Pavements for a High-Stress Environment

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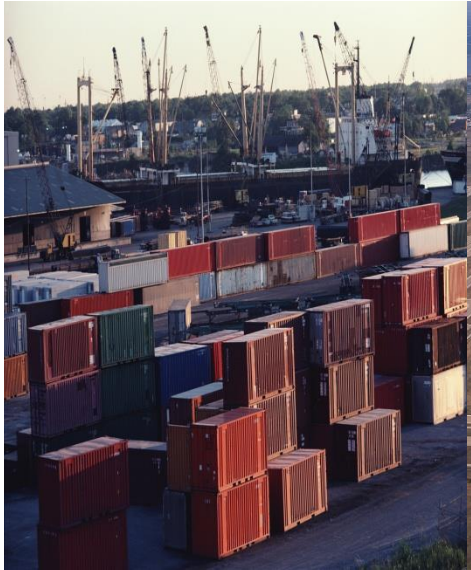
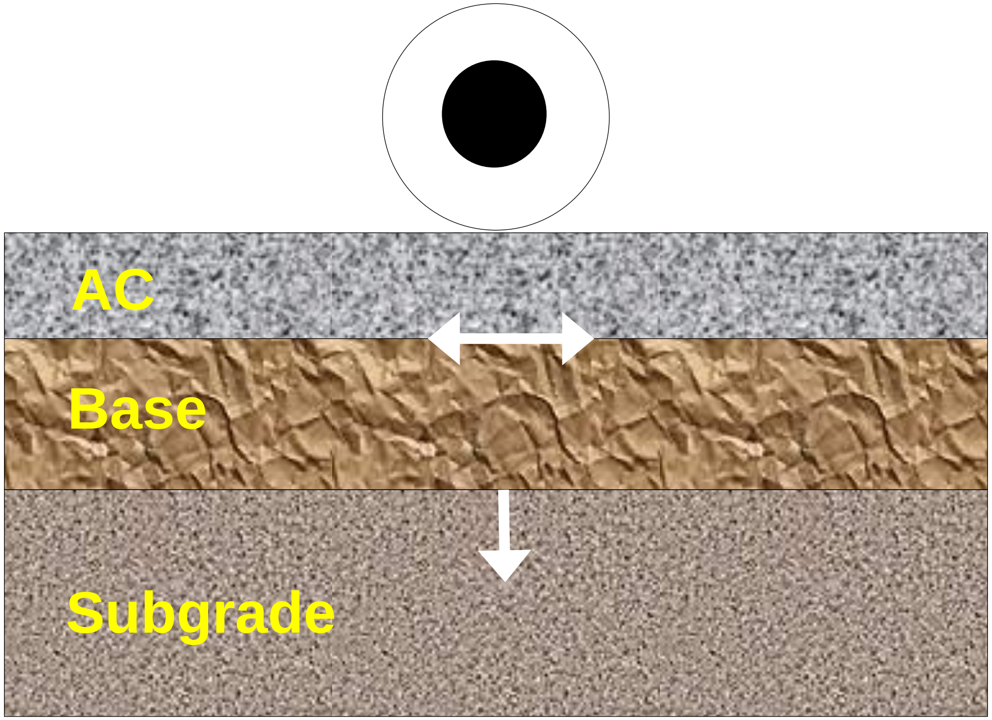


Presentation Outline

- Basics of Mechanistic Pavement Design
- Materials Characterizations
- Load Characterizations
- Special Considerations
- Summary

Basics of Pavement Design

- Standard design mechanisms involve the following two failure mechanism:
  - Limit tensile stress at the bottom of the asphalt layer(s)
  - Limit compressive strain at the top of the subgrade layer



Assumptions

- Layered Elastic Analysis
  - Elastic
  - Homogeneous – Material is the same throughout
  - Isotropic – Material behaves the same in all directions
  - Materials extend infinitely in the horizontal direction
  - Subgrade extends infinitely in the vertical direction
  - Tire load is assumed to have a circular footprint

Materials Characterization - Asphalt

- Modulus of Elasticity
  - Relative stiffness of the material
  - Impacted by materials
  - Impacted by climate
  - Impacted by age of the asphalt concrete

- Poisson's Ratio
  - Ratio of strain in orthogonal directions (longitudinal vs transverse)
  - Ranges from 0 to 0.5
  - Not easily measured

