~~AASHTO 2002 Design Guide~~ MEPDG Implementation

2011 Southeastern Asphalt User Producer Group
Savannah, GA
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Implementation Framework

Two – Phase Implementation Approach

- Phase I - SS No. 163 "Develop Mississippi DOT's Plan to Implement the 2002 Design Guide"
- SS No. 170 "Implement the 2002 Design Guide for MDOT (Phase II)"

Outline

- National Involvement
- Implementation Framework
  - Subgrade & Unbound Aggregates
  - HMA
  - Drainage Layer
  - Climate
  - Truck Traffic Loading
- Organizational Shift
- "Been there, done that!"

Implementation Framework

Applied Research Associates (ARA)

- Logical choice due to NCHRP 1-37A and NCHRP 1-40
- Facilitate establishment of materials libraries
- Coordinate with PIs of materials support studies
  - Ensure tests provide requisite inputs
  - Most up to date test protocols are used
  - Review test results
  - Substitute MDOT PMS for LTPP PMS

National Involvement

FHWA Lead States Group (DGIT)

NCHRP 1-40D "interested observer"

DARWin-ME task force

AASHTO Joint Technical Committee on Pavements

"People to Pester"

Judith Corley-Lay
Lynn Irwin
Linda Pierce
Chris Wagner

Subgrade & Base Characterization (SS No. 170)

- Subcontractor - Burns, Cooley & Dennis Inc. (BCD)
- Performing M_r testing of typical MS subgrade soils
- Unbound aggregates
- Testing cementitious stabilized soils
  - Lime
  - LFA
  - Cement

Subgrade & Base Characterization (SS No. 170)

- BCD coordinated with ARA to ensure proper test protocols were followed
- BCD coordinated with MDOT District Materials Engineers and Central Lab to identify typical subgrade soils and unbound aggregates in Mississippi
- Selected materials for laboratory testing that represent the range encountered in Mississippi

Resilient Modulus Testing for Subgrade and Unbound Aggregate

- Harmonized test procedure resulting from NCHRP 1-28A
- Interlaken Soil and Asphalt Testing Machine

Selected Subgrades

USCS	No. Spec.	AASHTO	No. Spec.	Range GI
CH	1	A-2-4	5	
CL	7	A-2-6	3	0 - 1
ML	3	A-3	2	
ML-CL	1	A-4	9	0 - 9
SC	10	A-6	9	2 - 10
SC-SM	1	A-7-6	2	28 - 34
SM	1			
SMd	2			
SP	2			
SP-SC	1			
SP-SM	1			

SS No. 166 "Hot Mix Asphalt (HMA) Characterization for the 2002 AASHTO Design Guide"

- Mississippi State University (MSU) study
  - Dr. Shane Buchanan
  - Dr. Tom White
- Characterize typical MDOT HMA mixes for Dynamic Modulus
- Test results included in Materials Library

Selected Unbound Aggregates

Crushed Stone Granular Base			Clay Gravel Base Class							
3/4" and down	No. 610	No. 825 B								
Group	1	2	3	4	5	6	7	8	9	10
A	X									
B				X						
C			X		X		X			
D										X
E									X	

Asphalt Test Matrix

- Aggregate Type – Gravel & Limestone/Gravel
- Binder PG – 67-22, 76-22, 82-22
- NMAS Gradation – 9.5mm, 12.5mm & 19.0mm
- N_{design} - 50 (ST), 65 (MT), 85 (HT)
- Voids @ N_{design} – 4% & 3%*

25 Combinations w/3 replicates of each

Dynamic Modulus Specimen Preparation

Results!

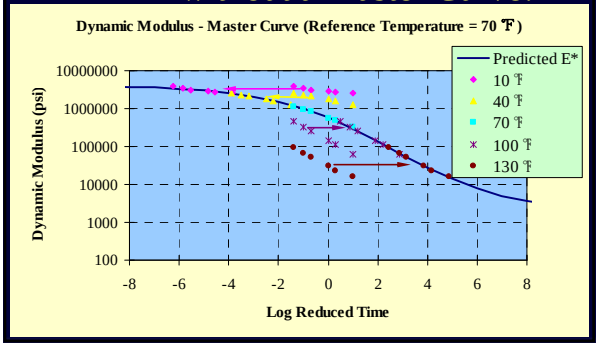
Mix	Coefficients				Shift Factors				
	δ	α	β	γ	-10°C	4°C	21°C	37°C	54°C
1	3.2064	3.1641	-1.0790	0.5229	4.7215	2.2228	0.0000	-1.6411	-3.2433
2	3.4203	3.0148	-1.1554	0.5659	4.5998	2.2532	0.0000	-1.6217	-3.2070
3	3.8108	2.5865	-0.8166	0.5950	4.4009	2.0596	0.0000	-1.6552	-2.9341
4	3.7831	2.6176	-1.1739	0.5588	5.1276	2.0294	0.0000	-1.7690	-3.0459
5	3.1748	3.2177	-1.4625	0.5457	5.4290	2.0296	0.0000	-2.3027	-3.7863
6	3.3403	3.0456	-1.4103	0.5733	5.4504	1.9846	0.0000	-2.2565	-3.6225
7	3.9670	2.3493	-0.7667	0.6473	4.0693	2.2224	0.0000	-1.2958	-2.6153
8	3.9021	2.4262	-0.7133	0.6287	4.1866	2.1743	0.0000	-1.3455	-2.4989
9	3.4578	2.8671	-0.9708	0.6108	4.2245	2.1440	0.0000	-1.1636	-2.8369
10	3.3989	2.9266	-0.9988	0.6035	4.2504	2.1543	0.0000	-1.3557	-2.8817
11	3.4769	2.8466	-0.9636	0.6174	4.2078	2.1323	0.0000	-1.1839	-2.6857
12	3.7515	2.6699	-0.8859	0.5494	4.6854	1.8690	0.0000	-1.2823	-2.6040
13	3.8861	2.5259	-0.9606	0.6583	4.5444	2.1347	0.0000	-1.5539	-2.9432
14	3.9811	2.4390	-0.9423	0.6759	4.3838	2.0895	0.0000	-1.4922	-2.9390
15	3.9821	2.5136	-0.7239	0.5659	4.5858	2.2007	0.0000	-1.4388	-2.7401
16	3.9823	2.3224	-0.9016	0.6504	3.6740	1.9551	0.0000	-1.7082	-2.9477
17	3.9796	2.5228	-1.0170	0.6421	4.6568	2.1130	0.0000	-1.5561	-3.0730
18	3.9904	2.5210	-0.8502	0.6040	5.2092	2.3326	0.0000	-1.6478	-3.0384
19	4.1267	2.2556	-0.8004	0.6494	4.3684	1.9557	0.0000	-1.2949	-2.7197
20	4.0392	2.4633	-0.8347	0.6260	5.3152	2.3092	0.0000	-2.1596	-3.3747
21	3.9349	2.5797	-0.8776	0.5941	5.1852	2.3405	0.0000	-1.0927	-2.6627
22	3.8774	2.6395	-0.9064	0.5830	5.2087	2.3575	0.0000	-1.0736	-2.5952
23	3.6548	2.8599	-1.1335	0.5364	5.8499	2.1906	0.0000	-1.3778	-2.9443
24	4.0129	2.4887	-0.7730	0.5578	5.4879	2.2106	0.0000	-1.6209	-2.8250
25*	2.4967	3.9736	-1.3659	0.4443	4.6798	2.3757	0.0000	-1.7377	-2.9990

