CE405 ADVANCED SOIL MECHANICS

Co-ordinator : Dr. M.R. Coop (Room 534), Email: m.coop@imperial.ac.uk

Status: Elective

Lecturers: Dr. M.R. Coop

Structure: 60 contact hours of lectures, tutorials and mini-projects

Links: CE303 : Recommended

Aims

Developing an understanding of the mechanical properties of soils forms an important part of the training and experience of the civil engineer. Because soils are made up of a wide range of particles of various sizes, shapes, gradings and packing arrangements, modelling their behaviour for engineering purposes is a difficult and challenging task. The aim of this elective is to explore, in some detail, the strength and stiffness of a wide range of natural soils and to develop appropriate mathematical models to describe and predict the engineering behaviour of the ground.

SYLLABUS

Stiffness and compressibility of soils

1. Strain at a point.
2. Ideal porous-elastic materials.
3. Compressibility of clays; intrinsic behaviour; compressibility of natural clays.
4. The fundamental work of Rendulic.
5. The Critical State framework.
6. Ideal elastic-plastic behaviour; the concept of the yield locus.
7. Elastic-plastic volume change of clays.

Undrained strength of clays

1. All of the above is used to develop an understanding of the factors influencing the undrained strength of soils.
2. MINI-PROJECT COVERING THE ABOVE WORK - To be handed out on Monday of Week 17 and submitted on Tuesday of week 20.

Cam-clay mathematical model

1. The concepts of elastic-plastic behaviour introduced above are used to develop the well known Cam-clay mathematical model for the behaviour of normally and lightly overconsolidated clays.
2. MINI-PROJECT COVERING THE CAM-CLAY MODEL - To be handed out on Monday of week 20 and submitted on Tuesday of week 23.

Course work assignments

The above two mini-projects are designed to cover the key aspects of the module and will help to reinforce the topics covered in the syllabus and with revision. The respective hand-in dates are listed above.

Assessment
One three hour examination counting 60% and the course work counting 40% of the total marks. The examination paper is split into two sections, *rubric* : Answer five questions, not more than three from either section.

Recommended Textbooks/Reading
The module is self-contained with full notes and hand-outs graded as follows:
. - required reading; - valuable background; - for information
The following are useful background texts:
Atkinson and Bransby, 'The Mechanics of Soils', McGraw-Hill (out of print but in the Library).
Lamb and Whitman, 'Soil Mechanics', Wiley.
Parry, 'Mohr Circles, Stress paths and Geotechnics', Spon.

Learning outcomes
At the end of this module, on completion of all classes, associated tutorial sheets, and mini-projects you are expected to be able to:

- Understand the roles and importance of ideal models, real soil behaviour and empirical procedures in Soil Mechanics.
- Have a thorough grasp of the effective stress principle and its limitations.
- Be able to represent stress changes for a variety of common practical problems as stress-paths using all of the common stress axes.
- Understand the Mohr-Coulomb strength criterion, its practical application and limitations.
- Have a clear understanding of the differences in behaviour between reconstituted soils (which act as ideal models) and natural soils including the influence of soil structure and bonding.
- Be completely familiar with the fundamental work of Hvorslev, Rendulic and the Cambridge School leading to the Critical State framework.
- Have a thorough understanding of ideal porous elastic and elastic-plastic materials and their application and limitations in representing the behaviour of real soils.
- Appreciate those factors that control the undrained strength of soils.

THE MODULE SHOULD GIVE YOU THE KNOWLEDGE AND CONFIDENCE TO APPLY MODERN SOIL MECHANICS PRINCIPLES TO GROUND ENGINEERING PROBLEMS.