# Moisture Damage and the Environmental Conditioning System

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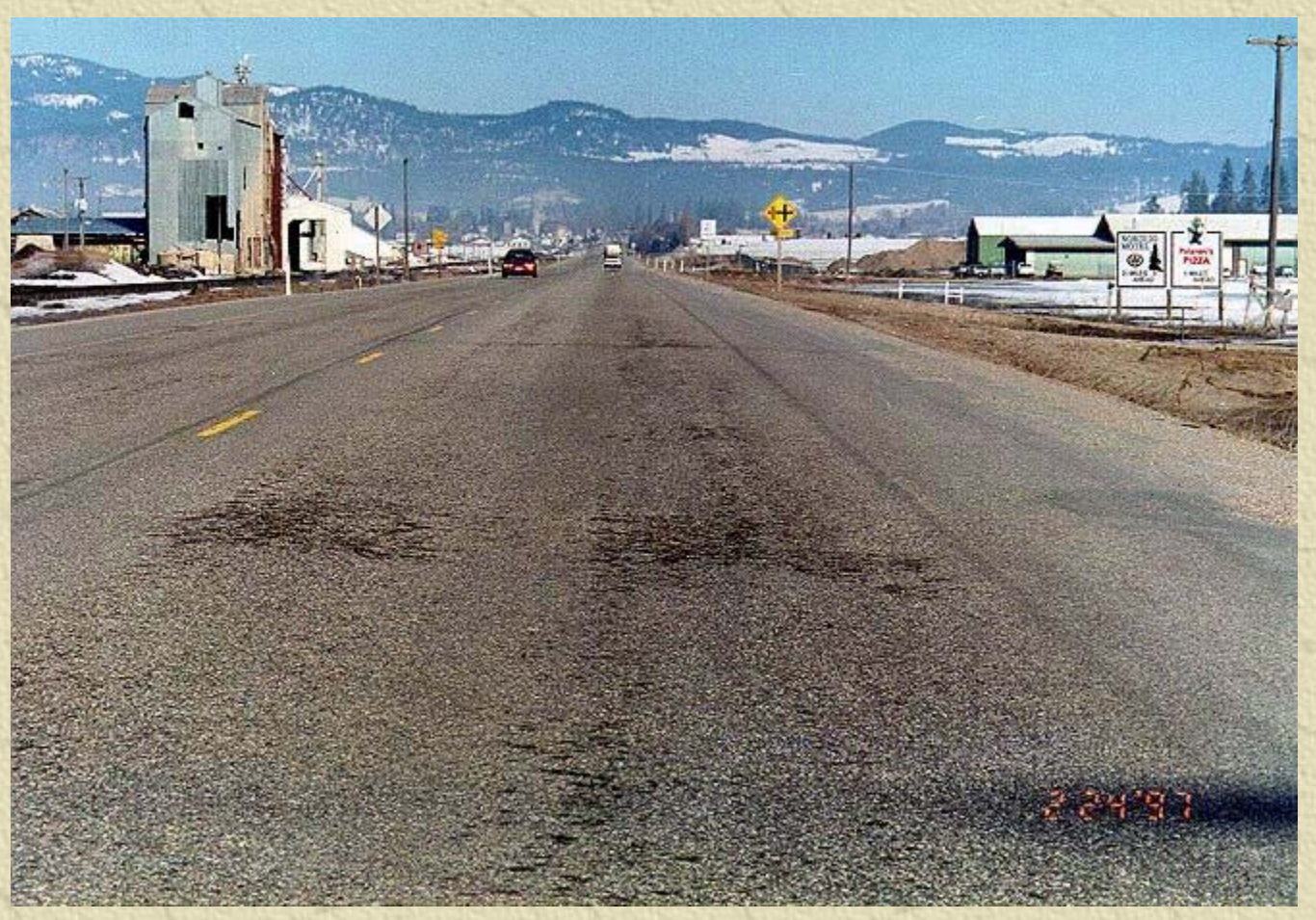
# Moisture Damage



