The Superpave System – Filling the gaps.

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Federal Highway Administration

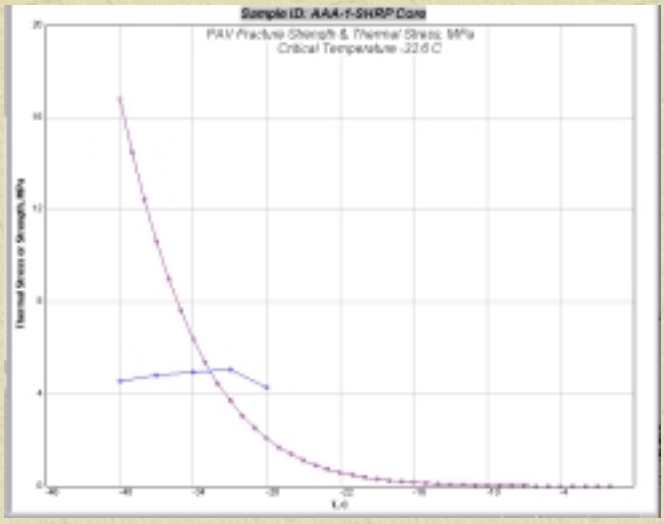
FHWA Binder lab

- Continuous support to the States:
  - Training / Ruggedness / Development / Validation
- Trouble shooting of binder problems.

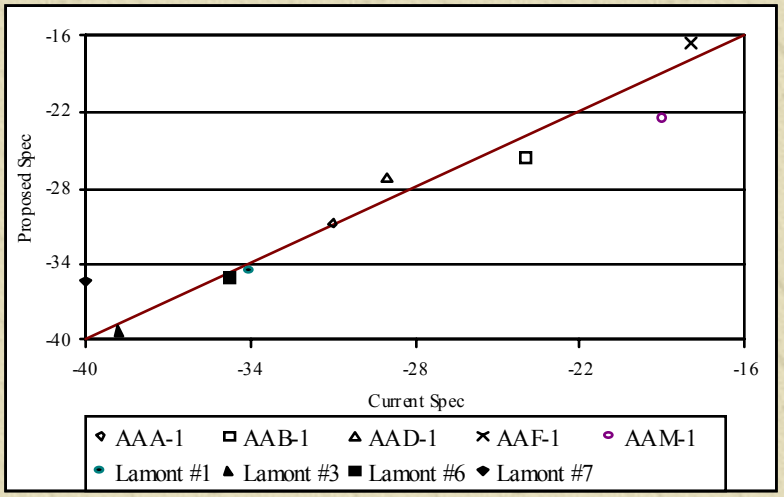
New Low Temp. Specification

- Combines the results of the BBR and DT.

Thermal stress compared to strength.



Specification Comparison



Proposed MP1a Spec.

Binder	T_{cr} Current Spec	T_{cr} Proposed Spec
70-22 Air Blown	-24.5	-22.5
70-22 Conventional	-25.1	-22.5
70-22 SBS Modified	-26.0	-30.5
Chemically Modified 64-28 A	-29.0	-28.0
Chemically Modified 64-28 B	-27.5	-27.0
Chemically Modified 64-28 K1	-29.5	-27.5
Chemically Modified 58-28 M1	-27.3	-27.0
Elvaloy Modified 64-34 DP	-34.7	-36.0

Binder High Temp Properties

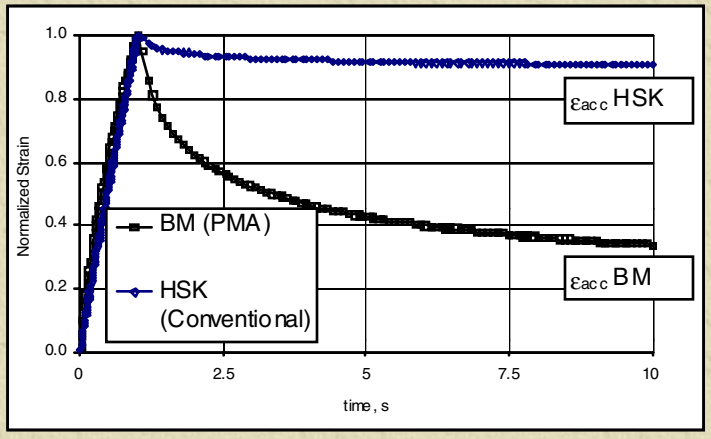
- Study same mix different binders.

