



**Simple Performance Tests
for
Hot-Mix Asphalt Concrete**

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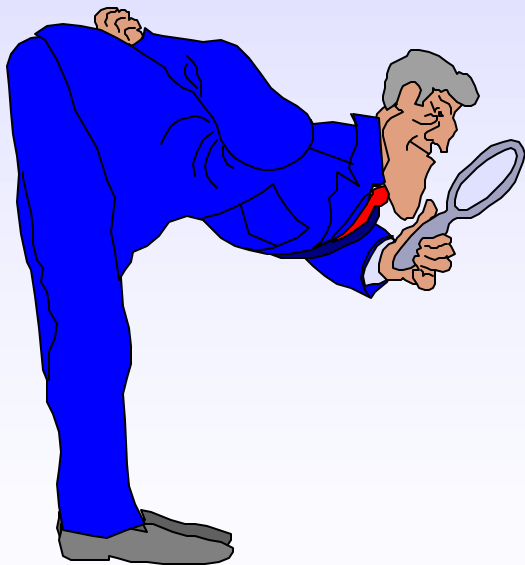
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What Is It?

Test That Indicates How Mix Will Perform

- Rutting
- Cracking

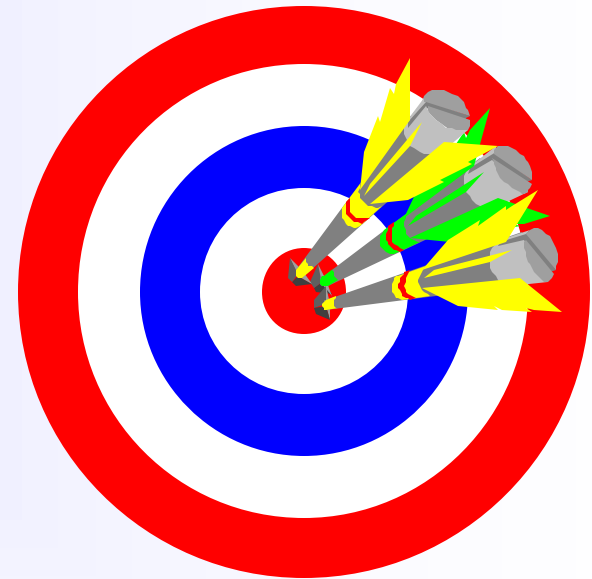


1. Identify Inferior Mixes
2. QC/QA Operations
3. Structural Design



Lots of Possibilities

- **Gyratory Compactor**
- **Rut Testers**
 - Asphalt Pavement Analyzer
 - Hamburg
- **Fundamental Tests**
 - Uniaxial/Triaxial
 - Shear
 - Indirect Tensile
- **Many Show Promising Correlation With Pavement Performance Using Limited Data Sets**



NCHRP/FHWA Research

- **To Recommend a Fundamental Based but Simple Performance Test(s) to Support of the Superpave Volumetric Mix Design Procedure**
- **Started 1997 FHWA Leadership**
- **Moved to NCHRP in Late 1998**
- **Continue Through 2002**



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Simple Performance Test Requirements

- **Absolute Requirements of Test**
 - Compliment Superpave Volumetric Design
 - Use Gyratory Compacted Specimens
 - High Correlation to Rutting/Fracture
 - Identify Inferior Mixes
- **Preferred Requirements of Test**
 - Tied to Structural Design
 - Adaptable to QC/QA



Approach

- ✍ **Identify Existing Test Methods**
- ✍ **Correlation Study**
 - **Relate Test Parameters to Observed Performance**
 - **Well Documented Experimental Sections**

