment Data for The University of Southern Mississippi Research Staff

Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>
3	2		1							

## State Study No. 215--Integrated Kudzu Control On Mississippi Roadsides

**Principal Investigator:** Mark Weaver  
**MDOT Project Monitor:** Dave Thompson

<b>Funds Allocated:</b>	\$50,215.00	<b>Date Started:</b>	October 1, 2008
<b>Expended to Date:</b>	\$11,153.30	<b>Completion Date:</b>	September 30, 2011
<b>Current Work Program:</b>	\$16,900.00	<b>Time Remaining:</b>	12 months
<b>Current Work Program Expenditures:</b>	\$ 9,300.00		

**Research Agencies:** United States Department of Agriculture  
Maintenance Division, Mississippi Department of Transportation

### Objective:

Management of invasive weed species is an ongoing challenge for land managers. Kudzu is among the 10 most common, aggressive and poorly controlled weeds in Mississippi and presently infests over 500,000 acres of private forestland within the state, resulting in annual loss of \$54 million dollars in timber sales. While various control options have been documented over the years, there are new, effective, affordable approaches that need to be integrated into a rapid and efficient land management strategy. This study will evaluate an intense, rapid, integrated kudzu eradication program at four locations in Mississippi. Use of herbicides with high selectivity and a biological control agent will allow for simultaneous re-establishment of desirable vegetation, thus providing more long-lasting kudzu exclusion.

### Progress:

Field plots established previously are being maintained by mowing individual plot borders every 1-2 weeks.

New treatments were made Near Eden, Mound Bayou and Byhalia. Each site includes, in triplicate, untreated controls, 2 'standard' herbicides, 1 new herbicide and 1 experimental herbicide. Also, there are 3 integrated programs under evaluation for rapid kudzu eradication.

The test initiated in 2009 in the Holly Springs National Forest has been greatly compromised. The Forest Service applied herbicide over ~20 of the 42 treatments, precluding further observations and determination of effective treatments.

Completed observations at the Grenada test site (HWY 7).

**Plans for Next Quarter:**

Limited activity during this quarter. Plots will be maintained biweekly until a frost occurs.

**EEO and Title VI Information:**

Employment Data for the United States Department of Agriculture Research Staff

<u>Total</u> <u>Staff</u>	<u>Male</u>					<u>Female</u>				
	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>
3	1					1	1			

## State Study No. 216-- Shrinkage And Durability Study Of Bridge Deck Concrete

**Principal Investigator:** Robert Varner, P.E.

**MDOT Project Monitor:** Adam Browne, P.E.

<b>Funds Allocated:</b>	\$72,000.00	<b>Date Started:</b>	October 1, 2008
<b>Expended to Date:</b>	\$75,114.09	<b>Completion Date:</b>	September 30, 2010
<b>Current Work Program:</b>	\$ 7,098.00	<b>Time Remaining:</b>	0 months
<b>Current Work Program Expenditures:</b> \$ 10,211.87			

**Research Agencies:** Burns, Cooley & Dennis, Inc.  
Materials Division, Mississippi Department of Transportation

### Objective:

Contractor's water cementitious ratio for concrete bridge decks is contributing to excessive shrinkage and cracking. Burns Cooley Dennis, Inc. will indentify two common sources of aggregates and common concrete materials used in bridge decks and will produce 15 laboratory mixtures for each aggregate source. Data will be collected that will be used to evaluate shrinkage and permeability characteristics for common MDOT bridge deck mixtures, mixtures using the University of Kansas mix method, and mixtures with increased water cement ratios having various combinations of supplemental cementitious materials and aggregate. (Note that The University of Kansas study is a pooled fund study of which MDOT is a participant, but does not consider the influence of local Mississippi materials.) This study will provide MDOT engineers with data to write specifications that will reduce shrinkage cracking while maintaining durability for concrete in bridge decks.

### Progress:

Burns Cooley Dennis conducted shrinkage testing as required.

### Plans for Next Quarter:

Burns Cooley Dennis will finish permeability and shrinkage testing in November. We plan to have a draft copy of the report to Adam Browne the week of November 8. Adam will have it back to BCD for revisions and final shrinkage data before November 30. MDOT will have the final report on December 31, 2010.

