AF2903 Road Construction and Maintenance

Indirect Tensile Test (IDT)

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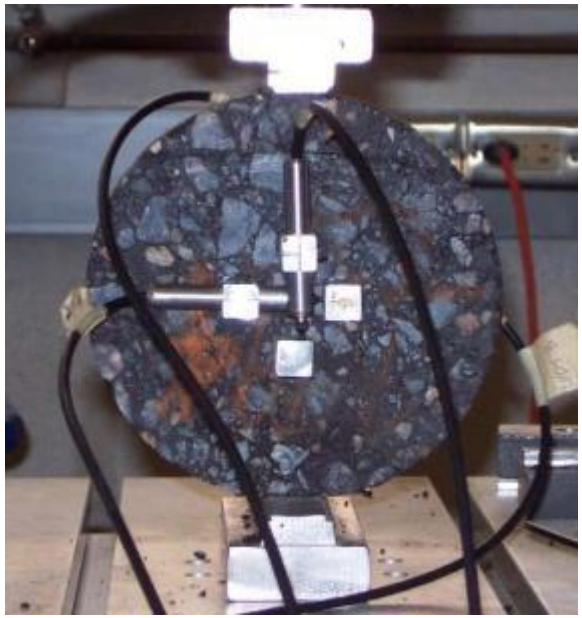
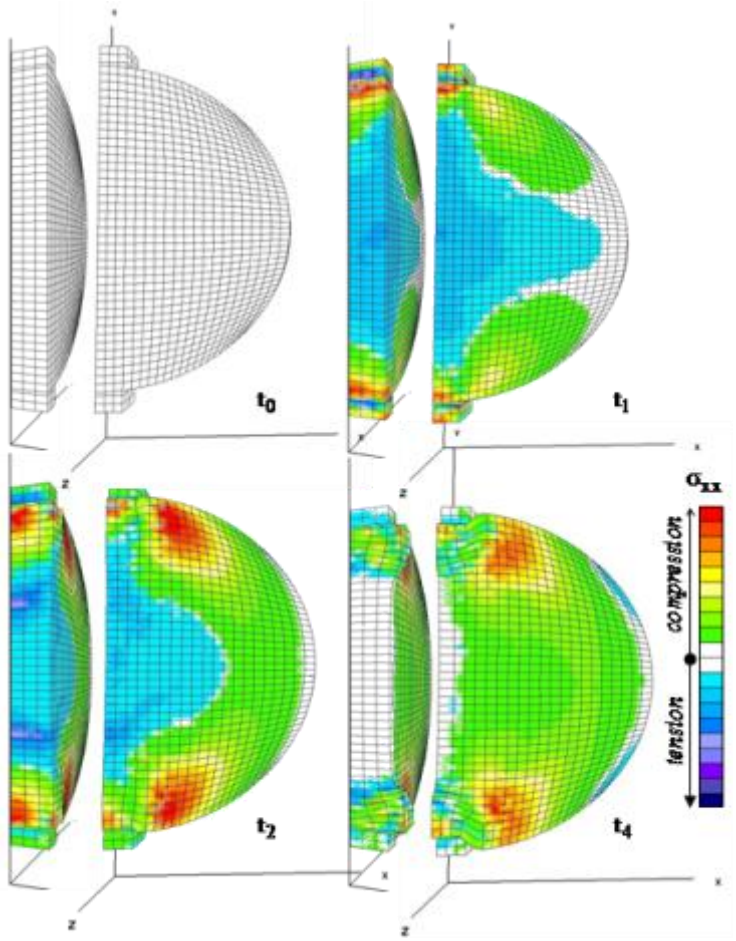
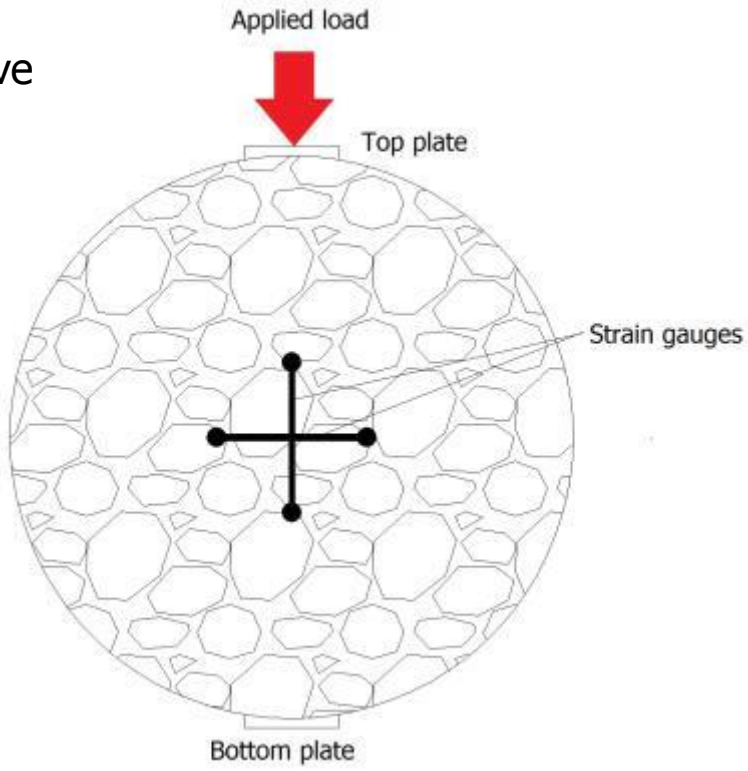




