SYLLABUS

CEE 8813D Plasticity of Geomaterials
Spring 2010

Instructor: Haiying Huang, Mason 253, 404 385 0059
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Schedule: T&Th 12:05-1:25
Office Hours: W 2:00 – 4:00pm or by appointment
Room: Mason 312

Course Objectives: The objectives of this course are to provide a basic understanding of the plasticity theory and to gain skills to solve geomechanics problems.

Course Requirement: homework (70%) and final project/exam (30%)

Tentative Course Content: yield criterion, flow theory, rigid plasticity, bifurcation theory, damage mechanics. The course will focus on problem solving with examples such as slope stability, bearing capacity/punch problems, flow of granular media in bins/hoppers, cutting processes, etc.

Required Reading

Davis, R.O. and Selvadurai, A.P.S. (1996). Elasticity and Geomechanics, Cambridge University Press.
Davis, R.O. and Selvadurai, A.P.S. (2002). Plasticity and Geomechanics, Cambridge University Press.

Suggested Reading

Hill, R. (1950). Mathematical Theory of Plasticity, Clarendon Press, Oxford.
Chen, W.F. (1975). Limit Analysis and Soil Plasticity, Elsvier.
Vermeer, P.A. and de Borst, R. Non-Associated Plasticity for Soils, Concrete and Rocks. Heron, **29**(1), 1984.
Kachanov, L.M. (1986). Introduction to Continuum Damage Mechanics, Springer.
Kachanov, L.M. (2004). Fundamentals of the Theory of Plasticity, Dover.
Wood, D.M. (1990). Soil Behavior and Critical State Soil Mechanics. Cambridge University Press.
Vardoulakis, I. and Sulem, J. (1993). Application of bifurcation theory to rock mechanics. In: Comprehensive Rock Engineering (ed. J.A. Hudson), Vol. 1, Section 23. Pergamon Press, Oxford.
Barber, J.R. (2002). Elasticity. Kluwer Academic Publishers.
Wu H.-C. (2005). Continuum Mechanics and Plasticity, CRC Press. (ebook in the library)

Course Outline - Plasticity of Geomaterials

Week	Subjects
1	Introduction - elasticity, plasticity, viscous behaviors - scalar, vector, tensor - stress, strain
2	Conservation laws Governing equations for elasticity
3	Yield Criteria - Tresca, von Mises, Mohr-Coulomb, Drucker-Prager, cap model
4	Circular and spherical openings subjected internal pressure and far field stress - elastic solution (Lamé) based on the Airy stress function - elasto-plastic solution (stresses)
5	Consistency conditions Hardening rules Flow rule
6	Principle of virtual work Uniqueness Normality rule Drucker's stability postulate
7	Cylindrical and spherical cavity expansion (pressuremeter problem)
8	Lower bound theorem - retaining wall - shallow foundation
9	Upper bound theorem & limit equilibrium - velocity jump conditions (incipient failure and mass flow) - hodograph - retaining wall (active and passive failure) - shallow foundation - mass flow in a hopper
10	Slip line analysis - governing equations (Tresca and Mohr-Coulomb) - stress characteristics and velocity characteristics - Prandtl/Hill solutions - retaining wall - circular opening
11	Nonlinear constitutive behavior - microscopic point of view - spring-bead system
12	Bifurcation analysis
13	Failure criteria for rocks (Hoek-Brown) rock quality evaluation (GSI; RQD; RMR)
14	Cam clay model
15	Final project