**EEO and Title VI Information:**

Employment Data for Burns, Cooley & Dennis, Inc. Research Staff

Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>
3	3									

## State Study No. 217--Strain Resistant, Extended Performance Pavements, An Alternate To Subdrainage

**Principal Investigator:** Tom White  
**MDOT Project Monitor:** James Williams, P.E.

<b>Funds Allocated:</b>	\$225,000.00	<b>Date Started:</b>	October 1, 2008
<b>Expended to Date:</b>	\$ 14,768.23	<b>Completion Date:</b>	March 30, 2012
<b>Current Work Program:</b>	\$ 78,000.00	<b>Time Remaining:</b>	18 months
<b>Current Work Program Expenditures:</b>	\$ 14,768.23		

**Research Agencies:** Mississippi State University  
Materials Division, Mississippi Department of Transportation

### Objective:

Deterioration or failure of pavement layers below the surface means pavement maintenance or rehabilitation costs will increase significantly. Moisture is one medium contributing to pavement deterioration. The effect can be countered by use of subdrainage systems. However, they increase pavement costs and are exhibiting their own maintenance needs. An alternate pavement type is the perpetual or strain resistant, extended performance pavement. This type of pavement uses a high binder, moisture and strain resistant HMA at the bottom of the pavement structure. Overlying layers are rut and fatigue resistant HMA mixtures.

This study proposes construction of a strain resistant, extended performance pavement test section. Tests, including distress, FWD, smoothness and skid resistance, will be conducted on this test section on a periodic basis. Groups of in service pavements, both with and without subdrainage layers, will also be identified and evaluated for condition, structural capacity, smoothness and skid resistance. Performance of the strain resistant, extended performance pavement will be arrayed against that of the conventional pavements with and without subdrainage systems.

### Progress:

A student has been identified and will start work at the end of classes. This quarter, work has continued on learning how to use software for modeling pavement systems to be addressed in the study. This will result in the three dimensional and two dimensional analyses. In addition, as this work has progressed a better understanding has evolved on the need for in situ and laboratory material properties.

**Plans for Next Quarter:**

With a student working on the project, laboratory tests will be set up to test for permeability and moisture retention potential of paving materials and subgrade. In addition, tests will be identified and planned for mechanical properties of materials used in pavements in Mississippi.

**EEO and Title VI Information:**

Employment Data for Mississippi State University Research Staff

Total Staff	Male					Female				
	White	Black	Hispanic	Asian	Native Am	White	Black	Hispanic	Asian	Native Am
1	1									

## State Study No. 218--In-House Support To State Study No. 217

**Principal Investigator:** Jordan Whittington, E.I.T.

<b>Funds Allocated:</b>	\$40,000.00	<b>Date Started:</b>	October 1, 2008
<b>Expended to Date:</b>	\$0	<b>Completion Date:</b>	March 30, 2012
<b>Current Work Program:</b>	\$17,380.00	<b>Time Remaining:</b>	18 months
<b>Current Work Program Expenditures:</b>	\$0		

**Research Agency:** Research Division, Mississippi Department of Transportation

### **Objective:**

This study will provide requisite distress, FWD, smoothness and skid resistance data of the strain resistant, extended performance pavement test section constructed for evaluation in SS No. 217. Collection of similar data will be conducted on in service pavements identified in the referenced study. This support study will also provide assistance for any forensic studies conducted on the test section.

### **Progress:**

No work was performed by Research Division in support of SS 217 during this last quarter.

### **Plans for Next Quarter:**

We will keep in contact with the P.I. for SS 217 and provide any testing necessary.

## **State Study No. 219--Development Of A Method For Estimating Lateral Earth Pressures For Retaining Structures Sited In Expansive Clay Deposits**

**Principal Investigator:** Chris L. Saucier  
**MDOT Project Monitor:** William Barstis, P.E.

<b>Funds Allocated:</b>	\$290,000.00	<b>Date Started:</b>	October 1, 2008
<b>Expended to Date:</b>	\$ 0	<b>Completion Date:</b>	March 30, 2012
<b>Current Work Program:</b>	\$ 0	<b>Time Remaining:</b>	18 months
<b>Current Work Program Expenditures:</b> \$0			

**Research Agencies:** Mississippi State University  
Materials Division, Mississippi Department of Transportation

### **Objective:**

A high degree of uncertainty exists for the prediction of lateral earth pressures applied to earth retention structures sited in the swelling clay deposits which exist throughout Mississippi. Current procedures for estimating these pressures are known to include some conservatism, by necessity. In consideration of the high degree of uncertainty in earth pressure estimates and the high costs of design inefficiencies, this research seeks to reduce these inefficiencies via the development of a rational procedure for evaluating stress states which may exist throughout the life of the retaining structure. This will be achieved through the introduction of soil suction measurements to conventional geotechnical analyses. The results of this research program would be subjected to prediction and validation in a field monitoring program involving a constructed retaining wall in an expansive clay deposit.

### **Progress:**

A contract was never developed for this study. Study has been cancelled due to PI leaving MSU. This will be the final quarterly progress report.

### **Plans for Next Quarter:**

No work planned.