- Indirect tensile test types:
  - Resilient Modulus test
  - Superpave IDT tests
    - Creep compliance test
    - Tensile strength test
- Test effects on the specimens:
  - Resilient Modulus test
  - Creep Compliance test

  } Non-destructive
  - Tensile Strength test

  } Destructive
- Aim of Superpave IDT testing:
  - Evaluation of HMA and inputs for models
    - Resilient Modulus (Mr)
    - Creep Compliance (Cr)
    - Tensile Strength (St)
    - Fracture Energy Limit (FE)
    - Dissipated Creep Strain Energy (DCSE)



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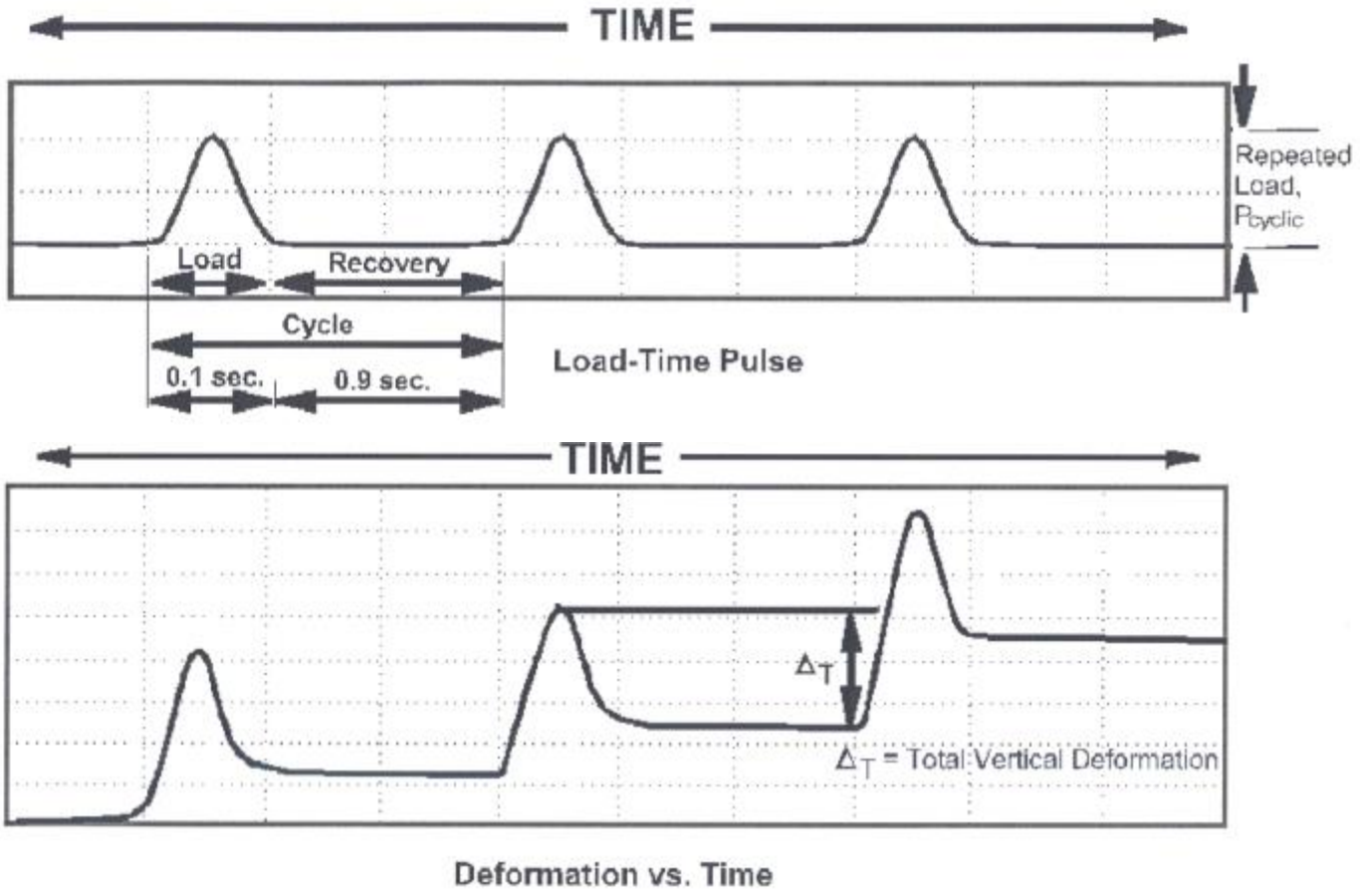
- **Resilient modulus test (AASHTO TP31, ASTM D4123):**
  - **Purpose:**
    - Measuring the elastic modulus of the material
  - **Usage:**
    - To calculate the pavement structural response to wheel loads
    - To de
  - **Definitio**
    - Mr=
  - **Test set**
    - Load simul
    - Typic