PG 64-22 mod. no rutting

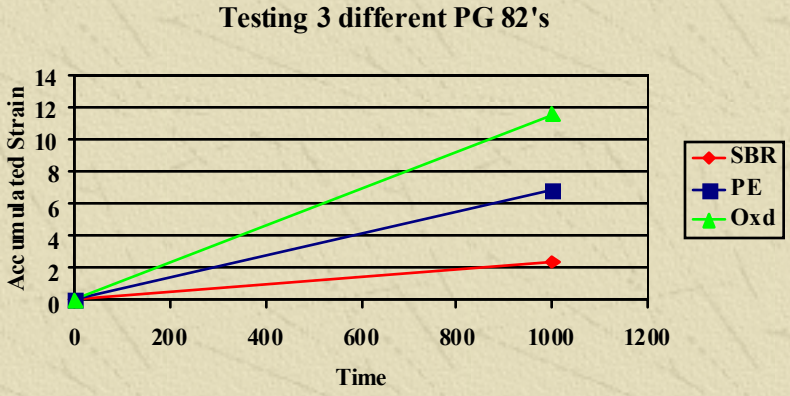
PG 64-22 unmod. 15mm rutting

Binder High Temp Properties

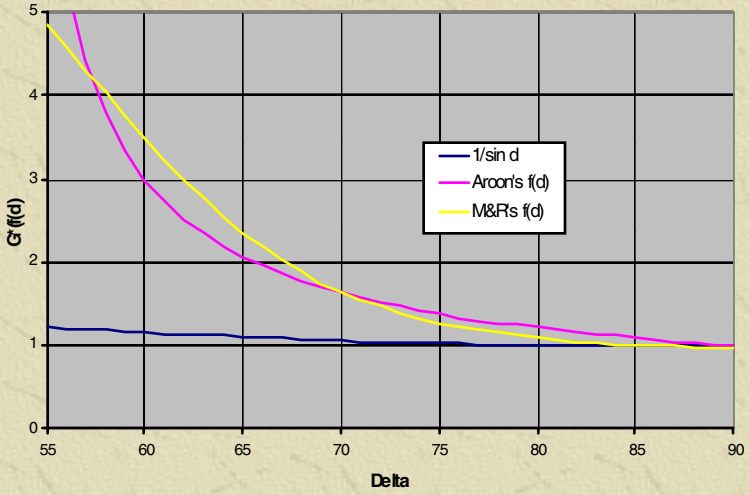
- New test procedure to evaluate binders.



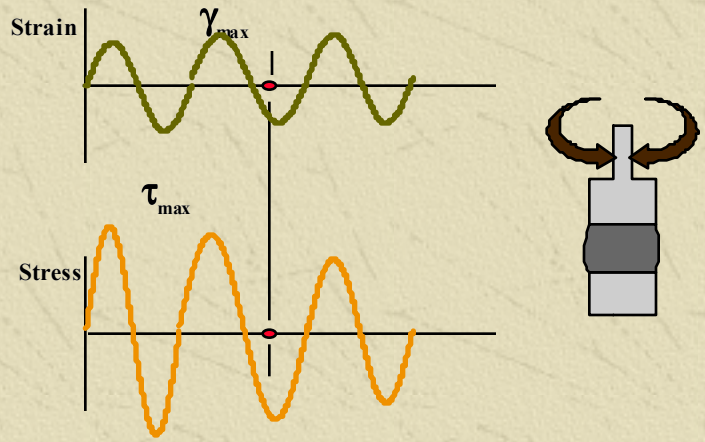
DSR Creep Testing



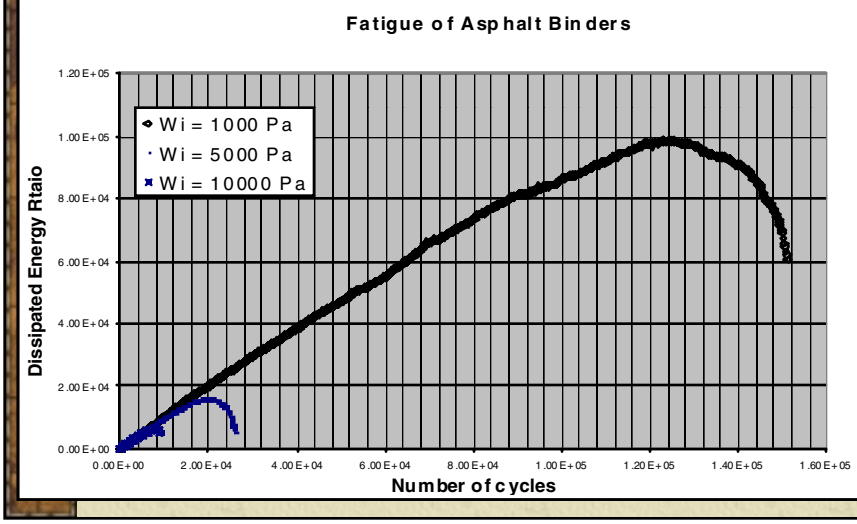
Comparison of Specification Values for Binders with a Value of G*/sin d = 1KPa as a Function of the Phase Angle



