Pavement Design

Guest Lecturer
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• Introduction
  – Design Factors
  – Pavement Types
• Fundamentals of Pavement Design
  – AASHTO
  – Asphalt Institute
Design Factors

INTRODUCTION

Climate

Traffic

Material Properties

Pavement Structure

Pavement Condition
Climate

- Temperature
- Moisture
Material Properties

- Nondestructive Testing
- Field and Laboratory Testing
Nondestructive Testing

- Falling Weight Deflectometer (FWD)
- Ground Penetrating Radar (GPR)
- Seismic Pavement Analyzer
- Magnetic Induction Tomography (MIT)
Falling Weight Deflectometer (FWD)

Uses
- Basis for estimating in-situ properties
- Estimate of structural capacity
- Assess variability
- Rehabilitation (overlay) design
Ground Penetrating Radar (GPR)

- Underground cross-sectional image
- Burst of radio-frequency energy radiated into the ground to detect discontinuities in the ground

Top of Bedrock
Portable Seismic Pavement Analyzer (PSPA)

- Operating principle is based on generating and detecting stress waves in the pavement structure.
Magnetic Induction Tomography (MIT)

- Sensor unit emits electromagnetic pulses and detects the induced magnetic field
Field and Laboratory Testing

- Drilling & Sampling
- California Bearing Ratio (CBR)
- Resistance Value (R-value)
- Dynamic Cone Penetrometer (DCP)
- Triaxial
- Fatigue
Drilling and Sampling

- Cores
- Soils
- Beams
California Bearing Ratio (CBR)

- Applying load to a small penetration piston at a rate and recording the total load at a certain penetration.
Resistance Value (R-value)

- Expresses a material's resistance to deformation as a function of the ratio of transmitted lateral pressure to applied vertical pressure.
Dynamic Cone Penetrometer (DCP)

- Supply kinetic energy to the penetrometer, which causes it to move a distance through the soil
Triaxial Testing

- Most versatile test available to determine the stress-strain properties of soil
Fatigue Testing

- Cyclic loading to test specimen
- Load can be a repeated application of a fixed load or simulation of in-service loads
- Load may be repeated millions of cycles at predefined loading time
Traffic

- Critical factor
- Consider both the loading magnitude and configuration and the number of load repetitions
Pavement Damage

2000 Repetitions < 1 Repetition
Types of Equipment

- Weigh-In-Motion (WIM)
  - Bending Plate, Load Cell, Piezo Sensors
Types of Equipment

- Classifiers
  - Road Tubes, Inductance Loops, Piezo Sensor, Video
Types of Equipment

- Counters
  - Road Tubes, Inductance Loops, Piezo Sensor, Video
Pavement Condition

- Profiler
- Automated Distress Survey
- Manual Distress Survey
Profiler

- Comprehensive system that is used to collect roadway surface data for determining the ride quality
Automated Distress Survey

- Inspection of pavement and identifying distresses
- High speed equipment that takes “pictures” of roadway
- Processed manually or by computer
Automated Distress Survey

Images are taken of pavement

Images are digitized

Distresses are classified and quantified

Images are processed and analyzed

Images are stored
Manual Distress Survey

- Distresses separated based on pavement type
  - Rigid, Flexible
- Distress Identification Manual (DIM)
Rigid Pavement

- Corner Breaks
- Durability “D” Cracking
- Longitudinal
- Transverse
Rigid Pavement

- Joint Seal Damage
- Longitudinal Joint Spalling
- Transverse Joint Spalling
Rigid Pavement

- Map Cracking
- Scaling
- Polished Aggregate
Flexible Pavement

- Fatigue Cracking
- Block Cracking
Flexible Pavement

- Longitudinal
- Transverse
Flexible Pavement

- Potholes
- Patches
Flexible Pavement

- Rutting
- Shoving
Flexible Pavement

- Bleeding
- Raveling
Flexible Pavement

- Water
- Bleeding & Pumping
Types of Pavement

- **Rigid Pavements**
  - Acts like beam over any irregularities in underlying supporting material

- **Flexible Pavements**
  - Layered system in contact with any irregularities in underlying supporting material
Rigid Pavement

- Constructed of portland cement concrete (PCC)
- Analyzed by the Plate Theory
- Jointed, Continuously Reinforced

Introduction

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<th>PCC</th>
<th>BASE (OPTIONAL)</th>
<th>SUBGRADE</th>
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Subgrade
Flexible Pavement

- Surface constructed of bituminous materials
- "Flexible" since the total pavement structure "bends" due to traffic loads
- Structure is generally composed of several layers of materials
Questions