**EEO and Title VI Information:**

Employment Data for Mississippi State University Research Staff

Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>
0										

## State Study No. 220--Framework Of Calculating The Measures Of Resilience (MOR) For Intermodal Transportation Systems

**Principal Investigator:** Li Zhang  
**MDOT Project Monitor:** Juan Flores

**Funds Allocated:** \$ 25,862.00      **Date Started:** October 1, 2008  
**Expended to Date:** \$ 8,349.16      **Completion Date:** December 31, 2010 (ext)  
**Current Work Program:** \$ 16,318.00      **Time Remaining:** 3 months  
**Current Work Program Expenditures:** \$ 8,349.16

**Research Agencies:** Department of Civil Engineering, Mississippi State University  
Freight/Rails/Ports and Waterways Division, Mississippi  
Department of Transportation

### Objective:

The main objective of this research is to develop a framework of calculating the Measures of Resilience (MORs) for intermodal transportation systems. This is to be accomplished by defining the MORs of intermodal transportation systems, propose a framework to calculate the proposed MORs, case study of MORs in the recovery of Mississippi Gulf Coast after Hurricane Katrina, and demonstrating the enhancement strategies of the MORs.

### Progress:

Revised draft of final report. Submitted final report to MDOT. All project deliverables have been received by MDOT. This will be the final quarterly progress report.

### Plans for Next Quarter:

None. Study is completed.

### EEO and Title VI Information:

#### Employment Data for Mississippi State University Research Staff

Total Staff	Male					Female				
	White	Black	Hispanic	Asian	Native Am	White	Black	Hispanic	Asian	NativeAm
2				1		1				

## State Study No. 221--Evaluation of MDOT's Distress Thresholds for Maintained Pavement Projects

**Principal Investigator:** Feng Wang, P.E.  
**MDOT Project Monitor:** Cindy Smith, P.E.

<b>Funds Allocated:</b>	\$120,422.00	<b>Date Started:</b>	March 29, 2010
<b>Expended to Date:</b>	\$ 0	<b>Completion Date:</b>	December 31, 2011
<b>Current Work Program:</b>	\$ 60,211.00	<b>Time Remaining:</b>	15 months
<b>Current Work Program Expenditures:</b>	\$ 0		

**Research Agency:** Jackson State University

### Objective:

Establishing warranty criteria and associated distress thresholds to monitor the performance of warranted pavement (maintained projects) is a very important issue that must be resolved. Currently MDOT uses converted deduct points for pavement distresses, and the distress thresholds are accumulated deduct points, while many other states use distress indicators or density of distresses. This research will evaluate the effectiveness of using the current MDOT thresholds and investigate new ways of quantifying distress thresholds to monitor the performance of maintained projects in Mississippi. Based on the investigation, the research will make suggestions for MDOT to adopt possible new features of warranty specifications on distress thresholds.

### Progress:

In the past months, the research team has achieved the following major progresses: (1) Dr. Amin El Gendy, a visiting scholar has joined the research team in August. (2) Had a visit to Fugro Company in Austin, TX, MDOT's consultant for pavement surface evaluation, to gather information on data collection equipment, procedure, and specifications adopted by MDOT. (3) Finished reviewing the pavement warranty program in Mississippi and submitted to the Project Director a summary report on the warranty practice in MS. (4) Developed a survey questionnaire regarding pavement evaluation methods, pavement warranty indicators and thresholds, and warranty enforcement of a pavement warranty program. (5) Acquired the LTPP pavement distress and profile data and retrieved the AC and JRC pavement data for MS and conducted preliminary analysis for distress evolution curves over time.

**Plans for Next Quarter:**

1. Continue to review literature to collect more information on pavement warranty specifications, distress indicators and thresholds, PMS data and data collection technologies, and pavement condition evaluation methods in other states; develop a summary report on the warranty practices in other states.
2. Finalize the survey questionnaire based on comments from MDOT researchers and engineers; distribute the survey questionnaire; and analyze survey results.
3. Acquire the PMS data from MDOT, conduct initial check on the adequacy and usability of the PMS data.
4. Develop histogram analysis for each of the warranted items using available PMS data and determine the corresponding percentile value for each distress threshold to evaluate the appropriateness of the current distress threshold levels.
5. In case of inadequacy of available data, the research team will discuss with the Project Director and RAC for possible options of data acquisition.

**EEO and Title VI Information:**

Employment Data for Jackson State University Research Staff

Total Staff	Male					Female				
	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>
3		1		1					1	

## State Study No. 222-- Best Practices Of MDOT's Survey Operation, Organization & Technology Implementation

**Principal Investigators:** Tulio Sulbaran and Andrew Strelzoff

**MDOT Project Monitor:** Cindy Smith, P.E.

**Funds Allocated:** \$131,217.00    **Start Date:** April 30, 2010  
**Expended to Date:** \$ 384.78    **Completion Date:** December 31, 2011  
**Current Work Program:** \$ 91,197.00    **Time Remaining:** 18 months  
**Current Work Program Expenditures:** \$ 384.78

**Research Agency:** University of Southern Mississippi

### Objective:

The objective of this project is to increase the cost efficiency, timeliness, and safety of MDOT's surveying activities through the identification of MDOT's best practices grounded on: (1) best operational approach to use a range of surveying technologies, (2) most effective organizational model/process to best utilize the newest surveying technologies, and (3) best roll-out strategy which will help MDOT districts move to the most efficient surveying technology.

