Engineering Tripos Part IIB, 4D7: Concrete and Prestressed Concrete, 2019-20

Module Leader

Dr J Orr [1]

Lecturers

Dr J Orr and Prof C Middleton [2]

Timing and Structure

Michaelmas term. 12 lectures + 2 examples classes + coursework. Assessment: 75% exam, 25% coursework

Prerequisites

2P8, 3D3

Aims

The aims of the course are to:

- convey the principles of analysis and design of reinforced and prestressed concrete structures (beams, slabs, columns, and frameworks, in shear, torsion and bending)
- evaluate the issues associated with reinforced and prestressed concrete structures which are core to the future use of the material, including sustainability, durability, and construction technology
- place concrete into context within the UN sustainable development goals

Objectives

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

- describe the constituents and properties of concrete.
- evaluate deterioration processes affecting concrete.
- apply the principles of limit state design for reinforced and prestressed concrete determinate and statically indeterminate structures
- analyse concrete structures using plasticity theory.
- deal with complex issues both systematically and creatively, make engineering judgements in the absence of complete data, and communicate conclusions clearly.

Content

Concrete is the world's most widely used man made material. This course will build on the knowledge you already have (2P8 and 3D3) to continue to examine the role of reinforced and prestressed concrete in the built environment. At the end of the course you will be capable in the design of both reinforced and prestressed concrete, understanding when each is appropriate to use. We will also place them in the wider context of sustainable design, examining how good design can save significant amounts of concrete and carbon dioxide emissions.

4D7 content is relevant to UN SDGs 11 (Sustainable cities and communities), 12 (Responsible consumption and production), and 13 (Climate Action).

Reinforced concrete (6L)

Assessed by Examination

Principles (4L)

- Introduction, Applications, Definitions, Lower bound theorem
- Ultimate limit state design (Beams, columns, slabs)
    - Instability
    - Shear behaviour
    - Torsion
- Other aspects – detailing, precast, composite structures.

Material properties (1L)

- Materials, present and future
- Hydration and strength of cement paste
- Uniaxial properties of concrete
- Concrete under multiaxial stress

Durability (1L)

- Deterioration of concrete and steel
- Preventative measures and future materials
- Whole life costing

Prestressed Concrete (5L)

Principles (3L) - Assessed by coursework (25% of 12 lectures)

- Introduction, applications, definitions.
- Section design, Magnel diagram (Statically determinate structures)
- Ultimate strength (simple modifications to RC theory), shear failure and prevention, tendon strains, anchorage zones

Continuous beams (1L) - Assessed by examination

- Secondary moments
- Design of continuous beams.

Losses and the long term (1L) - Assessed by examination

- Loss of prestress, creep behaviour

Structural failures (1L)

Assessed by examination.

- Risk of failure (reinforced and prestressed concrete)
- Case studies

Coursework

Coursework	Format	Due date & marks
Prestressed beam design Coursework 1: This will consist of carrying out test on prestressed (bonded and unbonded) beams, writing a short report and undertaking a conceptual design exercise. Learning objective: • To understand how concrete is prestressed • To see the effect such prestress has on a structure • To observe failure modes of a prestressed structure • To undertake calculations as part of a conceptual design exercise • To assess a submission and provide peer review feedback to colleagues Assessment criteria The best students will be able to: • Compare and contrast the behaviour of reinforced and prestressed concrete structures with commentary supported by their test data; • Reflect on the behaviour of prestressed concrete to respond to a conceptual design brief • Demonstrate effective communication of both mathematical and conceptual ideas. • Reflect on their own work having undertaken a peer assessment exercise.	Peer assessment Each student will mark two other reports and then reflect on their own submission Report / Presentation [non] anonymously marked	day during te Thu week 3 [xx/60]

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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Links
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