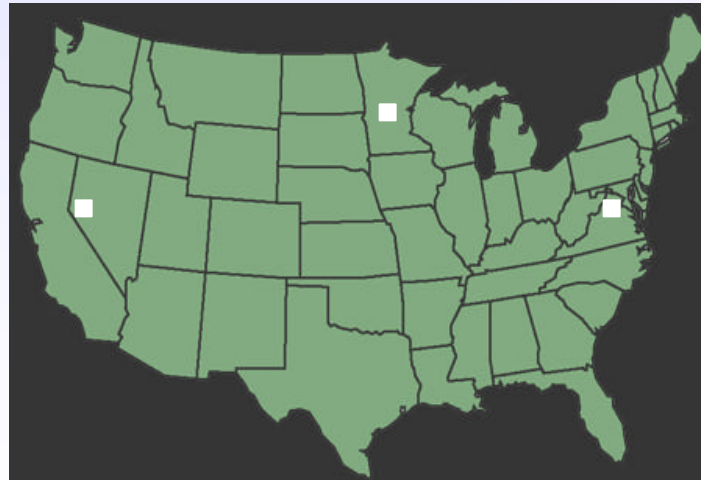


Sites for Correlation Study



MnRoad

WesTrack



FHWA-ALF



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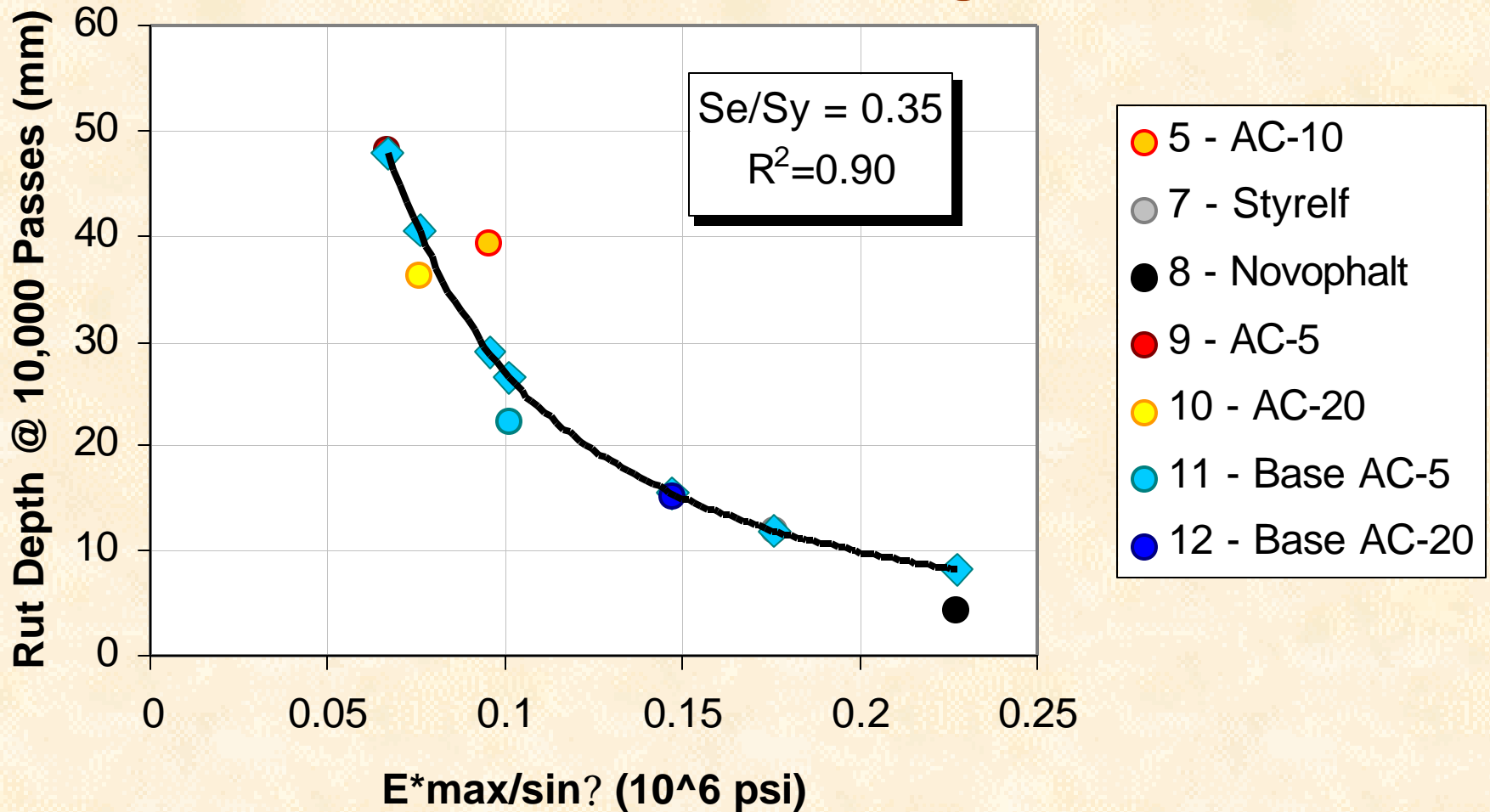
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ALF: Rut Depth vs. E*max/sin? @ 130 °F (54.4 °C)