Materials Characterization - Base

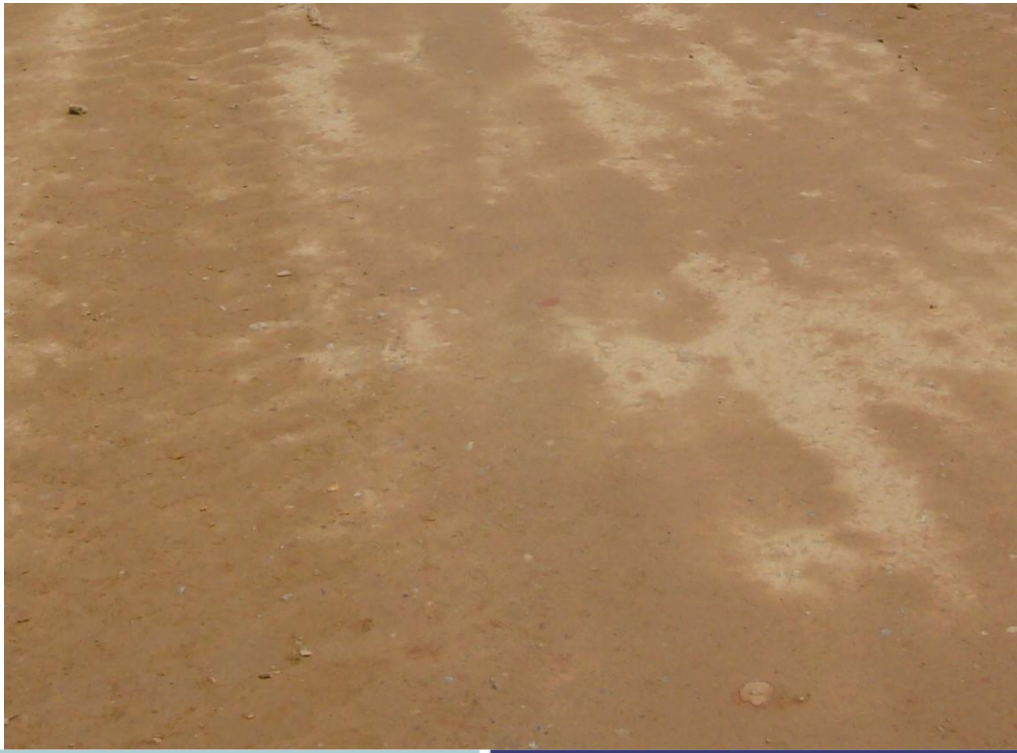
- Modulus of Elasticity
  - Impacted by material
  - Most likely to exhibit nonlinear elastic behavior
  - Impacted by climate (moisture)
  - Need to consider assumptions and spring thaw

- Poisson's Ratio
  - For granular materials generally assumed value of 0.40

Materials Characterization - Subgrade

- Modulus of Elasticity
  - Similar to granular base
  - Must consider spring thaw effects

- Poisson's ratio
  - Fine-grained materials assumed value of 0.45

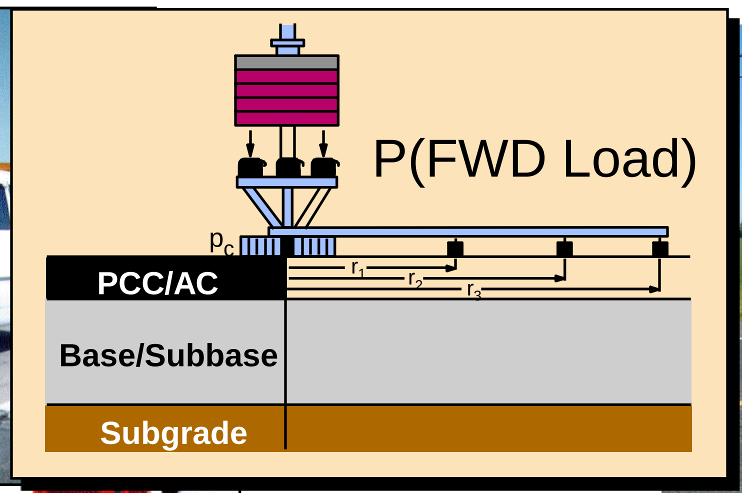


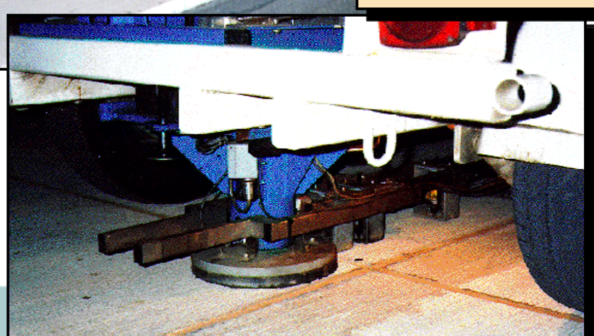
Modulus of Elasticity

- Laboratory Evaluation
  - Asphalt
    - Diametral resilient modulus, AASHTO TP31
    - Dynamic modulus, ASTM D3497
    - Simple shear test, AASHTO TP7
  - Subgrade / Base
    - AASHTO T292
    - Relative to bulk stress
    - CBR along with correlation commonly used