The result of this project will form a body of knowledge which will be used by policymakers to increase the use of cost- and time-effective technologies for surveying throughout MDOT.

### Progress:

During this period USM team successfully completed the following four major activities:

1. Prepared, hosted and led a two day Technical Advisory Committee (TAC) meeting July 6<sup>th</sup> and 7<sup>th</sup> 2010 at USM (Hattiesburg) during which questions to be asked of various groups of MDOT personnel were finalized and organized into five questionnaires as follows:
  - a. MDOT Field Survey Staff,
  - b. MDOT CADD Operators,
  - c. MDOT Survey Office local Administrators,
  - d. MDOT Survey Upper Level Administrators, and
  - e. MDOT Survey Customers.
2. Edited the five web-based questionnaires following the input from the TAC for final overview by the TAC.

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3. Developed a unified website hosted at USM which will be used to make the final research questionnaires easily available for MDOT personnel.

**Plan for Next Quarter:**

During the next period the team will:

1. Send final questionnaires versions to the TAC to obtain final feedback.
2. Prepare cover letter that will be sent by USM to questionnaire recipients
3. Hold Teleconference with MDOT project leader to discuss the logistics of deploying the research instrument.

**EEO and Title VI Information:**

Employment Data for University of Southern Mississippi Research Staff

Total Staff	Male					Female				
	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>
4	1		1	1		1				

## State Study No. 223--I55 Integrated Diversion Traffic Management Benefit Study

**Principal Investigator:** Li Zhang  
**MDOT Project Monitor:** James Watkins, P.E.

**Funds Allocated:** \$152,810.00      **Date Started:** March 29, 2010  
**Expended to Date:** \$ 6,302.14      **Completion Date:** December 31, 2011  
**Current Work Program:** \$ 74,699.00      **Time Remaining:** 15 months  
**Current Work Program Expenditures:** \$ 6,302.14

**Research Agency:** Mississippi State University

### Objective:

Integrating diversion traffic from a congested freeway with signal timing on parallel arterials could take advantage of the capacities of freeway and arterials, and therefore forms an Integrated Corridor Management strategy. The objective of this project is to evaluate the benefits of freeway congestion relief by utilizing corridor-wide capacity in the I-55 corridor. Possible strategies of a state-of-the-practice approach and a state-of-the-art approach will be proposed, then evaluated in a calibrated simulation environment. The state-of-the-practice approach would provide MDOT policymakers the information about the benefits that might be achieved under existing infrastructure, while the state-of-the-art approach would provide MDOT policymakers the information about the best possible benefits that can be achieved under the ICM approach.

### Progress:

- Two Meetings with MDOT traffic and planning divisions to discuss data collection efforts. Outreach to Jackson MPO, City of Jackson and City of Ridgeland.
- Worked with Siemens and Temp Inc. to install an ACTRA system so that lab test and development environment will be developed.
- A week traffic counts were conducted in detour routes in Jackson, MS

### Plan for Next Quarter:

- Data processing for traffic counts in Jackson
- Literature Review
- Establish Models

### EEO and Title VI Information:

Employment Data for Mississippi State University Research Staff

Total Staff	Male					Female				
	White	Black	Hispanic	Asian	Native Am	White	Black	Hispanic	Asian	NativeAm
4				3		1				

## State Study No. 225--Turbidity Monitoring at Select Construction Sites

**Principal Investigator:** Bobby Mosely, P.E.  
**MDOT Project Monitor:** James Watkins, P.E.

<b>Funds Allocated:</b>	\$99,999.99	<b>Date Started:</b>	March 10, 2010
<b>Expended to date:</b>	\$18,703.78	<b>Completion Date:</b>	June 30, 2012
<b>Current Work Program:</b>	\$98,000.00	<b>Time Remaining:</b>	21 months
<b>Current Work Program Expenditures:</b> \$ 18,703.78			

**Research Agency:** Thompson Engineering, Inc.

### Objective:

MDOT has no real-world data on effects of construction on turbidity levels in run-off from construction projects, and the EPA may soon be promulgating a Final Rule establishing numeric turbidity limits. The goal of this research project is to establish baseline turbidity conditions at select construction sites by establishing a water quality monitoring program and documenting existing and MDOT-approved BMPs. The water quality monitoring program will be primarily focused on gathering turbidity data, but because turbidity is related to other factors, may include parameters such as total suspended solids, pH, and temperature. Data, following initial site selection and site visits with MDOT, will be collected using MDEQ and EPA protocols as guidance. Because of the complex factors which affect turbidity, this may be the first phase of a multiphase project.

