Engineering Tripos Part IIB, 4D9: Offshore Geotechnical Engineering, 2019-20

Module Leader

Dr C Abadie [1]

Lecturers

Dr C Abadie, Dr S Stanier & Dr D Liang [2]

Timing and Structure

Lent term. 14 Lectures + 2 examples classes. Assessment: 100% exam

Prerequisites

3D2 assumed

Objectives

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

- Introduce the geology and geotechnical properties of the seabed in renewable energy and hydrocarbon producing regions;
- Develop awareness of the geohazards prevalent in the offshore environment;
- Introduce offshore site investigation techniques and methods of sediment characterisa- tion;
- Introduce the design of geotechnical offshore infrastructure including pipelines, shallow foundations, piles and anchors, for both renewable energy and hydrocarbon producing facilities;
- Develop an awareness of the potential impact of scour on subsea infrastructure.

Content

The offshore environment (2 hours: sas229)

- A historical perspective on energy production in the oshore environment
- Continental drift and plate tectonics
- Extent and topography of the Continental margins
- Sediment characteristics, distribution and origins
- Offshore geohazards

Offshore site investigation (2 hours: sas229)

- Purpose and techniques
- Geophysical and geotechnical surveys
- In-situ tests: cone penetrometer, full-flow penetrometers and vane shear
- Sampling methods
- Simple shear testing: strain and pore pressure accumulation
- Model testing

Pipelines (2 hours: sas229)

- Pipeline systems and terminology
- Routing and hazard avoidance
- Pipeline installation
- Hydrodynamic stability and thermal expansion management
- On-bottom pipelines: embedment, axial and lateral resistance
- Buried pipelines: uplift resistance

Shallow foundations (2 hours: cna24)

- Types and applications
- Ultimate limit state: bearing capacity and failure envelope approaches
- Installation of embedded shallow foundations
- Serviceability limit state: immediate and consolidation settlements
- Removal of shallow foundations

Piles (2 hours: cna24)

- Types and applications
- North Sea examples: oshore renewables and hydrocarbon producing platforms
- Axial response:
    - Capacity and stiffness
    - Behaviour in clay / sand / rock
    - Linear elastic pile stiness solutions
    - Numerical analysis using the load transfer method
- Lateral response:
    - Limiting lateral resistance and design charts
    - Typical P-y curves
    - PISA
    - Design for cyclic loading

Anchors (2 hours: cna24)

- Type of buoyant facilities and mooring configurations
- Types of anchor:
    - Surface / gravity anchors
    - Embedded anchors: piles, caissons and drag anchors
- Design principles for:
    - Anchor chain response
    - Drag anchors
    - Suction caissons
- Next generation anchors

Scour (2 hours: dl359)

- Scour processes: sediment transport and scour hole development
- Scour hole measurement techniques
- Predicting scour around: pipelines and pile foundations
- Scour remediation techniques

Booklists

Please see the Booklist for Group D Courses [3] for references for this module.

Examination Guidelines

Please refer to Form & conduct of the examinations [4].

UK-SPEC

This syllabus contributes to the following areas of the UK-SPEC [5] standard:

Toggle display of UK-SPEC areas.

General Learning Outcomes

Graduates with the exemplifying qualifications, irrespective of registration category or qualification level, must satisfy the following criteria:

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