# Moisture Damage

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# Moisture Damage Mechanisms

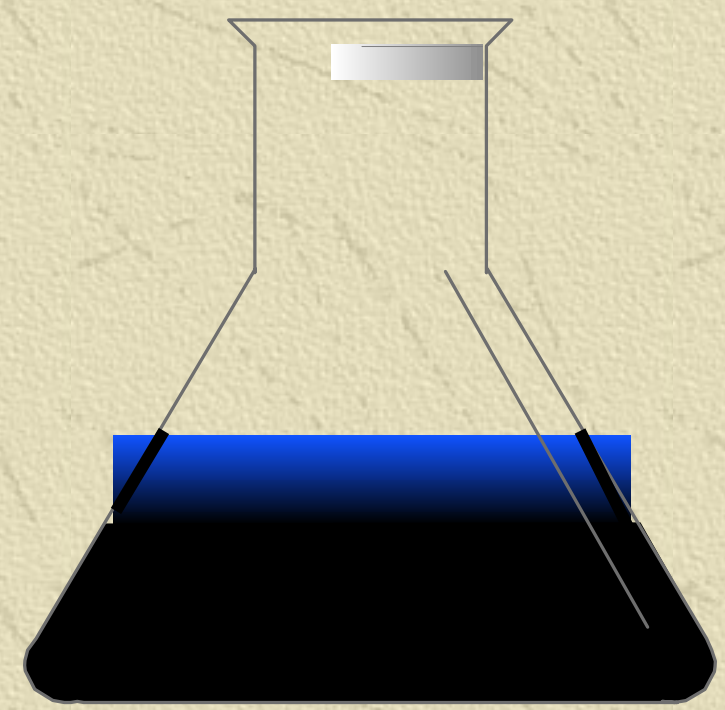
- Detachment, Displacement, Spontaneous Emulsification, Film Rupture, Pore Pressure, and Hydraulic Scouring.

# Moisture Damage Influenced By

- Aggregate Mineralogy
- Aggregate Surface Texture
- Interaction between Asphalt and Aggregate