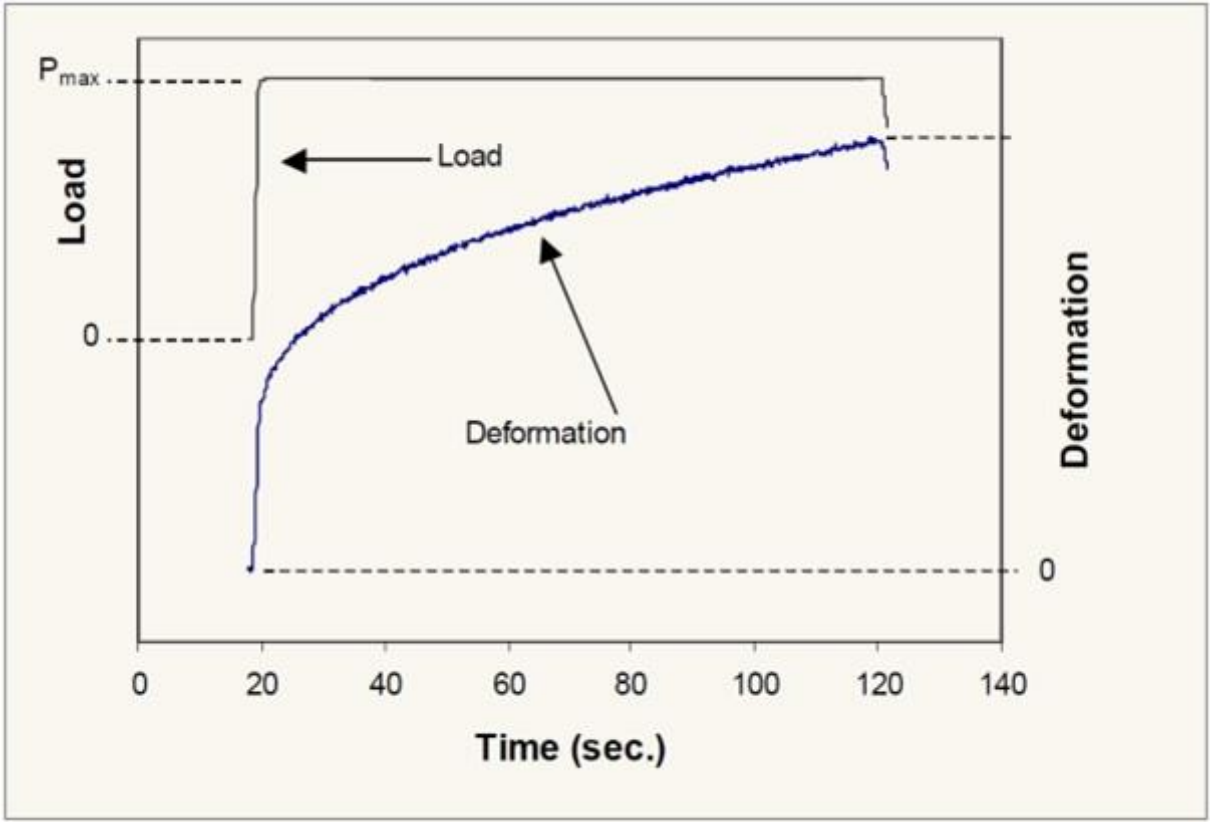


- Resilient modulus calculations:

$$Mr = \frac{P * GL}{\Delta H * t * D * C_{comp}}$$

P = Maximum load
GL = Gauge Length
ΔH = Horizontal Deformation
t= Thickness of specimen
D= Diameter of specimen
Ccomp = Non-dimensional creep compliance factor
Ccomp =-0.6354$(X/Y)^{-1}$ -0.332 and (X/Y) = Ratio of horizontal to vertical deformation

- **Creep compliance test (AASHTO T322):**
  - **Purpose:**
    - Determine the master relaxation modulus curve
  - **Usage:**
    - Thermal cracking analysis of HMA
  - **Creep compliance definition:**
  - **Test settings:**
    - Up to 1000 secor
    - Applied load < 4