Dynamic Modulus Specimen Preparation

SS No 181 "Structural Characterization of Asphalt Drainage Course Layers"

- Dr. Allen Cooley with Burns Cooley & Dennis, Inc.
- MDOT Drainage layer:
  - #57 crushed limestone, sandstone, or granite
  - Crushed gravel and/or blended mixtures of crushed gravel, limestone, sandstone, granite or reclaimed concrete pavement
  - 2.5% PG 67-22

Not an MEPDG presentation without a Master Curve!



How do you test these materials?

- Aggregate base?
  - Resilient Modulus Test
  - Haversine loading
- Asphalt Mix?
  - Dynamic Modulus Test
  - Sinusoidal loading
- Resilient modulus test selected due to assumption that the drainage layer is located deep enough within the pavement that the traffic loading imparts a haversine load form to the drainage layer

Test Sample Size/Preparation

- 170 mm height by 150 mm diameter
  - couldn't core test specimen from pill
- Compressive load used to compact specimen
  - Interlaken Servo-Hydraulic Load Frame
  - gyratory compacted specimens can not be trimmed
- 30% voids based on field tests of in-situ drainage layers

Traffic

- Develop MS-Atlas for Load Axle Spectra (SS 165 MSU & SS 188 ARA)
- Upgrade existing MS-Atlas program to produce traffic data in .XML file format for import into DARWin-ME
- Enhance MS-ATLAS program to allow MDOT Planning Division to consider special loading conditions.
- Use DARWin-ME to evaluate impact of overloaded trucks on pavement performance

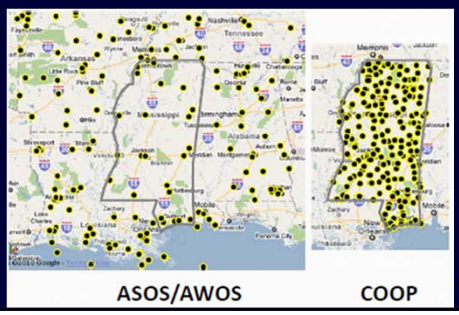
Developing MEPDG Climate Data Input Files for Mississippi

- Existing MEPDG climate files –
  - 12 weather stations
  - 10 counties
  - Only 7 stations with over 8 years of data
- New 40-year historic climate files for all 82 counties -
  - Used hourly data from 23 Automated Surface Observation System and Automated Weather Observation System sources
  - Daily data from over 100 Cooperative Observer Program sources
- Represents over 30 times more climate input data for MEPDG analyses in the state

"Living" Libraries

- OGFC
- SMA
- 4.75mm NMAS mixes
- Low Volume Thin Lifts
- WMA
- Preservation Treatments
- Whatever else is on the horizon!

Final Result



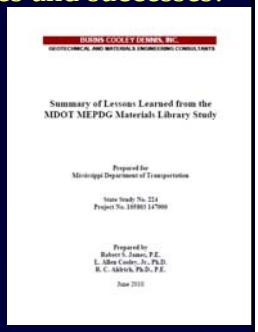
MDOT Organizational Shift

AASHTO 72 Guide	MEPDG
Roadway Design houses Pavement Design and Research houses FWD Operations and Pavement Management	Pavement Branch in Research to house Pavement Design, FWD Operations & Pavement Management for full "cradle to grave"

MDOT

Learn from our mistakes and successes!

- How “reliable” can your agency be?
- Sensitivity? What really matters?
- Would an organizational shift help?
- What are your financial resources?
- Stay involved and tuned for more lessons learned!


BURNS COOLEY DENNIS, INC.

Summary of Lessons Learned from the MDOT MEPDG Materials Library Study

Prepared for
Mississippi Department of Transportation

State Study No. 224
Project No. 105003 147000

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