### Progress:

This project was awarded in March 2010. Work performed from July through August 2010 includes review of sampling equipment and instrumentation (including meetings with vendors and discussions with MDEQ); and progress on site selection, including review of Erosion Control Plans and Best Management Practices at potential sampling locations. During September, we developed a sampling and analysis plan, and met with Mr. Brad Lewis, P.E. (MDOT State Construction Engineer) to discuss our sampling approach. A contract extension has been issued for this project through December 2011.

### Plan for Next Quarter:

During the next quarter, site sampling will be initiated.

**EEO and Title VI Information:**

Employment Data for Thompson Engineering Research Staff

<u>Total</u> <u>Staff</u>	<u>Male</u>					<u>Female</u>				
	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>
7	5					2				

## State Study No. 226--Environmental Management Plan Development for MDOT Laboratories

**Principal Investigator:** Bobby Mosely, P.E.  
**MDOT Project Monitor:** James Watkins, P.E.

**Funds Allocated:** \$ 99,999.00      **Date Started:** March 10, 2010  
**Expended to Date:** \$ 0      **Completion Date:** June 30, 2012  
**Current Work Program:** \$ 80,000      **Time Remaining:** 24 months  
**Current Work Program Expenditures:** \$ 0  
**Research Agency:** Thompson Engineering, Inc.

Maintaining compliance with environmental regulations, environmental permits and handling and disposal of waste materials is growing increasingly complicated. The establishment of a fully functioning Environmental Management Plan will serve as the framework for setting, reviewing and maintaining environmental objectives and targets throughout MDOT Laboratories. An Environmental Management Plan will ultimately maintain environmental policy and develop the procedures to achieve the goals and targets of various Plans within MDOT Laboratories.

The development of the Environmental Management Plan will be achieved through audits, inspections, and document development. The Environmental Management Plan will be maintained by routine inspections, review of procedures and documents, and implementation of corrective or preventative actions.

### Progress

This project was awarded in March 2010. Work performed from July through September included project planning and discussions with the State Materials Engineer. On August 17, 2010, a kick-off meeting was held with the District Materials Engineers to discuss the approach to the audits and to discuss specific issues and concerns.

### Plan for Next Quarter

The laboratory audit of the Central Laboratory is scheduled for December 17, 2010. Following the audit of the Central Laboratory, an audit checklist will be developed for use in audits of the District Laboratories. In addition, the framework for the Environmental Management Program Share Point Site will be developed.

### EEO and Title VI Information:

#### Employment Data for Thompson Engineering Research Staff

Total	Male					Female				
Staff	White	Black	Hispanic	Asian	Native Am	White	Black	Hispanic	Asian	NativeAm
8	5					3				

## State Study No. 227--Variability of Cement Treated Layers in MDOT Road Projects

**Principal Investigator:** Robert Varner, P.E.  
**MDOT Project Monitor:** William Barstis, P.E.

<b>Funds Allocated:</b>	\$ 80,000.00	<b>Date Started:</b>	May 13, 2010
<b>Expended to Date:</b>	\$ 430.55	<b>Completion Date:</b>	May 31, 2011
<b>Current Work Program:</b>	\$ 80,000.00	<b>Time Remaining:</b>	9 months
<b>Current Work Program Expenditures:</b>	\$ 430.55		

**Research Agency:** Burns, Cooley & Dennis, Inc.

### Objective:

MDOT does not currently require QC/QA testing for subgrade and subbase stabilization. MDOT specifications have recently been revised to reduce the cement content in cement treated layers. However, little or no field investigations have been performed to determine the impact of this change on the in-place layer. Burns Cooley Dennis, Inc. will work with MDOT to identify two projects that have utilized cement treated subbase layers and will perform tests to determine variability. Cores of cement treated subbase will be extracted and evaluated for cement content (ASTM D 806), thickness, and compressive strength (ASTM D1633).

### Progress

Hwy 84 in Jefferson Davis County and Hwy 25 in Winston County were the two projects selected for this research project. All cores have been cut from these two projects and all laboratory testing has been completed with the exception of cement content determination. Laboratory mixtures of soil cement have been prepared and tested to determine compressive strength correction factors for length to diameter ratios less than 1.05. A second set soil cement mixtures has been prepared to verify first set of correction factor data.

### Plan for Next Quarter

Burns Cooley Dennis (BCD) will continue laboratory testing to determine cement content of the soil cement cores. BCD will generate a second set of correction factor data and provided adjusted compressive strengths. BCD will provide the TAC Committee with data updates.