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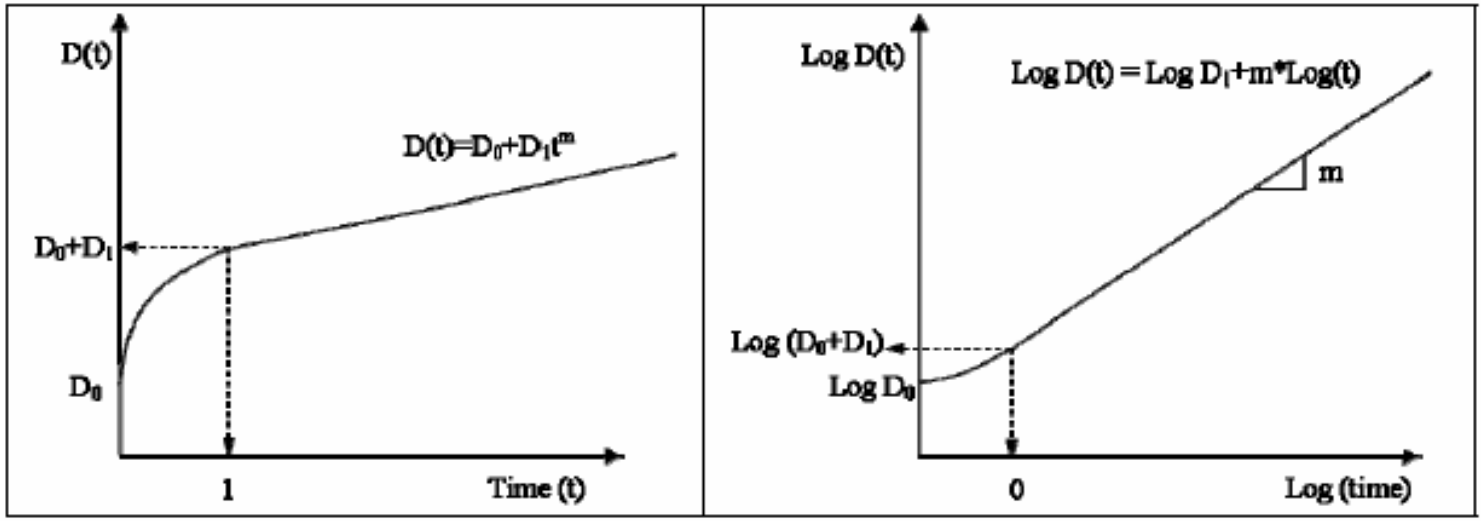
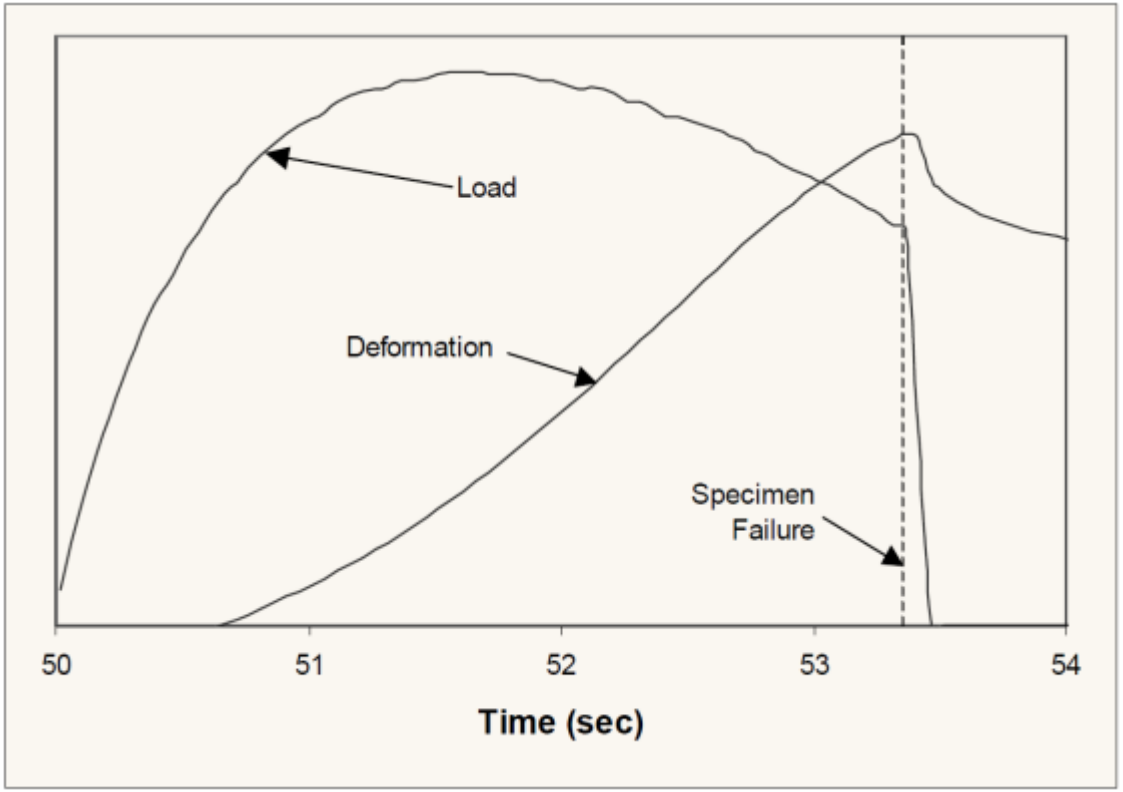
- **Creep compliance calculations:**
  - D0, D1 and m-value can be obtained from creep compliance test
    - D0 instantaneous elastic response
    - D1 gives idea about the initial portion of the creep compliance curve
    - m-value expresses the longer-term portion of the same curve



(Birgisson et al. 2007)

$$D(t) = D_0 + D_1 t^m$$

- **Indirect tensile strength test:**
  - **Purpose:**
    - Fracture parameters
  - **Usage:**
    - Fatigue cracking analysis of HMA
  - **Test settings:**
    - Displacement control
    - Constant loading rate



