

CE303 SOIL MECHANICS

Co-ordinator: Professor R J Jardine (Room 524), **Email:** r.jardine@ic.ac.uk

Status : Core Module

Lecturers: Prof. J. B. Burland (JBB)(room 502)
Prof. R. J. Jardine (RJJ)(room 532)
Dr. J. R. Standing (JRS) (room 528B)
Prof. D. M. Potts (DMP)(Room 530)
Dr. M. R. Coop (MRC) (room 534)

Laboratory Demonstrators: Postgraduates – room 430

Industry input: Skanska

Structure : 30 hours lectures; 10 hours tutorials; 1 hour laboratory; 9 hours mini-project.

Links: Geotechnics, Mechanics, Creative Design. See below for more details.

Introduction

The module runs over the Autumn and Spring terms. The mini-projects are carefully designed practical assignments that take you through much of the syllabus and provide a feel for the kind of decision-making you will meet in practice.

Aims

To allow you to learn how a geotechnical engineer analyses practical problems and designs real structures.

Links with other course modules

This module pulls together skills and knowledge picked up in mechanics classes, geotechnics classes and creative design sessions. You will be thinking about how structures interact with the ground. For example, where does the load from a structure go, how do I create a space in the ground to construct a basement? The module draws on the knowledge and skills gained during the first and second year modules in geotechnics – effective stress, soil strength, stiffness and compressibility, flow nets, and methods of analysis. The mini-projects in the earth pressures and foundations parts of the module will demand a creative approach to design, supported by sound calculations. The technical skills gained will feed directly into your 3rd year design project.

SYLLABUS

Introduction – 2 lectures – Prof. Burland; Mini-project – Dr. Coop.

- Recapitulation of effective stress, stress paths, dilatant and contractant behaviour, Mohr's circle, drained and undrained strength.
- Mini-project on the interpretation of laboratory data from shear box and triaxial testing.

Construction – 1 lecture – industry led session

- A case study will be presented covering the construction issues of a major civil engineering project in the South East of England.

Foundations – 9 lectures – Dr. Standing

- The design process.
- Capacity of foundations.
- Shallow – theoretical solutions and practical design for drained and undrained conditions.
- Deep – design of single and group piles in drained and undrained conditions.
- Settlement of foundations.
- Mini-project on conversion of the Queen's Tower to a free-standing bell tower.
- Laboratory investigation of shallow or deep foundations.

Earth pressures and retaining structures – 9 lectures – Prof. Jardine.

- At-rest, active and passive earth pressure conditions (Jaky, Rankine).
- Model wall test.
- Wall friction, analyses of Coulomb, Caquot and Kerisel.
- Problems in clay (drainage conditions, vertical cuts, tension cracks, flow nets etc.).
- Design of gravity structures.
- Sheet pile wall design and ground anchor design.
- Deep excavations, strut loads, base heave and ground movements.
- Mini-project on retaining wall design.

Slopes – 9 lectures – Prof. Potts.

- Description and classification of landslides.
- Stability analysis for drained and undrained conditions on failure surfaces of planar, circular and a general shape.
- Introduction to the use of stability charts and the effects of tension cracks.
- Partial submergence, critical pool level and rapid drawdown.
- Landslide investigation and instrumentation.
- Stabilization techniques – modification of the profile, drainage and retaining structures.

Coursework and submission dates

Three mini-projects with class time and self study; one laboratory:

- Interpretation of laboratory data – week 2/3
- Retaining wall design – week 9
N.B. this is an entirely class based exercise with submission on the same day that the project is set – be prepared!
- Foundation design – week 16/17
- One laboratory with associated write up in private study time - weeks 19 to 24 depending on group allocation

Assessment

- One 3 hour written examination after Easter with a mix of questions covering the syllabus, of which you must answer 5. The *first 5* will be marked.

Recommended Textbooks/Reading

Each of your lecturers provides a comprehensive set of notes covering the entire module requirements. Useful additional material can be found in:

BROMHEAD, E. N. *The Stability of Slopes*, Surrey University Press, 1986.

CLAYTON, C.R.I., MILITITSKY, J., and WOODS, R.I., *Earth Pressures and Earth Retaining Structures*, 2nd Edition, Blackie Academic and Professional.

TOMLINSON, M. *Foundation Design and Construction*, 6th Edition, Longman Scientific and Technical.

WHITAKER, T. *The Design of Piled Foundations*, Pergamon Press.

Learning outcomes

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

- Calculate the total and effective stress and pore pressure regimes in the ground.
- Design and analyse simple retaining wall and foundation systems:
- Size a retaining wall or foundation to perform safely under given loading conditions.
- Assess the ground movements associated with a given retaining wall or foundation system.
- Assess the stability of a slope under different loading conditions and using a variety of methods.
- Suggest sensible investigative methods and safe stabilising measures for slopes.

More specific learning objectives will accompany each component of the module.