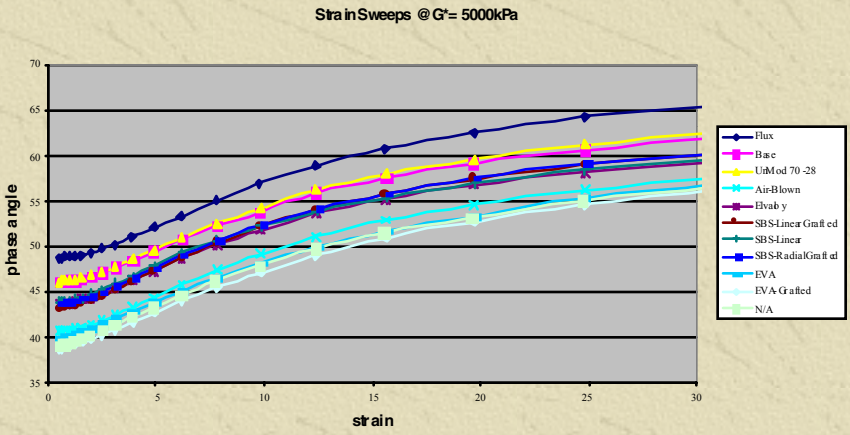
Binder Fatigue Test:
Time Sweep in the DSR



Binder Fatigue Properties



Binder Characterization



Fine aggregate specific gravity test

Test controls FAA and VMA

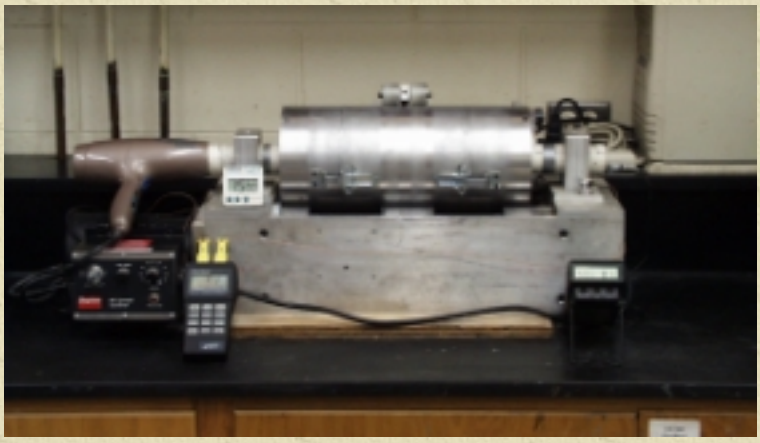
Current procedure highly variable

Measure Temp & Moist. out

Measure Temp & Moist. in

New test will reduce variability by taking out operator error.

New Specific Gravity Equipment

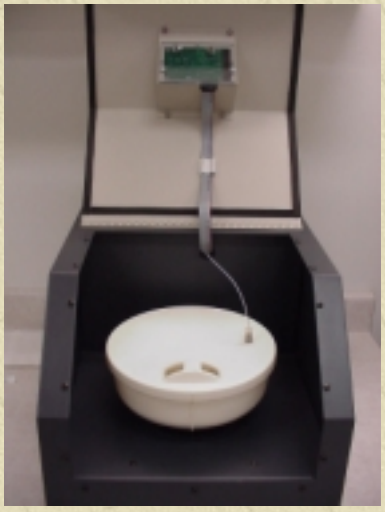


90-05 Agg. Gravity Procedure

- Production version under development.

90-05 Agg. Gravity Procedure

- Production version under development.