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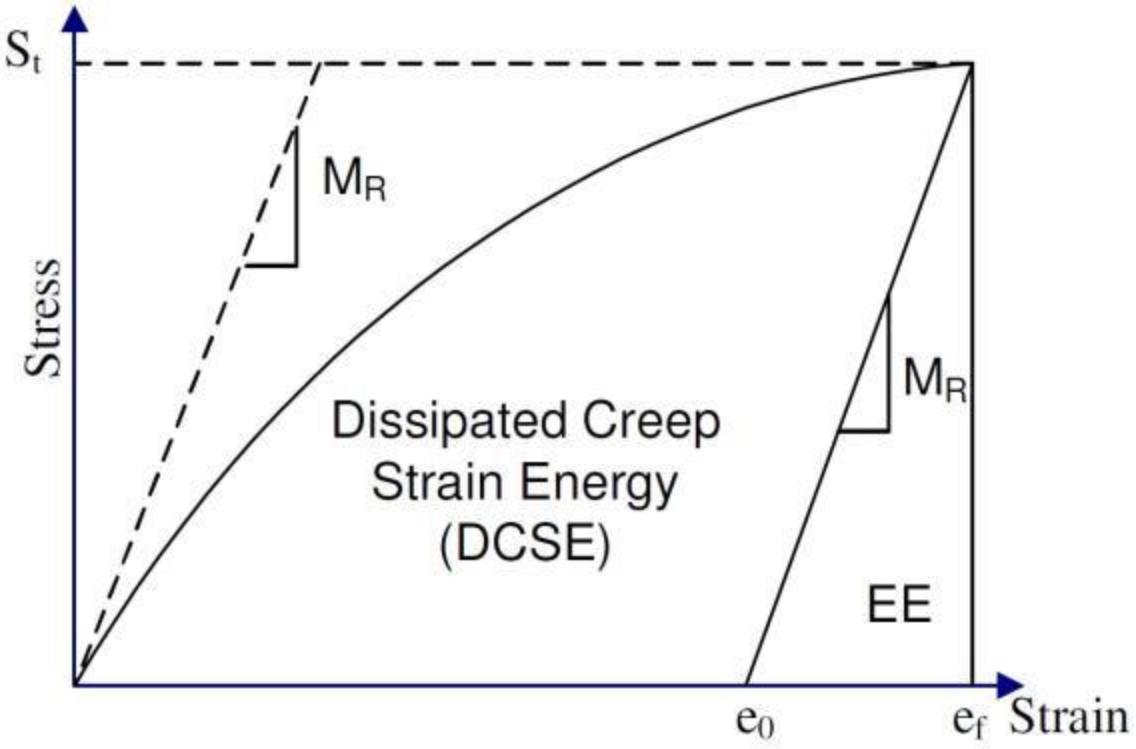
- Indirect tensile test calculations:

$$St = \frac{2 * P * Csx}{\pi * D * t}$$

St = indirect tensile strength
P = load of the specimen
D = diameter of the specimen
t = thickness of the specimen
Csx = horizontal stress correction factor
Csx = 0.948 - 0.01114(t/D) - 0.2693v + 1.436(t/D)v
v = Poisson's ratio
$v = 0.1 + 1.480(X/Y)^2 - 0.778(t/D)^2(X/Y)^2$
(X/Y)= ratio of horizontal to vertical deformation

- **Calculation of the remaining properties:**



$$e_0 = (M_R * e_f - S_t)/ M_R$$

$$EE = ½ S_t (e_f - e_0)$$

$$DCSE = FE – EE$$

- **Common requirements for IDT tests:**
  - 100kN load frame
    - Load control mode
    - Displacement control mode
  - Environmental chamber
    - Temperature control (-30℃ to +30℃)
  - Cylindrical specimens with the diameters of:
    - 100mm
    - 150mm
  - 2 strain gauges (vertical and horizontal)
    - 25 mm for 100mm specimens
    - 38 mm for 150mm specimens