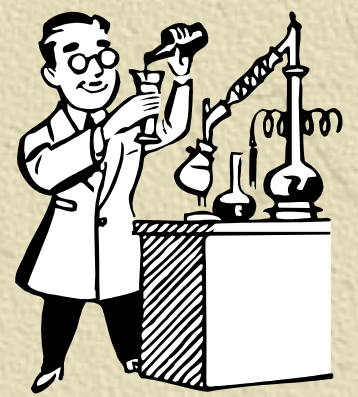
# Moisture Damage Influenced By

- Asphalt Binder Chemistry
- Asphalt Binder Aggregate Interaction



# TESTS for MOISTURE SENSITIVITY

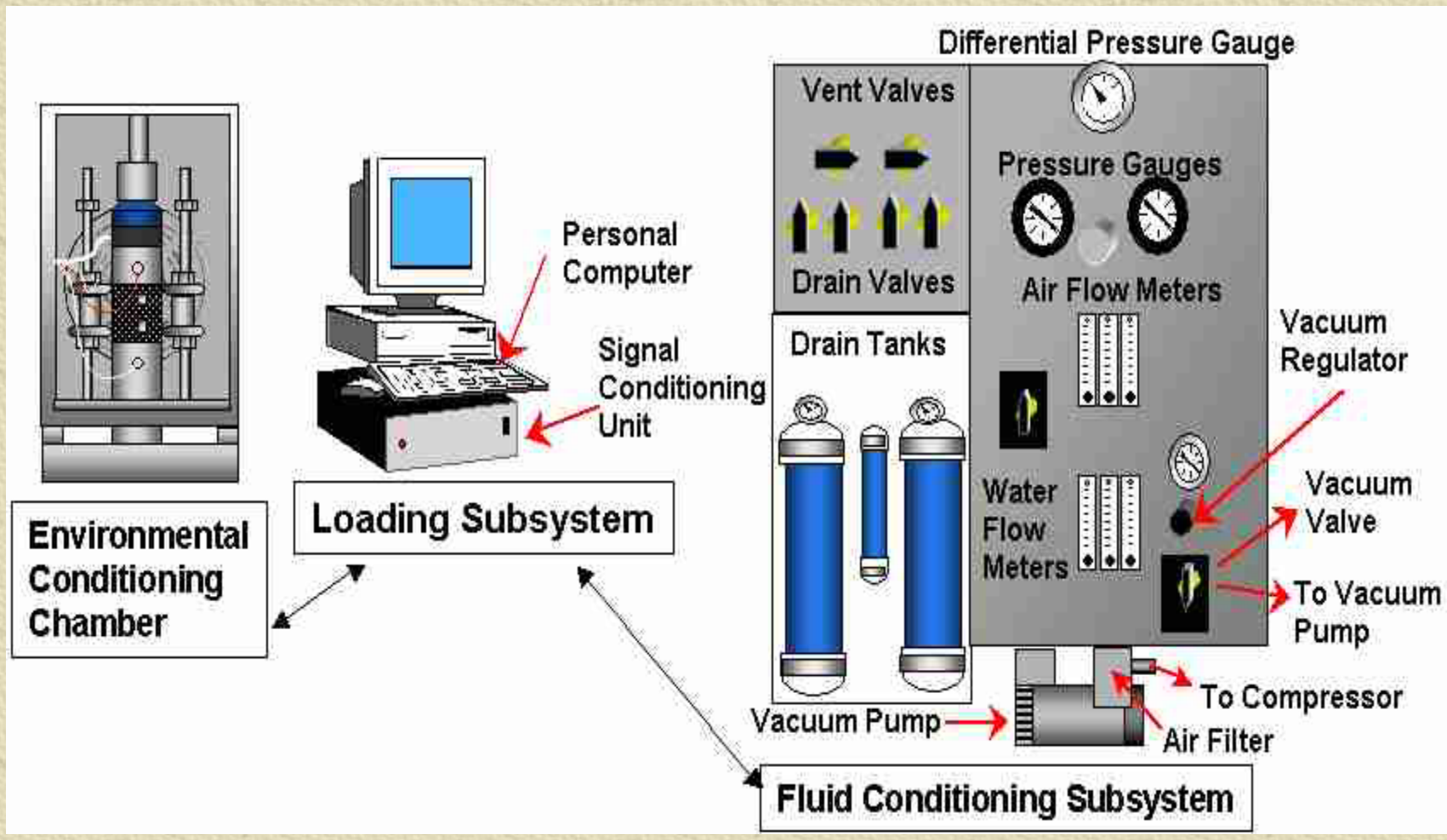
- IMMERSION COMPRESSION
- BOIL TEST ASTM D 3625
- PEDESTAL TEST
- AASHTO T-283
- ASTM D-4867