Unconfined -- Linear Range



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Approach

- ✍ **Identify Existing Test Methods**
- ✍ **Correlation Study**
 - **Relate Test Parameters to Observed Performance**
 - **Well Documented Experimental Sections**
- ✍ **Select Candidate Tests**



Candidate Tests



- **Dynamic Modulus**
 - Rutting
 - Cracking
- **Creep Test**
 - Rutting
- **Repeated Load Test**
 - Rutting



Approach

 **Identify Existing Test Methods**

 **Correlation Study**

- Relate Test Parameters to Observed Performance
- Well Documented Experimental Sections

 **Select Candidate Tests**

 **Develop Guidelines/Criteria**

 **Validate**

 **Development Equipment Specifications**

- **Procure/Evaluate First Article Equipment**

NCHRP 9-19



NCHRP 9-29

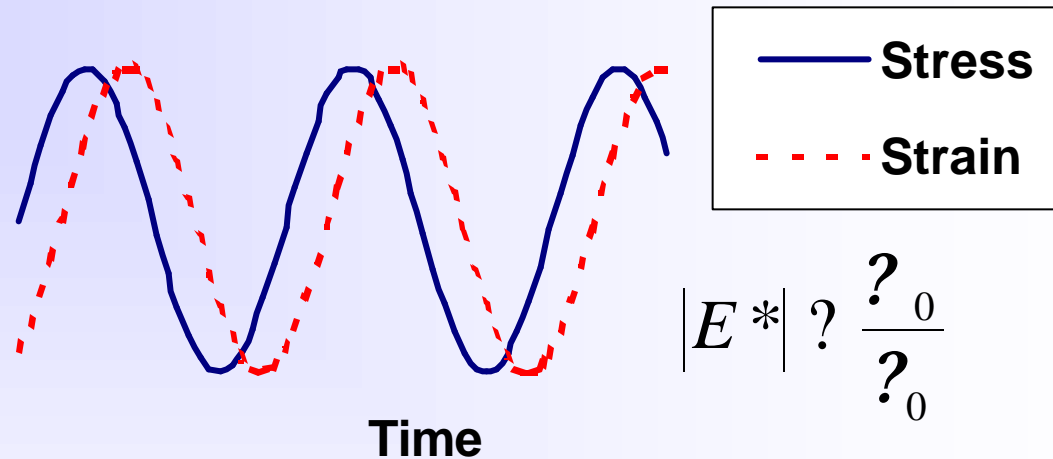
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Dynamic Modulus Test



- **Rutting**
 - Min $|E^*|$ at High Temp
- **Fatigue Cracking**
 - Max $|E^*|$ at Intermediate Temp

