Spring Semester 2007

Advanced Soil Mechanics
(E 6246)

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General Information

Time: Tuesday, 18:50 – 21:20

Room: 644 MUDD

References: *The Mechanics of Soils: An introduction to critical soil mechanics* Atkinson, J.H. and Bransby, P.L., McGraw Hill, 1978

Soil Behavior and Critical State Soil Mechanics, Wood, D.M. Cambridge University Press, 1990

Critical State Soil Mechanics, Schofield, A.N. and Wroth, C.P., McGraw Hill, 1968

Foundations and Slopes: An Introduction to Application of Critical State Soil Mechanics, Atkinson, J.H., McGraw Hill, 1981

Critical Soil Mechanics via Finite Elements, Britto, A.M. and Gunn, M.J., Ellis Horwood, Ltd., 1987.

Constitutive Laws for Engineering Materials, Desai, C.S. and Siriwardane, Prentice-Hall, 1984.

Fundamentals of Soil Behavior, 2nd Ed., Mitchell, J.K., John Wiley, 1993

Office: 632 MUDD

Office Hour: Thursday, 13:00 - 15:00

Grading

Homeworks and Lab Reports (30%)
Midterm Examination (30%)
Final Examination (40%)

Course Descriptions

This Course is designed to integrate all aspects of geotechnical engineering at an advanced level. Students are required to conduct advanced soil testings (e.g., triaxial and plane strain compression tests). Characterizations of sand and clay are introduced using constitutive models, which are based on elastoplasticity. The modified Cam-clay model is implemented into coupled stress-flow finite element procedures. A final project is required where students conduct and compare the finite element results with the field measurements. MIT I-95 and Muar Test Embankments have been used as case histories and revisted using CRISP Program. A 30-minute presentation of the Final Project is required.

Note: The Final Report for this Course is as challenging as a Master's Thesis.

Stress and Strain in Soils

- States of Stress and Strain
- Mohr's Circle of Stress and Strain Increments
- Principal Stresses, Poles of Plane/Direction
- Plane of Maximum Stress Obliquity
- Plane of Zero Extension

Stress-Strain-Strength Characteristics of Sand

- Stress Conditions: Plane Strain, Triaxial, Simple Shear
- Triaxial and Plane Strain Compression Tests (Lab)
- Rowe's Stress-Dilatancy Relationships
- Stress Invariants
- Mohr-Coulomb Failure Criteria
- Failure Criteria under Three-Dimensional Stress Conditions
- Effects of Confining Stress, Intermediate Principal Stress, Bedding Plane, Stress Paths on Strength and Dilatancy
- Hyperbolic Model

Critical State Soil Mechanics

- Drained and Undrained Conditions
- Stress Path
- Consolidation and Dilatancy
- Critical State Line
- State Boundary Surface
- Modified Cam-Clay Model
- Cap Model

Time-Dependent Behavior of Clay

- Quasi Preconsolidation
- Creep and Stress Relaxation
- Singh-Mitchell Model
- Rheological Models

Elasto-Plasticity in Finite Element Consolidation Analysis

Elasto-Plasticity
Implementation of Modified-Cam Clay Model
Biot's Theory
Finite Element Formulation of Coupled Problem
Introduction to Commercial Program (CRISP was used in previous classes)
Case Study Analysis: MIT I-95 Test Embankment, Muar Test Embankment