# 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

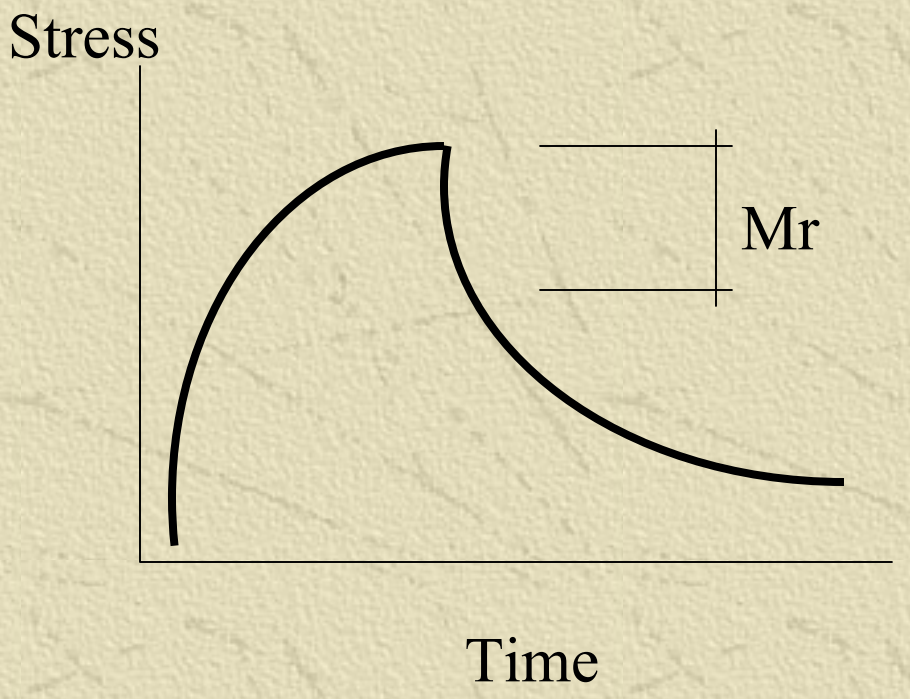


# Environmental Conditioning System

- Sample is conditioned at 60 ºC 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

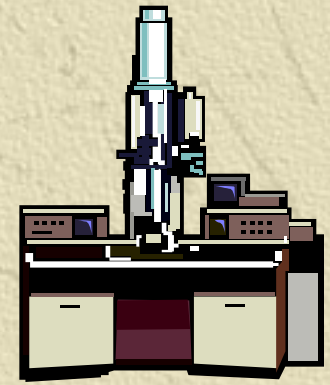
- Colorado Study:  Will the new systems provide any better prediction of field performance.
  - Modified AASHTO T 283
  - Hamburg wheel test
  - ECS

# Environmental Conditioning System

- Colorado Study:
  - Hamburg test the most sever 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.