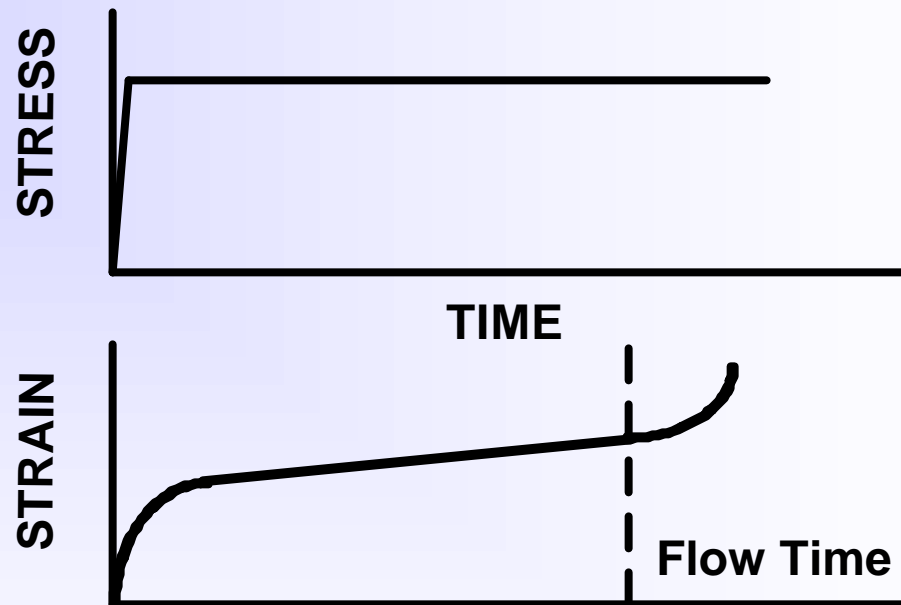
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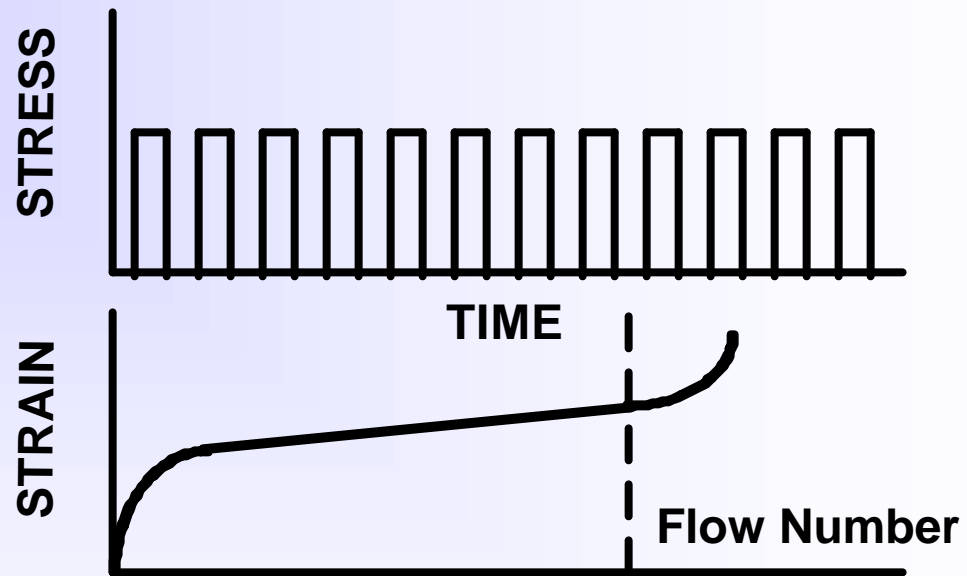
Creep Flow Time Test



- **Rutting**
 - Min FT at High Temp



Repeated Load Permanent Deformation Test



- Rutting
 - Min FN at High Temp



Advantages

- **Dynamic Modulus**
 - Used For Structural Design in 2002 Design Guide
 - Addresses Rutting and Cracking
 - Optimization
- **Creep**
 - Simple Test Equipment
 - Minimal Training
- **Repeated Load**
 - Potentially Best Simulation of Actual Loading



Disadvantage



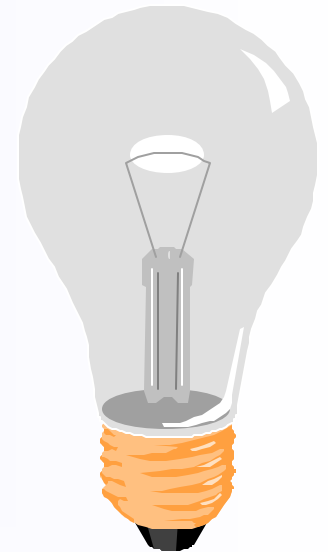
- **Specimen Size**
 - 100 mm Diameter by 150 mm High
 - Smooth Parallel Ends (Sawed)
- **Sawed and Cored From Over-Height Gyratory Specimens**
 - Some SGC Can Not Produce Tall Specimens
- **Needed to Ensure Fundamental Properties**



