ADVANCED SOIL MECHANICS

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INTENDED AUDIENCE : Undergraduate students in Civil Engineering, Postgraduate and Ph. D. students in geotechnical engineering

PREREQUISITES : Nil for PG. For UG, geotechnical engineering basic courses need to be done before this course.

INDUSTRIES SUPPORT : Basic civil engineering infrastructural companies.

COURSE OUTLINE :

This course intends to bridge the basic soil mechanics concepts with the advanced topics related to stresses and soil strength. In the process, it will help to reinforce the understanding gained during the undergraduate learning and would help to alleviate any misconceptions related to the stress-strain response and strength behaviour of soils. Not all the concepts explained in this course are advanced, but attempts to add clarity to the knowledge gained at undergraduate level. This course is ideal for the orientation of geotechnical engineering post-graduate students and final year undergraduate students to the higher realms of geomechanical characteristics of soils. The course will help to appreciate the basic concepts of continuum mechanics, which is a pre-requisite for research in geomechanics. Even though the name is advanced, the course is introductory in nature when it deals with the advanced topics. It may be noted that this course do not deal with the other soil characteristics, namely flow characteristics and compressibility.

ABOUT INSTRUCTOR :

Prof. Sreedeep S is a Professor in the Geotechnical Engineering Division, Department of Civil Engineering, Indian Institute of Technology Guwahati since 2006. Since then he has taught the course Advanced Soil Mechanics multiple times till date. He obtained his Ph.D. and M.Tech. degrees from IIT Bombay and B. Tech. degree from Calicut University. His research interests include behavioural studies of unsaturated geomaterials, hazardous waste management, utilization of waste materials and bio-geotechnology. He has published around 100 peer reviewed journals and several conference/seminar proceedings. He was a recipient of the Shamsher Prakash Research Award for Geotechnical Engineering in 2014. He is a member of ASCE, ASTM, IACMAG, IGS and TC 106 of ISSMGE. He is a reviewer for several national and international journals.

COURSE PLAN :

Week 1: Module 1 Introduction to continuum mechanics

Introduction to course contents
1.1a Stress at a point-Cauchy stress
1.1b Stress at a point-Stress tensor
1.2 Stress acting on a plane
1.2a Stress acting on a plane example
1.3 Transformation of stress tensor

Week 2: Module 1 Introduction to continuum mechanics

1.4 Stress invariants
1.4a Relationship between stress invariants
1.4b Principal stresses and Eigen vectors
1.5 Strain in soil
1.6 Cause-effect relationship

Week 3: Module 1 Introduction to continuum mechanics

1.7 Important constitutive relationship
1.8 3D to 2D idealization
1.9 Mathematical formulation of plane stress, plane strain
1.10 Mathematical formulation of axisymmetric conditions
1.11 Summary of Module 1

Week 4: Module 2 Shear strength of cohesionless and cohesive soil

2.1a Basics of shear strength
2.1b Stress representation
2.2a Shear strength granular soil
2.2b Shear strength granular soil
2.3a Shear strength cohesive soil
2.3b Shear strength cohesive soil - Stress strain

Week 5: Module 2 Shear strength of cohesionless and cohesive soil

2.4a Pore water pressure and Skempton's equation
2.4b Overall pore water pressure parameter
2.4c Pore water pressure -plane strain-effect of sampling
2.4d Pore water pressure estimation

Week 6: Module 2 Shear strength of cohesionless and cohesive soil

2.5a Triaxial test
2.5b Interpretation triaxial test-UU UCS
2.5c Interpretation triaxial test-CU
2.5d Interpretation triaxial test-CD

Week 7: Module 2 Shear strength of cohesionless and cohesive soil/ Module 3 Stress path

2.6 Some additional aspects of shear strength
2.7 Summary of Module 2
Module 3 Stress path
3.1a Stress path and representation
3.1b Failure line in stress path
3.2a Stress path-some common cases
3.2b Stress path-some common cases

Week 8: Module 3 Stress path

3.3a Stress path-triaxial test-drained
3.3b Stress path-triaxial test-undrained
3.3c Stress path-additional undrained case
3.4a Stress path-field cases

Week 9: Module 3 Stress path/ Module 4 Critical state soil mechanics

3.4b Stress path-field cases
3.5 Stress path problems
3.6 Summary of Module 3
Module 4 Critical state soil mechanics
4.1a Introduction-Critical state soil mechanics

Week 10: Module 4 Critical state soil mechanics

4.1b Introduction-Critical state soil mechanics
4.2 CSSM-2 D representation
4.3 Peak state

Week 11: Module 4 Critical state soil mechanics

4.4 Soil yielding
4.5 Cam clay
4.6 Modified Cam clay
4.7a Prediction of soil behavior from MCCM

Week 12: Module 4 Critical state soil mechanics

4.7b Prediction of soil behavior from MCCM
4.8 Strain from MCCM
4.9 State boundary surface
4.10 CSSM problems
4.11 Summary of Module 4
Closure of Advanced Soil Mechanics Course