**EEO and Title VI Information:**

Employment Data for Burns, Cooley & Dennis, Inc., Research Staff

Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>

4		4								
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## State Study No. 228--Evaluating Alternative Mowing Regimen and the Use of Native Grasses & Wildflowers on Roadside Right-Of-Ways

**Principal Investigators:** John Guyton and Jeanne Jones  
**MDOT Project Monitor:** Cindy Smith, P.E.

<b>Funds Allocated:</b>	\$135,045.00	<b>Date Started:</b>	January 29, 2010
<b>Expended to Date:</b>	\$ 9,326.78	<b>Completion Date:</b>	December 31, 2013
<b>Current Work Program:</b>	\$ 49,359.00	<b>Time Remaining:</b>	39 months
<b>Current Work Program Expenditures:</b>	\$ 9,326.78		

**Research Agency:** Mississippi State University

### Objective:

This three year project will determine if a limited mowing regimen is sufficient to make ROW maintenance more cost effective while increasing the beauty of Mississippi's ROWs. It will also identify additional propagules that may be useful in expediting the transition to natural ROWs and ascertaining motorist patience with the transition and perception of a more natural ROW.

This project will begin to showcase some of the following benefits:

- o Reduce vegetation expenditures by an average of over \$10-\$20 on the acres not mowed,
- o Slow the rate of spread of invasive plants which require bare soil and disturbance for spreading along road ROW,
- o Obscure visibility of roadside litter and trash,
- o Increase roadside beauty due to occurrence of wildflowers, native bunch grasses and native pollinators (butterflies and hummingbirds),
- o Increase food plants for wildlife species of old fields, prairies and meadows and
- o Provide nesting habitat for wild turkey, rabbits and other ground-nesting birds and small mammals while discouraging deer.

### Progress

During July August and September, 2010, we completed the initial floristic inventory in the research plots along Hwy 25. We met with Lynn Crow and reviewed the time table, plans, discussed utility crews work in the right of way research plots that destroyed a lot

of vegetation and an unexpected mowing of the research plots. The construction crew damage will be used to monitor the sequence of plants that return. Pictures of summer wildflowers have been taken for the MDOT wildflower guide. We also published an article in the Mississippi Native Plant Newsletter describing the research and are pleased to report that Dr. Bronson Strickland, a deer specialist, has joined our team. The instruments that will be used to evaluate public perception of the ROWs are under construction.

**Plan for Next Quarter**

During October, November and December, 2010 we will attend the Mississippi Native Plant Society annual conference and give a talk on the research as well as producing another article. Edward Entsminger and I will continue taking pictures on the ROWs for the MDOT website wildflower guide and we will discuss using a link or photographs from the southeasternflora.com website to supplement our photographs. The frequency of deer signs in the research plots has suggested the need for spotlight counts that we will begin as soon as the temperature drops. This was not described in the original proposal but is deemed necessary to document deer use of the plots. We anticipate the installation of “Do Not Mow or Spray” signs.

**EEO and Title VI Information:**

Employment Data for Mississippi State University Research Staff

Total	Male					Female				
<u>Staff</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>
4	3					1				

## State Study No. 229--Instrumentation & Computational Modeling for Evaluation of Bridge Substructures Across Waterways

Principal Investigator: Wei Zheng  
 MDOT Project Monitor: Cindy Smith, P.E.

<b>Funds Allocated:</b>	\$150,000.00	<b>Date Started:</b>	January 29, 2010
<b>Expended to Date:</b>	\$ 0	<b>Completion Date:</b>	September 30, 2012
<b>Current Work Program:</b>	\$ 65,246.00	<b>Time Remaining:</b>	24 months
<b>Current Work Program Expenditures:</b>	\$ 0		

**Research Agency:** Jackson State University

### Objective:

The bridge substructures across waterway in Mississippi are frequently subject to scour due to flood currency and collision from barge or ship. Scour is major cause of bridge failure from floods in Mississippi. This research project seeks to investigate the instrumentation and computational modeling that can monitor scour and pier damage and correlate substructure deteriorations with the remainder of bridge's capacity. It will supplement current underwater inspection of bridge substructures with more reliable measurement-and-analysis-based approaches. It also provides wireless instrumentation platform for future MDOT research to monitor other critical components of transportation systems. It will lay down foundation for professional preparation and multidisciplinary collaboration to implement field instrumentation for bridge substructure system.

### Progress:

Continued performing literature search. Contacted scour sensor vendors.

### Plan for Next Quarter

Complete literature review. Brief MDOT TAC on results of literature search. Facilitate scour sensor vendor presentations with the TAC.