Modulus of Elasticity

- Field Evaluation using the falling weight deflectometer
  - Requires cores to obtain thickness
  - Temperature at time of testing will impact measured deflection
- Dynamic Cone Penetrometer





Traffic Characterization

- Types of loading

Traffic Characterization

- The following is required for each type of vehicle:
  - Gross loaded vehicle weight
  - Number and spacing of axles
  - Number and configuration of tires
  - Tire pressure
  - Number of loads over pavement design life

Mix Design Considerations

- Selecting an appropriate mix design

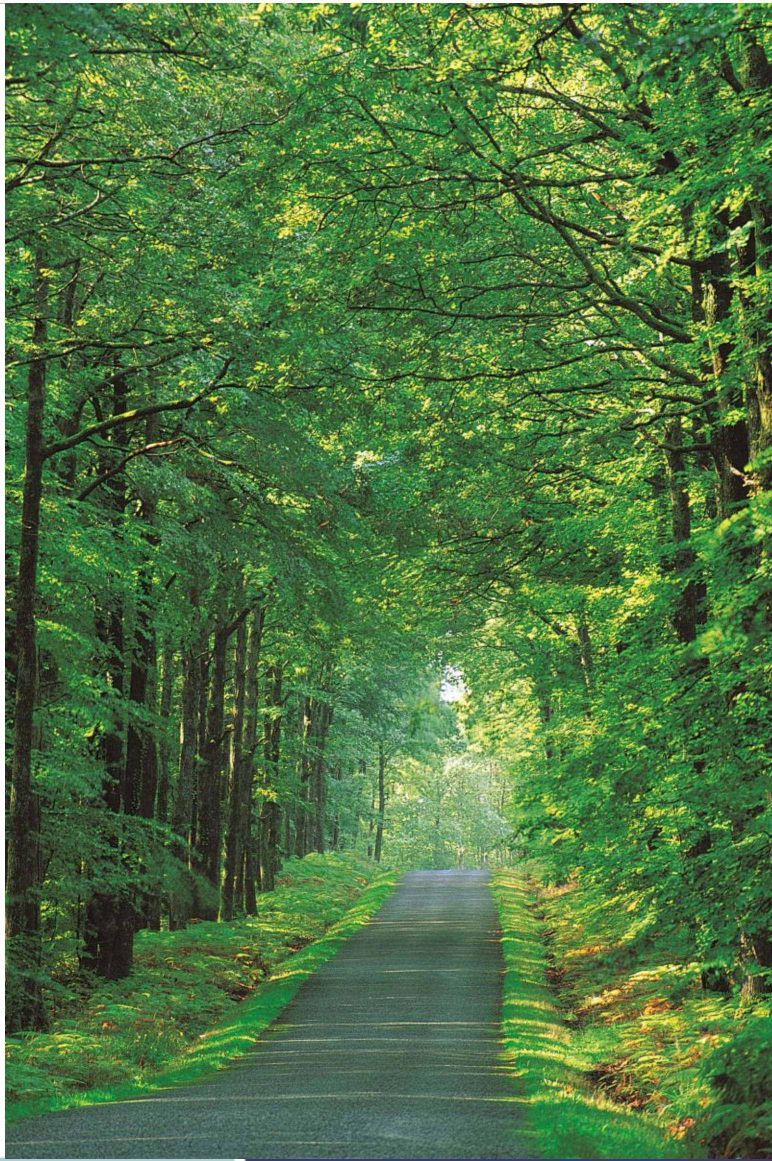
- Based on type of high stress environment
  - Intersection or other turning movements
  - Grade
  - Unusual loading characteristics (large wheels or heavy loads)

- Consider aggregate gradation
  - SMA
  - Larger aggregate

- Consider asphalt grade
  - For PG binder grade increase higher temperature by one or two levels

Summary

- Current design standards don’t account for some loading conditions
- Mechanistic design approaches can handle unusual loading conditions or materials
- Requires material property inputs
- Requires more detailed loading data
- Consider requirements at site for selection of mix design



Questions?