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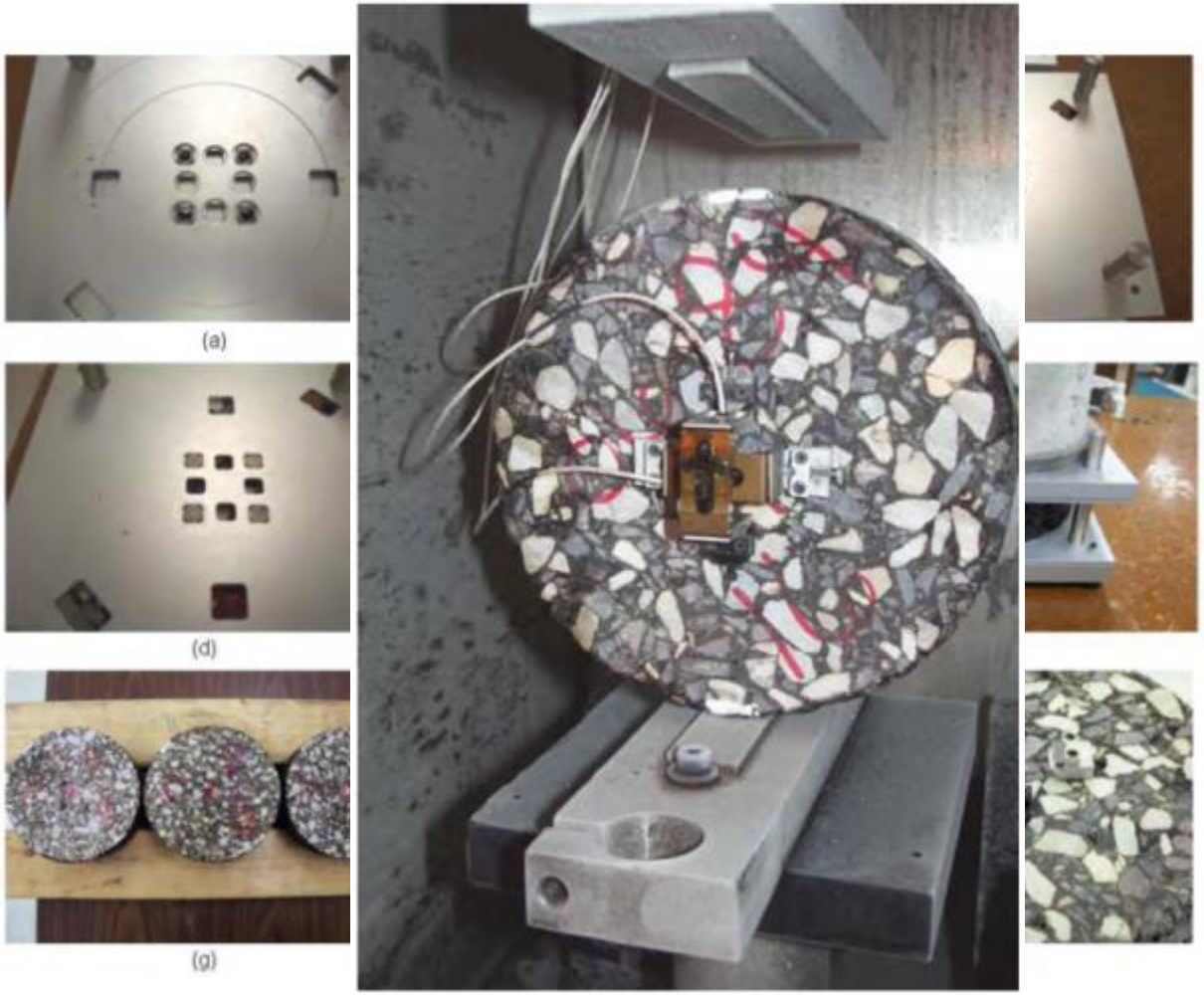
- Specimen preparation:



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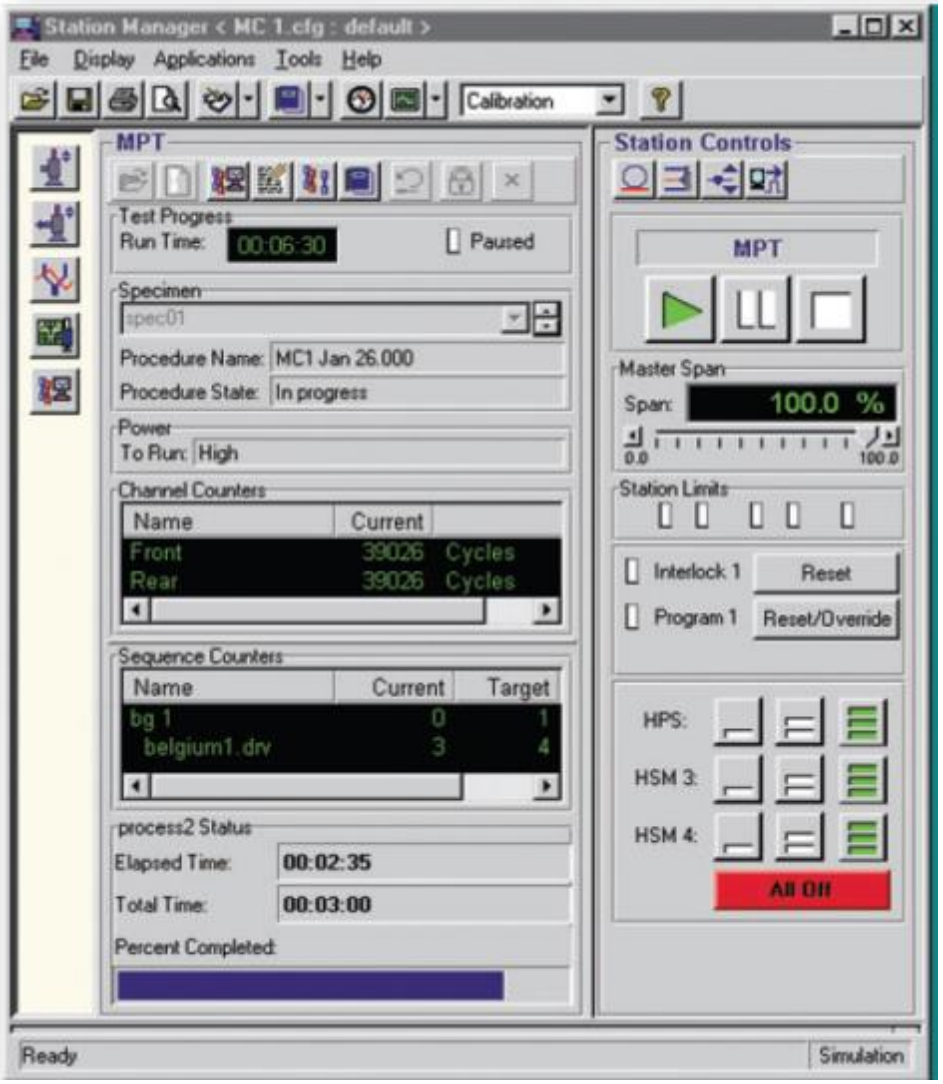
- **Pavement Testing Application Software (MTS 793)**
  - Station manager (controlling the loading frame)
    - Input specimen information
    - Activating the hydraulic pisto
      - Software control
      - Manual control
    - Setting the type of test
    - Applying load to the asphalt
    - Acquiring data from the load Transducer (LVDT) strain
    - measuring components



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- **General test procedure for IDT tests**
  - Loading the applicable method (Mr / Cr / St) [Software]
  - Setting the test temperatures [Environmental Chamber]
  - Input sample identification [Software]
  - Placing the prepared specimen [Manual]
  - Applying loads and initiating the test [Software]
- **Testing sequence example for each specimen:**

1. Creep Compliance -10 °C (14 °F)
2. Resilient Modulus 5 °C (41 °F)
3. Creep Compliance 5 °C (41 °F)
4. Resilient Modulus 25 °C (77 °F)
5. Creep Compliance 25 °C (77 °F)
6. Resilient Modulus 40 °C (104 °F)
7. Tensile Strength 25 °C (77 °F)

THANKS FOR YOUR ATTENTION.

QUESTIONS?

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