### EEO and Title VI Information:

#### Employment Data for Jackson State University Research Staff

Total	Male					Female				
Staff	White	Black	Hispanic	Asian	Native Am	White	Black	Hispanic	Asian	NativeAm
1				1						

## State Study No. 231--Optimizing Mississippi Aggregates for Concrete Bridge Decks

**Principal Investigator:** Robert Varner, P.E.  
**MDOT Project Monitor:** William Barstis, P.E.

<b>Funds Allocated:</b>	\$ 97,500.00	<b>Date Started:</b>	May 7, 2010
<b>Expended to Date:</b>	\$ 22,632.89	<b>Completion Date:</b>	June 30, 2012
<b>Current Work Program:</b>	\$65,246.00	<b>Time Remaining:</b>	21 months
<b>Current Work Program Expenditures:</b> \$ 22,632.89			

**Research Agencies:** Burns, Cooley & Dennis, Inc. and Materials Division,  
Mississippi Department of Transportation

### Objective:

A class BD concrete has been recently added to MDOT's classes of concrete in an effort to reduce the amount of shrinkage cracks in bridge decks. A primary focus of the BD class concrete is to optimize aggregate gradations to reduce voids in the concrete mixture matrix and reduce cement paste that is required to fill the voids. Limits have been included in the BD class concrete based on combined gradations. These limits will require possible blending of aggregates, crushing, and modifications to ready mix concrete plants. Little or no data has been generated using Mississippi aggregates that confirm that gradation limits included in the BD class concrete specifications provide concrete mixtures that exhibit less shrinkage and cracking.

Burns Cooley Dennis, Inc., will work with the department to identify one sand and gravel source of local aggregates for this research project. The aggregates will be processed and stockpiles will be create for the 1", ¾", 1/2", 3/8", No. 4, No. 8, No. 16, No. 30, No. 50, and No. 100 sizes. These stockpiles will then be used to meet combined gradation requirements listed in the BD class concrete specification. Concrete mixtures will be developed to follow the contour of the middle and upper and lower limits of the combined aggregate gradation. An additional forty-two concrete mixtures will be developed to evaluate extending the limits of the BD gradation and to determine the impact on shrinkage and strength. Unit weight and voids will also be determined for each combination of aggregates used in the mixtures. Data collected from these forty-five mixtures will be used to develop combined gradation limits for Mississippi aggregates. Each mixture will be tested for slump, temperature, air, unit weight, strength, and shrinkage (ASTM C 157).

**Progress**

The TAC committee met on October 14 and discussed preliminary results of this research. All laboratory work has been completed for the mixtures except for shrinkage measurements. Data has been added to an excel file and provided to the TAC Committee.

**Plans for Next Quarter:**

Burns Cooley Dennis (BCD) will continue measuring shrinkage. BCD will review preliminary results and determine if any mixtures need to be repeated. Data updates will be provided to MDOT TAC Committee.

**EEO and Title VI Information:**

Employment Data for Burns, Cooley & Dennis, Inc., Research Staff

Total Staff	Male					Female				
	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>Native Am</u>	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian</u>	<u>NativeAm</u>
4	4									

## State Study 232--Development of Climate Data Input Files For The Mechanistic-Empirical Pavement Design Guide (MEPDG)

**Principal Investigators:** Dennis Truax, Ph.D., P.E.,MSU  
Michael Heitzman, Ph.D., P.E., Auburn University  
Eugene Takle, Iowa State University  
**MDOT Project Monitor:** William Barstis, P.E.

<b>Funds Allocated:</b>	\$ 65,180.00	<b>Start Date:</b>	January 29, 2010
<b>Expended to Date:</b>	\$ 15,550.45	<b>Completion Date:</b>	December 31, 2010
<b>Current Work Program:</b>	\$65,246.00	<b>Time Remaining:</b>	3 months
<b>Current Work Program Expenditures:</b> \$15,550.45			

**Research Agencies:**

Dennis D. Truax, Ph.D., P.E., BCEE  
Department of Civil and Environmental Engineering  
Mississippi State University

Michael Heitzman, PhD, PE  
National Center for Asphalt Technology  
Auburn University

Eugene S. Takle  
Climate Science Initiative  
Iowa State University

### Objective:

This project was implemented to develop a sufficient and appropriate climate database for use by the Mississippi Department of Transportation (MDOT) during the calibration and application of the MEPDG. This data will be delivered to the National Center for Asphalt Technology (NCAT) to support this development with copies provided the MDOT for archival and application. This quarterly progress report was prepared, and is submitted, in partial fulfillment of the project scope of work and contract requirements. It summarizes the effort and activities of the defined quarter. It presents the activities and anticipated results for the next quarter of effort. It summarizes information about the project staffing for the current report period and provides budget information on fund expended during the report period and anticipated levels of expenditures for the next period.

**Progress:**

This was the third quarter of the project award. A significant amount of the first quarter was spent organizing and initiating efforts. The last of the subcontracts from Mississippi State University (MSU) with Auburn University's National Center for Asphalt Technology (AU-NCAT) and the Climate Science Initiative at Iowa State University (ISU) was in place by the end of March. During the second quarter the research team focused on transferring data and developing the virtual climate files. Issues in the modeling of this were raised and addressed with MDOT. These activities were supported by a series of email exchanges by the team and two AU-NCAT facilitated teleconference meetings.