Gyratory Comparisons

Analysis of 30 Production Mixes
F test & Student " t " test

	Standard Deviation		Average (Mean)	
Gyrations	Calculated F value	Critical F value	Calculated " t " value	Critical " t " value
Design	**1.30 < 2.07**		**3.142 < 2.042**	

There is a measurable bias between the two compactors. On average the one unit's Gmb is **0.005** higher. However, this is well within T 166's precision (0.02).

Key

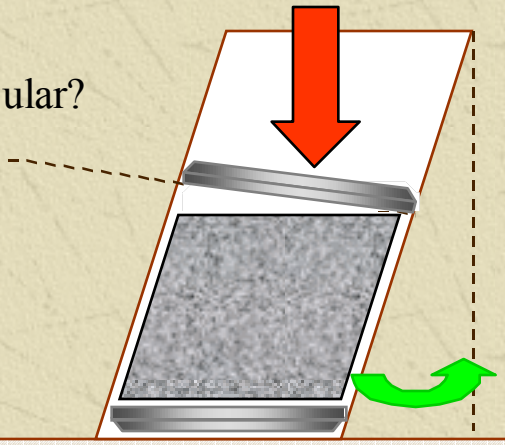
- Uniform procedures between the two mobile laboratories
  - AASHTO PP XX-01, **"Standard Practice for the Evaluation of Different SGC's used in the Design and the Field Management of Superpave Mixes"**
- Routine maintenance and calibration was performed

We are seeing measurable differences in the field.

- State DOT expressed concern regarding measured differences in specimens compacted in SGC's between the State and several local Contractors
- **Differences as high as 1.5 % air voids !**

Angle Definitions

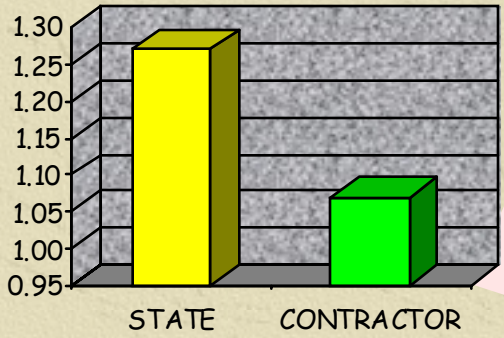
- How parallel?
- How perpendicular?

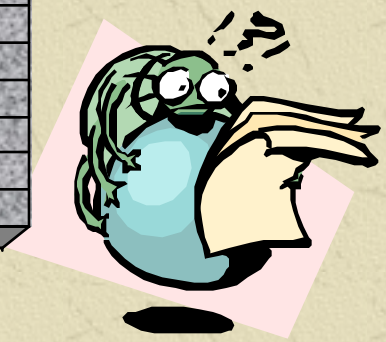


Gyratory Internal Measuring Device

State DOT vs Contractor

- Based on the data, how would you expect the compactors to compare?

