

## Module 2-4

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### Laboratory Materials Characterization

## Objectives

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Describe stress states, identify major material property test procedures

Describe basic terminology

Describe concept and importance of resilient modulus testing

Identify major material tests for PCC and HMA; describe use in rehabilitation design

## Definitions

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Resilient modulus

Resilient strain

Permanent strain

## Introduction

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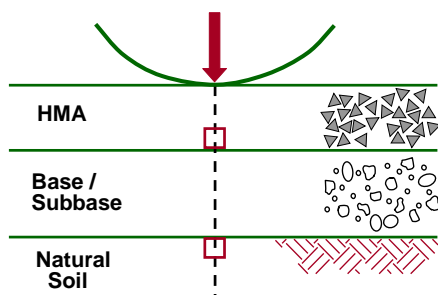
Overview of states of stress

Importance of laboratory testing

When is laboratory testing required?

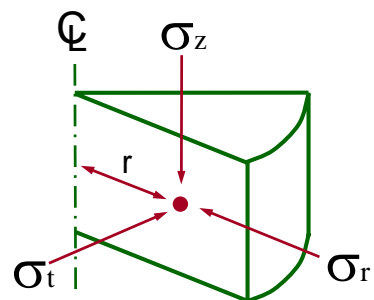
## Overview of States of Stress

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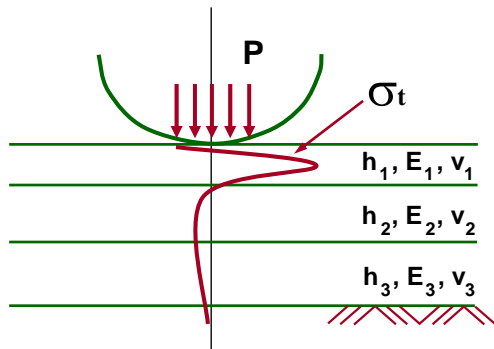


## Element Under Load

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### Typical Distribution of Tensile Stress



### Importance of Laboratory Testing

- Economics
- Recycling
- Emphasis on rehabilitation
- Verification of NDT results

### When is Lab Testing Required ?

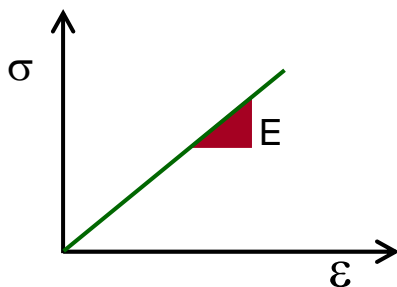
- Complement NDT (low level)
- Absence of NDT (high level)
- Diagnose causes / mechanisms of distress

### Typical Laboratory Test Methods

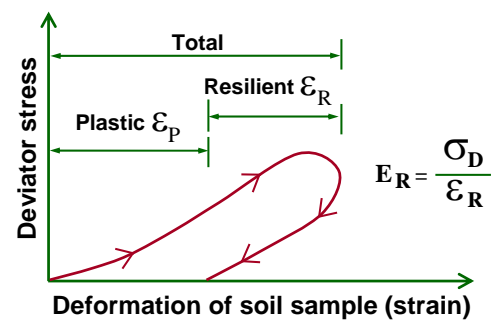
- Unbound vs. bound materials  
General characteristics
- Stiffness (and permanence)
  - Strength (and permanence)
  - Compaction (and permanence)
  - Permeability
  - Volume stability
  - Durability
  - Aggregate gradation