One team meetings was held during this quarter with representatives from MDOT, MSU, AU-NCAT, and ISU in attendance. Flooding and other issues resulted in closures and work impedance in Iowa which slowed progress on work by ISU and the other team members.

Regarding the progress on the specific work tasks:

Task 1 - Historic Climate Data Files

AU-NCAT worked with ISU and ARA (MEPDG support contractor) to clean-up and properly apply new climate files in MEPDG. ISU established a quality control check of the HCD files to insure the files were correct before sending them on to NCAT. ISU completed the historic files for all the Mississippi counties. NCAT checked the files and delivered the data files to MS DOT.

In mid-August, ARA provided the other two cone files for the HMA pavements in Montgomery and Desoto Counties. The three cone files represent one concrete section, a thin asphalt section and a thick asphalt section. NCAT checked the files and successfully ran them in the MEPDG program. All three pavement cone files are now in place for the sensitivity analysis.

NCAT prepared a sensitivity analysis plan and will discuss it with the research team in the next quarter. One county from each of the ten Mississippi climate zones was randomly selected for the sensitivity analysis using the three pavement sections. For each county, an MEPDG-generated climate file and an ISU-generated historic climate file was used. Three of the ten MEPDG-climate simulations used weather station locations within the particular county. The remaining seven MEPDG-climate simulations generated a climate file by triangulating off the three nearest weather stations for the particular county. The ISU-historic climate simulations used the 40-year historical climate file for

the corresponding county. A total of 60 simulations were conducted (3 pavements x 10 locations x 2 climates). Each simulation was a 40-year analysis beginning in 1970. The output files are currently being analyzed for model sensitivity to climate.

#### Task 2 - Virtual Climate Data Files

NCAT and ISU began developing the frame work for the virtual climate files. ISU and NCAT prepared a white paper describing several options for these files and discussed the options with MDOT. MDOT directed the team to build option-1 virtual files and to exam the effort required to build option-4 files. Virtual climate data files were developed by the ISU team and made available to the AU-NCAT team. The nine files represented the nine points of the compass rose (i.e., north, south, etc.). The files were checked and validated for functionality.

#### Task3 – Reporting

The final version of the white paper on processing options was submitted to MDOT for consideration. NCAT and ISU completed the description of the process used to generate the historic climate files.

### **Plans for Next Quarter:**

Work slowed during the current quarter. Efforts to reestablish project momentum will be the focus of this quarter. However, the delays in starting will compound issues created with the August flooding in Iowa to require that we start the process of requesting an extension. As such, the team feels the project is somewhat behind schedule at this time and will need several additional months to complete work.

During the coming quarter of effort, several things will be achieved and a significantly greater level of effort will be expended. Regarding the progress on the specific work tasks:

#### Task 1 - Historic Climate Data Files

ISU should be effectively finished with generation of virtual climate data file generation by the end of the next quarter. Subsequently, NCAT will review the historic and virtual climate files with MDOT, MSU and ARA. NCAT will run the sensitivity analysis for the historic files.

#### Task 2 - Virtual Climate Data Files

In the next quarter, NCAT will work with ISU to complete building and verifying the virtual climate files. NCAT and ISU will document the process for generating

virtual climate files. NCAT will run the sensitivity analysis for the virtual files. NCAT and ISU will exam the effort and time required to build option-4 virtual files. A time and cost extension for this additional work would be required. MSU, NCAT and ISU will prepare a request for project addendum if requested. Finally, during this next project period the Virtual climate files will be run using the same pavement sections and counties described above under Task 1.

Task3 – Reporting

Teleconferences will continue to be scheduled at about one per month and minutes of the teleconferences will continue to be distributed. Not other reporting is anticipated during the next quarter. In the next quarter, NCAT will work with ISU to document the process for building the virtual climate files.

**EEO information**

The following table reflects the team staffing involvement during the report period. As activities during this period were focused on organization and initiation of effort, these efforts represent a preliminary staffing commitment. The numbers are individuals involved during this period rather than a level of commitment during the period.

Project EEO and Title VI Information Employment Data										
Second Quarter 2010										
Female					Male					Staff
Asian	Black	Hispanic	Native American	White	Asian	Black	Hispanic	Native American	White	
Mississippi State University Research Staff										
0	0	0	0	0	0	0	0	0	1	1
Auburn University Research Staff										
0	0	0	0	0	0	0	0	0	2	2
Iowa State University Research Staff										
0	0	0	0	0	0	0	0	0	2	2
Project Research Staff										
0	0	0	0	0	0	0	0	0	5	5