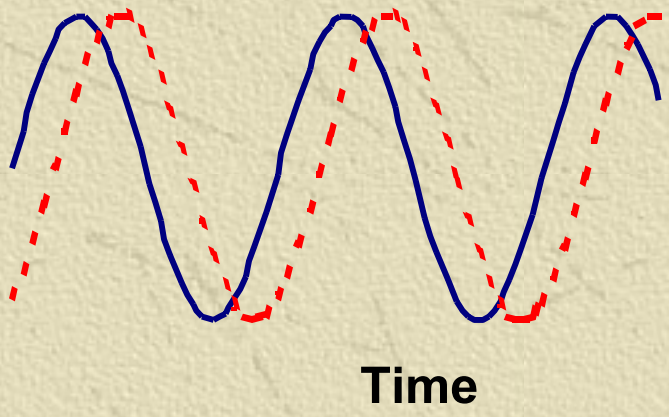
# NCHRP 9-34

- ECS Study
  - Refine conditioning
    - Time
    - Temperature
    - Loading

# NCHRP 9-34

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

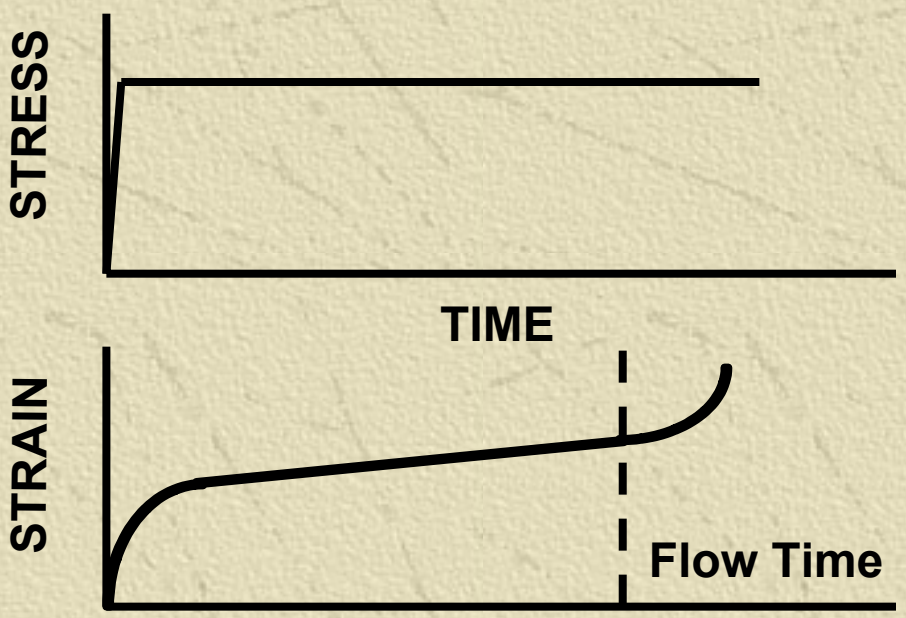
# Dynamic Modulus Test




$$|E^*| = \frac{\sigma_0}{\varepsilon_0}$$

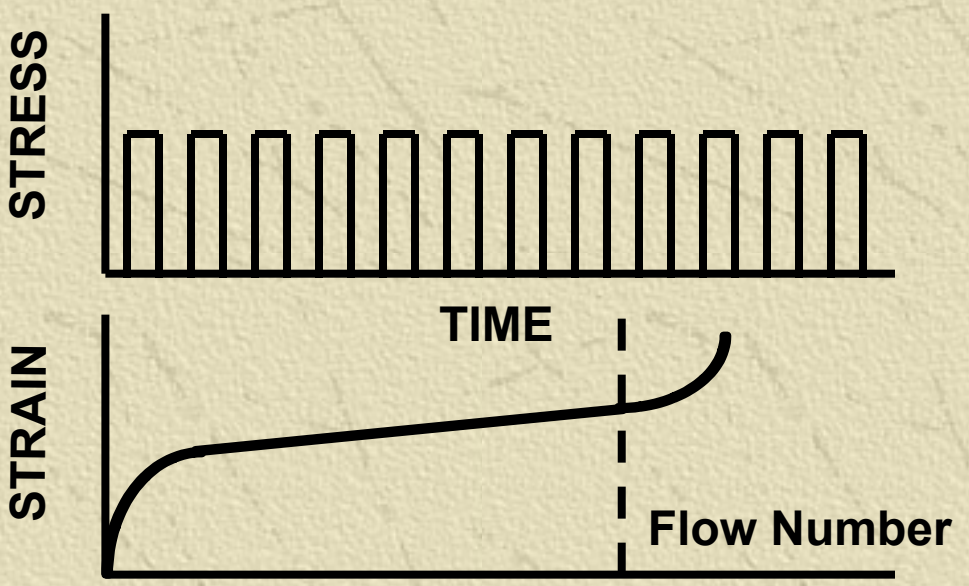
- Rutting
  - Min |E*| at High Temp
- Fatigue Cracking
  - Max |E*| at Intermediate Temp

# Creep Flow Time Test




- Rutting
  - Min FT at High Temp

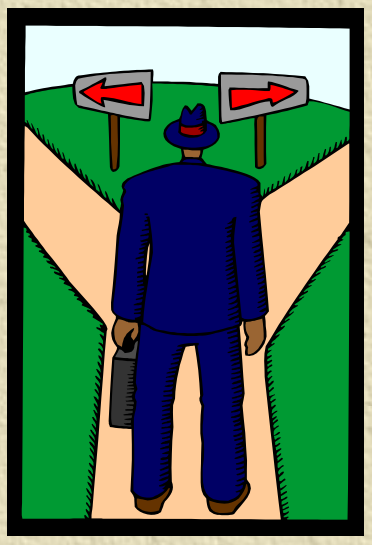
# Repeated Load Permanent Deformation Test




- 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 ?