DEPARTMENT OF CIVIL AND ENVIRONMNETAL ENGINEERING, HKUST

CIVL 3320Design of Reinforced Concrete

Spring 2023-2024

Instructor:

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Lectures: 1.5 hours twice per week

Tutorial: 1 hour per week

Credits: 3

Course description

This is a required course for civil engineering students and a necessary background for any structural engineer. It follows a chain of structural engineering courses which includes CIVL 2110 (Statics), CIVL 2120 (Mechanics of Materials) and CIVL 3310 (Structural Analysis).

The purpose of the course is to introduce the fundamental and indispensable for structural engineers, basic design principles. Specifically, the course introduces the principles and methods of design for reinforced concrete structures. The focus is on the limit states design approach that is at the core of most contemporary design codes. Subsequently, the course discusses how to design reinforced concrete members namely: slabs, beams, columns, and (depending on the available time) potentially staircases, and beam-column joints, for the most common ultimate, as well as, serviceability limit states (of deflection and cracking). The course materials are written to conform to the Hong Kong Code of Practice for Structural Use of Concrete 2013, while BS 8110 and EC2 are also referred when appropriate.

Course outline

The course comprises of the following chapters-modules:

1. Design of Reinforced Concrete
2. Analysis of Sections of Reinforced Concrete Members
3. Shear, Bond and Torsion
4. Serviceability
5. Design of Reinforced Concrete Beams
6. Design of Reinforced Concrete Slabs
7. Design of Reinforced Concrete Columns

Text

- Kuang JS. Design of Reinforced Concrete, CIVL 3320 Course Notes. HKUST.

References

1. **Design to BS 8110:**
   Mosley WH, Bungey JH, Hulse R (1999). Reinforced Concrete Design, 5th edn. Palgrave MacMillan, Hampshire.
   Bhatt P, MacGinley TJ, Choo BS (2006). Reinforced Concrete: Design Theory and Examples, 3rd edn. Taylor & Francis, Abingdon, Oxfordshire.

2. **Design to Eurocode 2:**
   Mosley WH, Bungey JH, Hulse R (2012). Reinforced Concrete Design to Eurocode 2, 7th edn. Palgrave MacMillian, Hampshire.

   Bhatt P, MacGinley TJ, Choo BS (2014). Reinforced Concrete: Design Theory and Examples, 4th edn. CRC Press, Boca Raton, Florida.

Codes of practice

- Buildings Department (2013). Code of Practice for Structural Use of Concrete 2013. The Government of Hong Kong SAR, Hong Kong. (This design code can be downloaded from "http://www.bd.gov.hk/english/documents/index_crlist.html") British Standards Institution (1997). Structural Use of Concrete, BS 8110. BSI, London.

- British Standards Institution (2004). BS EN Eurocode 2:2004 Design of Concrete Structures – Part 1-1: General Rules and Rules for Buildings. BSI, London.

Assessment

Assessment serves two purposes: to help the student achieve the learning outcomes and to produce evidence of that learning.

course grading**:**

Participation:	5%
Assignments & Labs:	20%
Midterm:	30%
Final Exam:	45%

- Assignments and lab reports are generally due one week after they are assigned.
- Fail to take the final exam may incur a failing grade of the course.

Learning Process

There will be two lectures each week, lasting approximately 1h and 20 minutes each. Lecture notes will be provided the day before each lecture. In addition, tutorials will be given each week according to the time schedule.

Throughout the course the students will be able to put theory into practice by participating in the solutions of example problems (during lectures and tutorial sessions) and by working on assignments (out-of-class).

Advice: If you miss a class you are advised to seek the material taught that day (e.g. in the form of class notes) from a classmate.

Prerequisite and co-requisite skills

Prerequisite(s):

- CIVL 2810 – "Construction Materials" (Properties of engineering materials and their relation to the internal structure of materials; includes physical properties of construction materials like portland cement concrete, asphalt, polymers, ferrous metals and non-ferrous metals)
- CIVL 3310 "Structural Analysis" (Structural forms and modeling, statically determinate structures, statically indeterminate structures, force and displacement methods, deflections of structures, influence lines, approximate analysis, energy methods)

Learning Outcomes

At the end of this course students should have the ability to:

1. Adopt the critical Ultimate Limit States and the Serviceability Limit States concerning deflection and cracking control and satisfy the pertinent design requirements.
2. Design reinforced concrete beams for flexure, shear, torsion and serviceability and provide proper detailing.
3. Design reinforced concrete slabs for flexure, shear, (punching) shear and serviceability.
4. Design reinforced concrete columns for Uniaxial and Biaxial Bending combined with Axial loading.

In the above-described outcomes, it has been implicitly assumed that by the end of this course you are familiar with the terminology used in it (e.g. "punching" shear etc.).

Class Schedule

mod	Topics	Assignments & Assessment
1	Design of Reinforced Concrete • introduction • Limit State Design • analysis of the structure	**HW1**
2	Analysis of Sections of R/C Members • design stress-strain curves • general behaviour of R/C beams in bending • analysis of the structure • singly reinforced rectangular section in bending • doubly reinforced rectangular section in bending • flanged section in bending (T-beam and L-beam sections) • summary of section design of singly and doubly reinforced beams	**HW2**
3	Shear, Bond and Torsion • axial load plus uniaxial bending • shear strength of beams with shear Reinforcement • sections subjected to torsion • bond and laps	**HW3**
4	Serviceability • Serviceability Limit States of Deflection and Cracking • load Combinations for Serviceability Limit States • detailing requirements • deflection • cracking	**Midterm**
5	Design of Reinforced Concrete Beams • preliminary analysis and member sizing • design for bending • design for shear and torsion • design example of RC beam	
6	Design of Reinforced Concrete Slabs • introduction • one-way solid slabs • two-way solid slabs • stairs • punching shear	**HW4**
7	Design of Reinforced Concrete Columns • types of columns • column classification • reinforcement detailing • design of short columns	
9	Recap	
10	***Final-exam***	