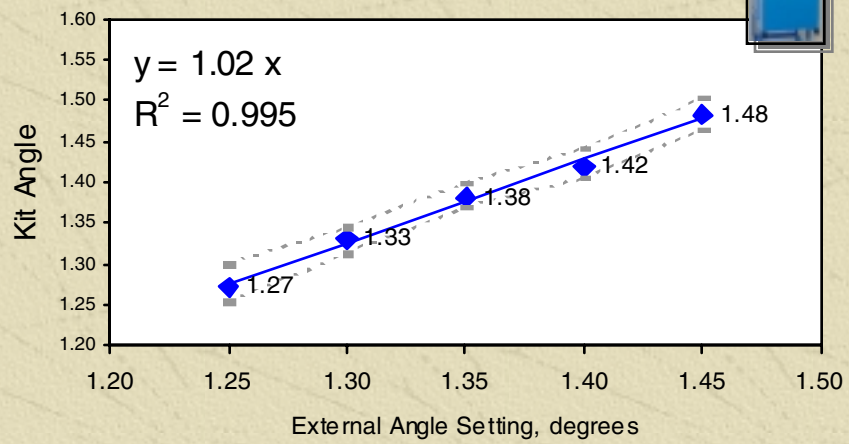




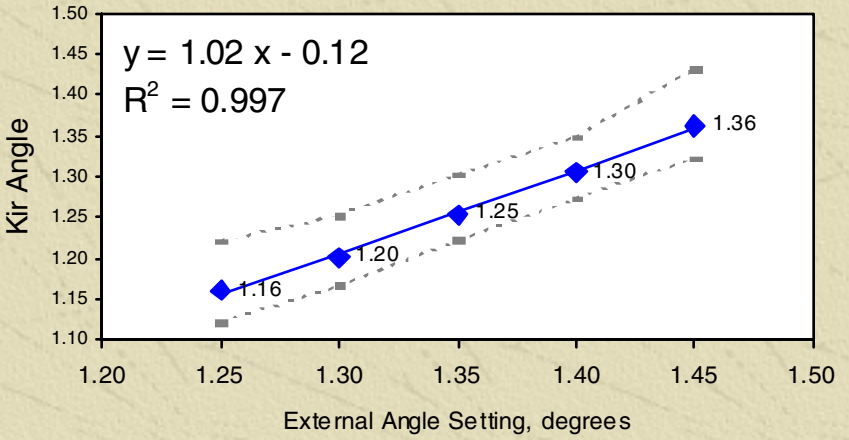
Findings

- Based on the limited testing, the Contractors SGC appears not to be maintaining the internal angle of gyration dynamically.
- Also, the DOT's SGC appears to be operating on the high side if the specification.

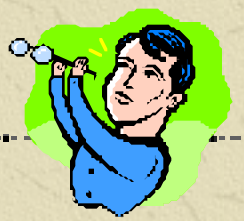
The Kit Only in the Mold



HMA and the Kit in the Mold



Vision



"Future validation will be based upon an angle of gyration, measured dynamically, under load of a specimen."

What Do We Do Now

- Interim Step – is to use a procedure to compare compactors and determine an offset between them.

Gyratory Internal Measuring Device

FHWA Mobile Asphalt Lab

Mobile Asphalt Labs

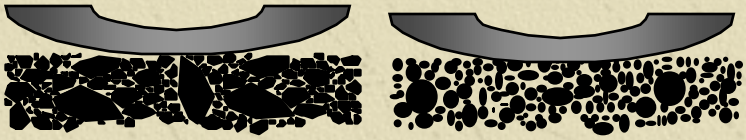
- Provide "Hands-on" of Superpave System
  - Volumetric Mix Design
  - Field QC/QA Procedures, NCHRP 9-7
  - Simple Performance Test Device, NCHRP 9-19
  - Performance Related Specifications 9-22
- 4 to 6 week visits
- Data used to support ETG's

Superpave Specifications

- Roadway Densities
  - Specifications the same, mixes different.

Superpave Specifications

Contrasting Stone Skeletons



Superpave Specifications

- Roadway Densities.
  - Lift thickness does effect compaction.
  - Recommended lifts should be **3 to 4** times **nominal maximum** size or **2 1/2 to 3** times **max size.**