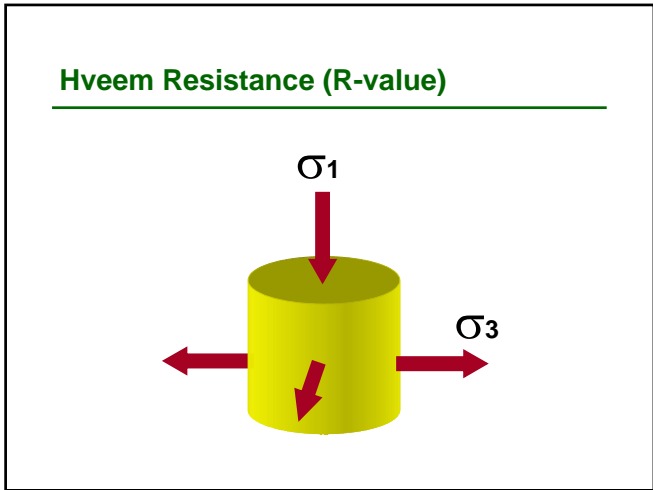
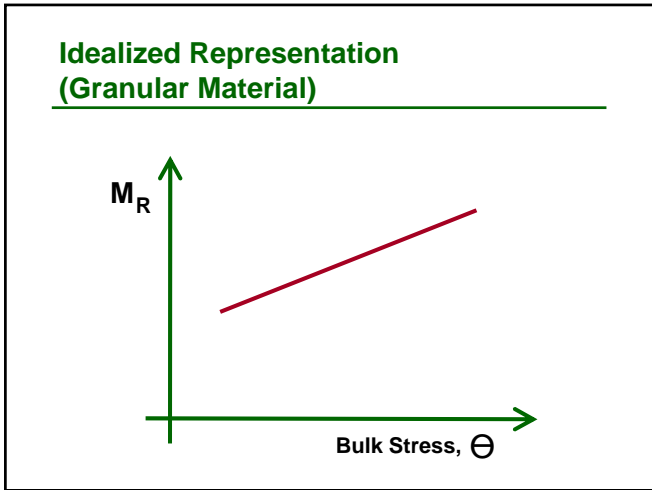
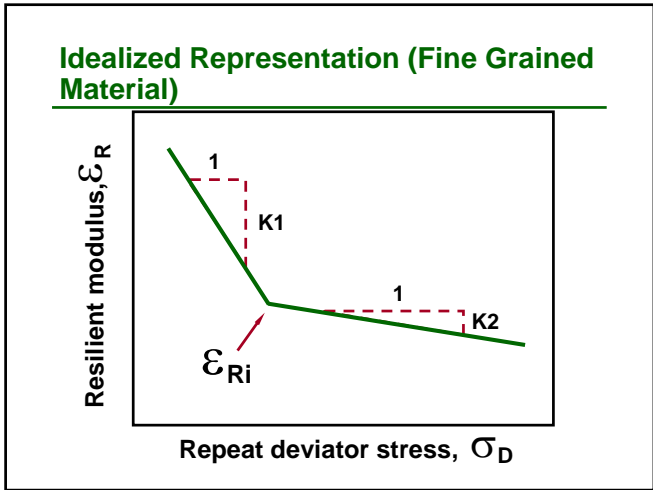
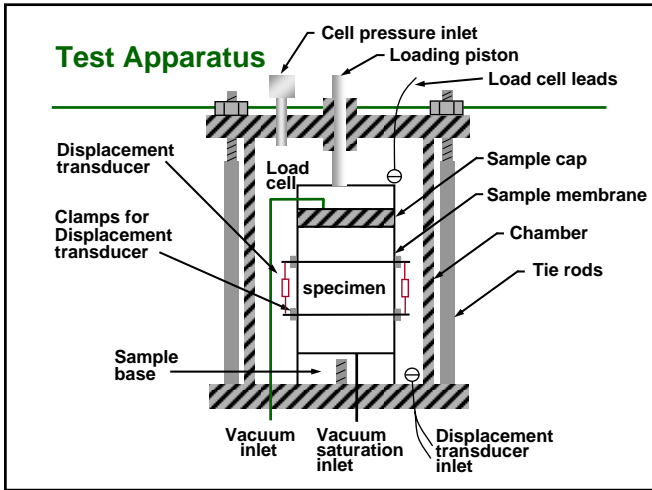
### Unbound Materials / Stiffness

- Resilient modulus - similar to Young's (elastic) modulus



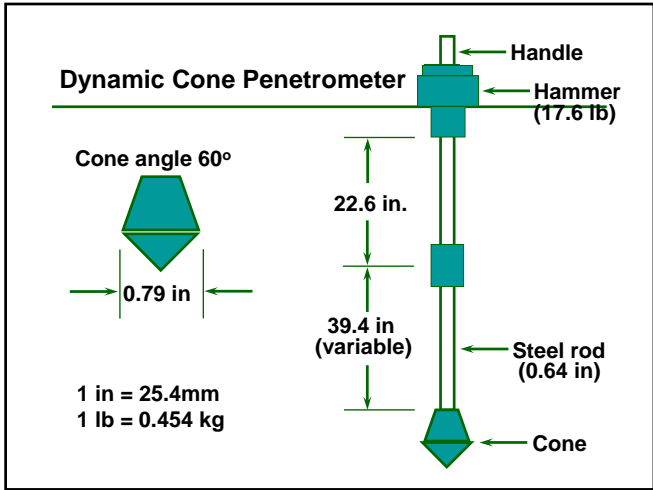
### Typical Sample Response to Load Pulse





### Unbound Materials / Strength

CBR  
 Unconfined compressive strength  
 Plate bearing (field test)  
 Dynamic cone penetrometer (field test)

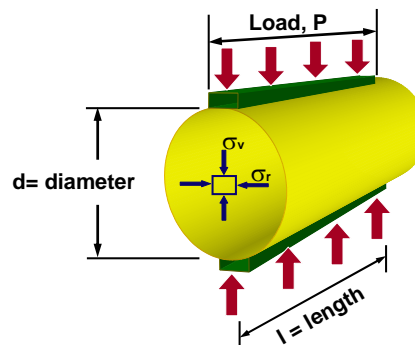


## Bound Materials / Stiffness

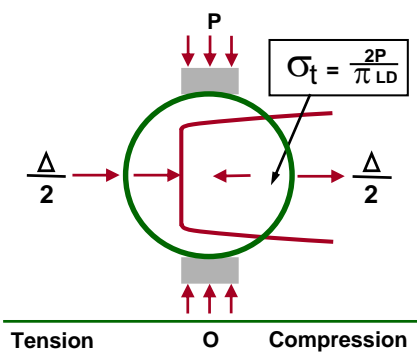
Resilient modulus - axial loading

Resilient modulus - indirect tension

## Specimen Loading



## Stress Distribution



## Bound Materials / Strength

Unconfined compression

Direct tension

Indirect tension

## Bound Materials / Stability

Marshall

Hveem

## Material Property Relationships

Soil classification

- AASHTO
- Unified
- FAA

Moisture and density

## **Correlations**

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**Strength vs. strength**

**Stiffness vs. strength**

**Stiffness vs. classification**

## **Other Considerations**

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**Volume stability**

**Stripping**

**Concrete durability**

**Seasonal variations**

## **Summary**

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**States of stress**

**Basic terminology**

**Importance of lab testing**

**Resilient modulus test**

**Other test procedures**

**Relationships and correlations**