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<th>Lecture No.</th>
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<td>Scope of Expansive Soils Problems and the Engineering Approach to their Solution</td>
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| 2          | Characterization of Expansive Soils for Engineering  
  a. Crack fabric diagrams  
  b. Mixture theory of continua |
| 3          | Characterization of Expansive Soils  
  c. Unsaturated Permeability: Formulation for large strain; effect of inorganic and organic solutions  
| 4          | Characterization of Expansive Soils  
  e. Unsaturated Permeability: Gardner's relation; Juarez-Badillo formulation field measurements  
  f. Shear strength of unsaturated soils Fredlund's formulation with two independent stress tensors |
| 5          | Characterization of Expansive Soils  
  g. Shear strength of unsaturated soils Lamborn's result from micromechanics application to shear strength theory  
  Use of nuclear moisture-density or radar equipment to assist in measuring shear strength of unsaturated soils |
| 6          | Characterization of Expansive Soils  
  h. Volume Change in Unsaturated Soils: Large strain formulation using the Juarez-Badillo approach  
  i. Volume Change Properties of Expansive Soils: Their dependence on the percent fine clay, the plasticity index, and the cation exchange capacity |
Characterization of Expansive Soils
   j. Stress-strain curves for unsaturated soils. Their dependence on suction, temperature, percent fine clay
   k. The time-temperature and time-suction shift functions for unsaturated soil
   l. Permanent deformation properties under repeated load of unsaturated soils
   m. Thermal properties

Characterization of Expansive Soils
   n. Thermal expansion and contraction properties and their dependence on suction, specific surface area, and electrical conductivity

Unsaturated Flow in Expansive Soils
   a. Darcy’s Law in Unsaturated Soil: Horizontal and vertical steady state flow

Unsaturated Flow in Expansive Soils
   b. Mitchell’s formulation of unsaturated transient flow
   c. Solutions to partial differential equations for transient flow using Laplace transforms
      Laboratory Samples: Suction and drying flux boundary conditions

Unsaturated Flow in Expansive Soils
   d. Field Conditions: Wetting, drying flux, and sinusoidal surface suction boundary conditions
   e. Steady state envelopes of suction change with depth. Examples

Prediction of Volume Change in Expansive Soil Masses
   a. Volume change due to suction change
   b. Overburden correction term, lateral earth pressure
   c. Crack fabric factor
   d. Example calculations
   e. Differential movement

Prediction of Volume Change in Expansive Soils
   f. Demonstration of microcomputer program
Design of Stiffened Slabs on Expansive Soils
a. Historical development
b. Problems: Long slabs, reinforcing
c. Status of design standards
d. Legal and ethical obligations

Laboratory Measurements of Expansive Soil Properties:
a. Psychrometers
b. Thermal moisture sensors
c. Electrical conductivity
d. Pressure plate apparatus
e. Cation exchange capacity
f. Hydrometer
g. Filter paper
h. pH

Field Measurements in Expansive Soils
a. Nuclear moisture and density
b. Dual tube nuclear density
c. Drop weight wave propagation
d. Electrical conductivity and pH

Design of Stiffened Slabs on Expansive Soils
e. Soil support characteristics
f. Design Equations: Moment, shear, and differential deflection
g. Design Capacity: Moment, shear, and differential deflection with and without post-tensioning

Design of Stiffened Slabs on Expansive Soils
h. Demonstration of microcomputer program for slab design

Design of Stiffened Slabs on Expansive Soils
i. Composition a design problem of a stiffened slab on ground. Description of the problem, site conditions.
j. Effects of site conditions on building damage

Design of Stiffened Slabs on Expansive Soils
k. Prediction of risk of exceeding Acceptable levels of damage
l. Use of risk to adjust the design quantities of moment shear, and differential deflection
Design of Drilled Piers in Expansive Soils
   a. Construction of drilled piers
   b. Soil stress conditions, suction conditions along the surface of a drilled pier
   c. Depth of the active zone for drilled piers

Design of Drilled Piers in Expansive Soils
   d. Historical development
   e. Problems: Bells, reinforcing, lateral support, tensile and bending stresses in the pier

Design of Drilled Piers in Expansive Soils
   f. Corps of engineers design method
   g. Reese and O'Neill contributions

Design of Drilled Piers in Expansive Soils
   g. Technion (Israel) design method
   h. Texas A&M analysis method

Design of Drilled Piers in Expansive Soils
   h. Texas A&M design method
   i. Needed improvements

Design of Highway Pavements on Expansive Soils
   a. Roughness spectrum
   b. Field observations
   c. Design equation and what governs the development of expansive clay roughness

Design of Airport Pavements on Expansive Soils
   a. Roughness spectrum
   b. Decorrelation distance
   c. Field observations - related to depth of the active zone
   d. Design equation

Design of Vertical Moisture Barriers
   a. Field observations
   b. Theory of moisture barrier effectiveness
   c. Interpretation of field observations
   d. Design approach

Design of Vertical Moisture Barriers
   e. Prediction of roughness
   f. Dependence on soil type, climate, vegetation, initial suction conditions, depth of cracks
Slopes in Expansive Soils

a. Downhill creep in slopes
b. Prediction of downhill creep
c. Slab design on slopes
d. Drilled pier design on slopes

Summary of Design of Foundations on Expansive Soils

References


