Engineering Tripos Part IIB, 4D5: Foundation Engineering, 2017-18

Module Leader
Dr G Biscontin [1]

Lecturers
Dr G Biscontin and Dr S K Haigh

Timing and Structure
Lent term. 14 lectures. Assessment: 100% exam

Prerequisites
3D2 assumed

Aims
The aims of the course are to:

- introduce the challenges of foundation design and examine possible solutions; from simple pad footings, through piles and caissons, to drop-and drag-anchors.

Objectives
As specific objectives, by the end of the course students should be able to:

- assess the design requirements of a foundation.
- deduce appropriate soil properties for foundation design from site investigation data.
- decide whether to use a shallow or deep foundation.
- design shallow and deep foundations against collapse.
- design shallow and deep foundations against excessive settlement.
- explain the difference between drained and undrained response.
- recognise mechanisms which contribute to generating deformations and load capacity.
- back-analyse observed foundation performance
- appreciate lessons learnt from field data obtained from case histories.

Content
All civil engineering structures from houses to tethered oil platforms require foundations.

The module begins by examining the requirements of a foundation; the applied loading, the acceptable deformations and the derivation of appropriate soil properties for each aspect of design.

The module then builds on material from 3D2 (geotechnical engineering) to examine theoretical solutions for the capacity (strength) and settlement (stiffness) of shallow and deep foundations under simple loading conditions in idealised soils. Strength is dealt with using plasticity. Stiffness is dealt with using elasticity. These theoretical solutions are then extended to more complex loading conditions and less idealised soils. The course is widely
illustrated with case studies from the offshore industry.

**Foundations Design (2L)**

- Foundation types;
- Loading conditions;
- Allowable deformations;
- Relevant soil behaviour and soil models;
- Selection of design soil properties

**Shallow Foundations (6L)**

- Strength: Undrained failure of strip footings: Vertical (V), Horizontal (H) and Moment (M) capacity;
- Strength: Drained failure of strip footings: V-H-M capacity, superposition of surcharge and self-weight effects;
- Effects of footing shape and embedment, and soil heterogeneity;
- Stiffness: Elastic settlement of shallow foundations: drained and undrained;
- Stiffness: Settlement of shallow foundations on non-linear soil.

**Deep Foundations (6L)**

- Deep foundation types and construction methods; piles, caissons, drop-anchors;
- Pile strength: Axial and lateral capacity;
- Pile stiffness: Axial and lateral deformations;
- Piles: load testing, influence of installation method on performance;
- Pile groups: mutual influence, block behaviour, differential settlement;
- Offshore solutions: caissons, anchors: installation methods and capacity.

**Coursework**

The preliminary evaluation of three design solutions for an offshore wind turbine foundation.

**Booklists**

Please see the Booklist for Group D Courses [2] for references for this module.

**Examination Guidelines**

Please refer to Form & conduct of the examinations [3].

**UK-SPEC**

The UK Standard for Professional Engineering Competence (UK-SPEC) [4] describes the requirements that have to be met in order to become a Chartered Engineer, and gives examples of ways of doing this.

UK-SPEC is published by the Engineering Council on behalf of the UK engineering profession. The standard has been developed, and is regularly updated, by panels representing professional engineering institutions, employers and engineering educators. Of particular relevance here is the ‘Accreditation of Higher Education Programmes’ (AHEP) document [5] which sets out the standard for degree accreditation.

The Output Standards Matrices [6] indicate where each of the Output Criteria as specified in the AHEP 3rd edition document is addressed within the Engineering and Manufacturing Engineering Triposes.

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