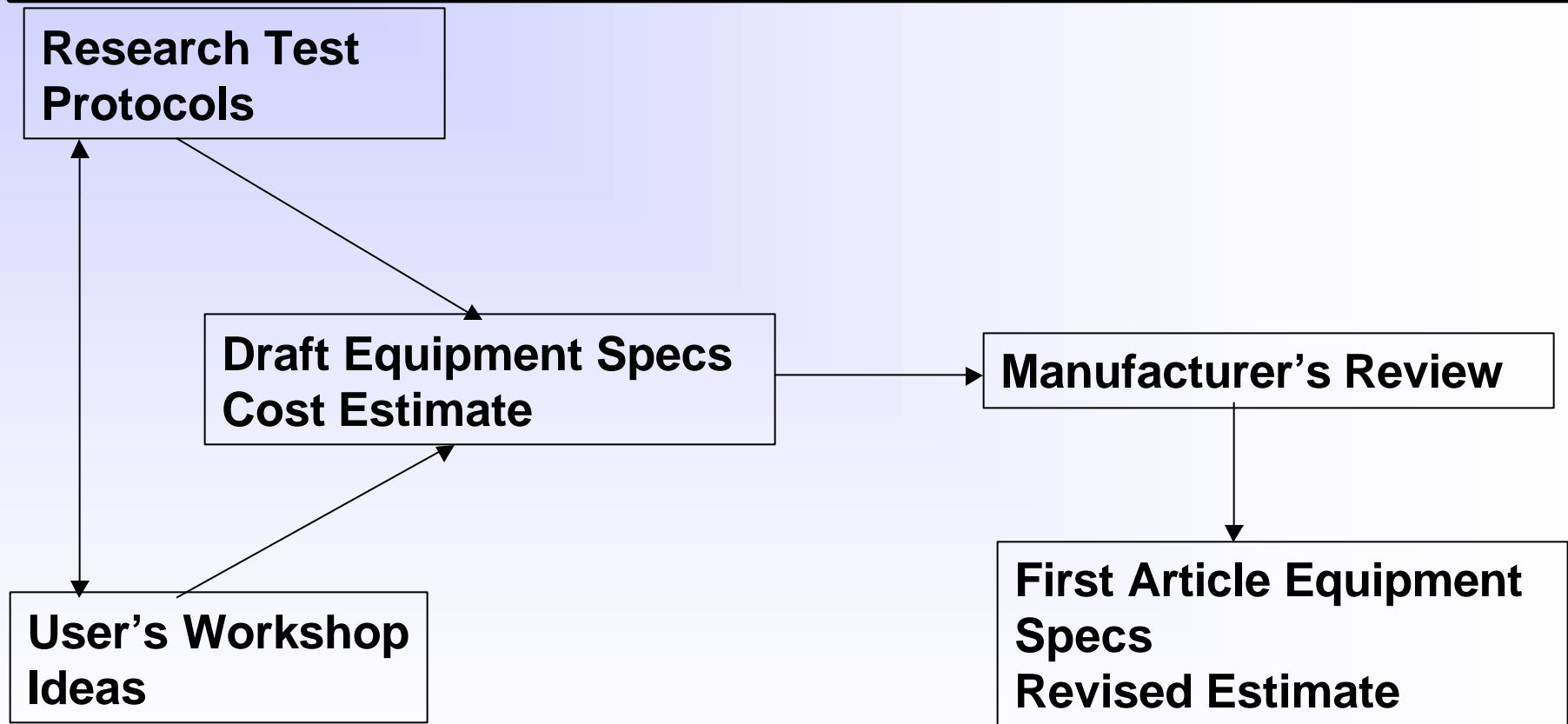
Equipment Specifications

- **Automated Specimen Fabrication Equipment**
- **Creep / Flow Time Test**
- **Repeated Load / Flow Number Test**
- **Dynamic Modulus Test**

- **Encourage Innovation by Manufacturers**
 - **User Friendliness**
 - **Reliability**
 - **Cost**



Specification Development



Work In Progress

- **Finalize Criteria For Acceptable Performance**
 - Early 2002
- **Validate Criteria**
 - Data From Field Sections
 - July 2002
- **Procure First Article Equipment**
 - July 2002
- **Evaluate First Article Equipment**
 - January 2003



Summary

- **Many Tests Show Promising Correlation With Pavement Performance**
- **NCHRP / FHWA Research Very Extensive**
 - 1997 to 2003
 - Initial Evaluation of Over a Dozen Tests Using Data From Three Experimental Sites
 - Three Candidate Tests Recommended For Validation
 - Currently Undergoing Validation Using Data From Field Sites



Summary

- **Detailed Equipment Specifications**
 - Input From Users and Manufacturers
 - Routine Laboratory Use
- **Inconvenient Specimen Geometry**
 - 100 mm Diameter by 150 mm High
 - Automated Specimen Fabrication Equipment





Questions ?

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