Moisture Damage and the Environmental Conditioning System

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FHWA
Moisture Damage
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Moisture Damage Mechanisms

- Detachment
- Displacement
- Spontaneous Emulsification
- Film Rupture
- Pore Pressure
- Hydraulic Scouring
Moisture Damage Influenced By

- Aggregate Mineralogy
- Aggregate Surface Texture
- Interaction between Asphalt and Aggregate
Moisture Damage Influenced By

- Asphalt Binder Chemistry
- Asphalt Binder Aggregate Interaction
TESTS for MOISTURE SENSITIVITY

- IMMERSION COMPRESSION
- BOIL TEST ASTM D 3625
- PEDESTAL TEST
- AASHTO T-283
- ASTM D-4867
Environmental Conditioning System

Developed as part of the SHRP.

Initial cost $65K to $80K.

Initial output did not provide any better results than AASHTO T283.
Environmental Conditioning System
Environmental Conditioning System

- Sample is conditioned at 60 °C for 6 hrs.
- Cooled to 25ºC for 2 hrs. and tested.
- A freeze cycle can be added.
- This process is repeated 3 times.
Environmental Conditioning System

The ECS originally used the Resilient Modulus to evaluate damage.
Environmental Conditioning System

Colorado Study: Will the new systems provide any better prediction of field performance.

- Modified AASHTO T 283
- Hamburg wheel test
- ECS
Environmental Conditioning System

Colorado Study:

- Hamburg test the most severe with many false positives.
- ECS no general trend with poor prediction.
- Modified T 283 Best prediction for Colorado mixes.
RECENT DEVELOPMENTS

- **SHRP / SUPERPAVE**
  - T-283 or ECS

- **NCHRP 9-13**
  - T-283 Revisions 6 inch Gyratory / Freeze-Thaw

- **ASTM D-4867**
  - No Change

- **NCHRP 9-34**
  - Focus on Conditioning of Specimen
NCHRP 9-34

Combines the SHRP Environmental Conditioning System with the Superpave Simple Performance Test.
NCHRP 9-34

ECS Study
- Refine conditioning
  - Time
  - Temperature
  - Loading
NCHRP 9-34

Simple Performance Tests
- Dynamic Modulus
  - Rutting
  - Cracking
- Creep Test
  - Rutting
- Repeated Load Test
  - Rutting
Dynamic Modulus Test

\[ E^* = \frac{\sigma_0}{\varepsilon_0} \]

- **Rutting**
  - Min \(|E^*|\) at High Temp
- **Fatigue Cracking**
  - Max \(|E^*|\) at Intermediate Temp
Creep Flow Time Test

- Rutting
  - Min FT at High Temp
Repeated Load Permanent Deformation Test

- Rutting
  - Min FN at High Temp
NCHRP 9-34

Improving the ECS to better simulate field conditions.

Using a performance test that better relates to the actual performance of the mix in the roadway.
Questions ?