Superpave Compaction

X-ray Tomography System

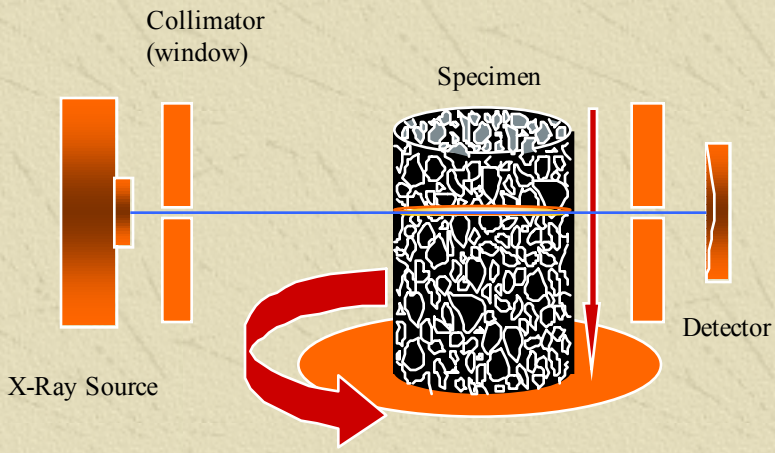
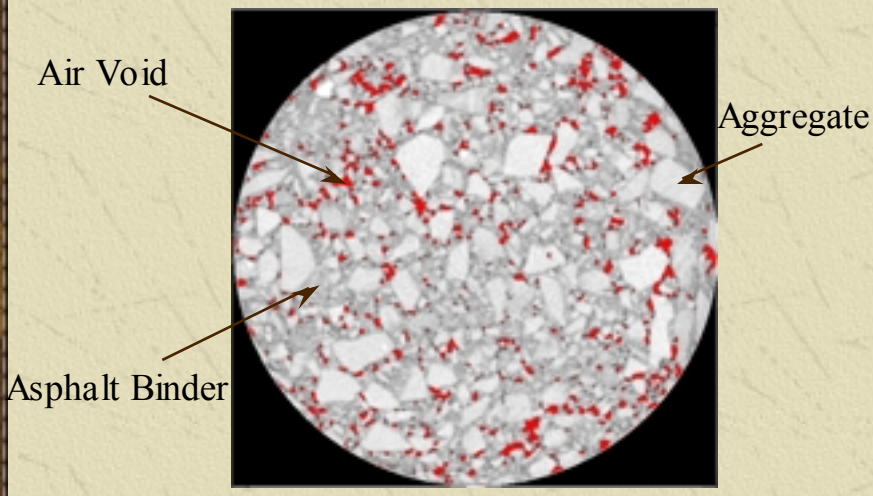
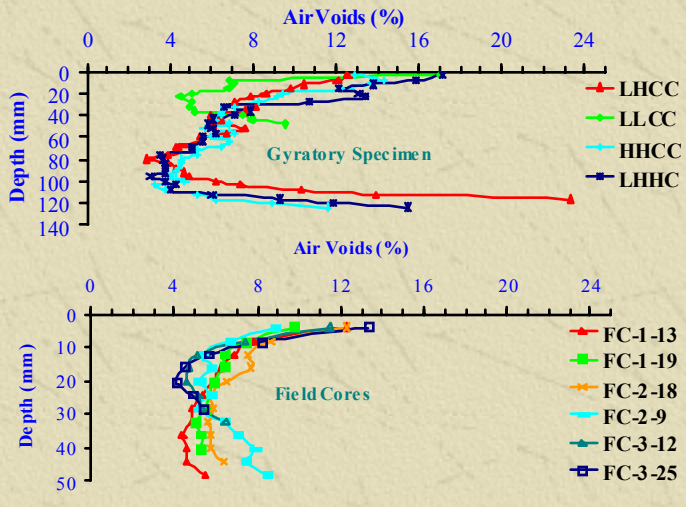


Image Processing-Air Voids



Vertical distribution of Air Voids in Gyratory Specimens and Field Cores



90-03 Mix Tenderness

- Study variables
  - Determine effect of moisture on mix properties.
    - Procedure developed to produce mix with 2% moisture in agg.
  - Measure moisture in plant mix.
    - Develop procedure to determine actual measure in plant mix.

Superpave Compaction

- Mix Tenderness
  - Study underway with the Asphalt Institute.
  - Major cause of tenderness is moisture
  - Minor affect gradation

90-03 Mix Tenderness

90-03 Mix Tenderness

SUPERPAVE PERFORMANCE MODELS

Proposed Changes to the Long-Range Plan for 2005

Superpave Performance Models and Test Methods

- **1999 - 2002: NCHRP Project 9-19, Superpave Support and Performance Models Management**
  - **Complete all tasks begun in FHWA project.**
- **1998 - 2001: NCHRP Project 1-37A, Development of the 2002 Guide for the Design of New and Rehabilitated Pavement Structures**
  - **Mechanistic-empirical HMA performance models.**

Original 1999 Plan

- Project 9-19: Materials characterization model and test.
- Future Projects: Mechanistic models for non-linear, viscoelastic HMA behavior based on 3-D finite element analysis and similar advanced computing techniques.
- Realistic completion date: 2007 or 2008.
- Estimated future funding: $7.65 million.

Revision of the Long-Range Plan for 2005

- NCHRP Project Panels 9-19 and 1-37A
- TRB Superpave Committee
- AASHTO Standing Committee on Research

Revised Plan

- Use HMA performance models and integrated climatic model from the 2002 Design Guide (Project 1-37A) for Superpave mix analysis and, possibly, HMA PRS (Project 9-22).
- Realistic completion date: 2004 or 2005.
- Estimated future funding: $1 -2 million.

Revised Plan

- Superpave effort finished on schedule.
- Common tools for HMA mix design, structural design, and PRS.
- Common materials characterization test; reduced need for new equipment; simplified technician training.
- Next generation of multi-use, mechanistic HMA performance models developed with minimal duplication of effort.

NCHRP 9-19 simple performance test. Preliminary evaluation currently underway.

The Superpave System

- Superpave is in place and it does work.
- There is a great deal of work needed to fill gaps in the system.
- Work is continuing to fill the gaps.
- A plan is in place to complete the system by 2005.


Thank You