School of Civil and Environmental Engineering

Term 1, 2020

CVEN9809 REINFORCED CONCRETE STRUCTURES

COURSE DETAILS

Units of Credit	**6**	
Contact hours	3 hours per week	
Class	Wednesday 18:00 – 21:00	Room: Colombo Theatre A (K-B16-LG03)

Course Coordinator and Lecturer

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INFORMATION ABOUT THE COURSE

Assumed knowledge: CVEN3301 OR CVEN2303, CVEN3304 OR CVEN3302

This course will continue with and will build on the concepts introduced in Structural Analysis and Modelling (CVEN3301 OR CVEN2303), Concrete Structures (CVEN3304) OR Structural Behaviour and Design (CVEN3302) and Advanced Concrete Structures (CVEN4301).

HANDBOOK DESCRIPTION

A dynamic course in the design of reinforced concrete structures to AS3600-2018 and international standards using advanced methods of analysis and design. Topics covered will be chosen from: concrete materials, failure theories, models and behaviour under load; design using linear stress analysis; strut-and-tie modelling; shear and torsion; serviceability; detailing and special provisions for the use of high strength concretes; collapse load methods for the design of regular and irregular slabs.

https://www.handbook.unsw.edu.au/postgraduate/courses/2020/CVEN9809/

OBJECTIVES

The aim of this course is to undertake an advanced coverage of various topics relating to the design of concrete structures. The course is targeted at students who specialise in Structural Engineering and are in the early stages of their career.

The main objective of this course is to provide opportunities for students to

- reinforce their knowledge of structural concrete and design
- further develop in-depth understanding and advance skills in structural design
- reinforce their understanding of philosophy and principles of design and link design and analysis with respect to nonlinear behaviour of concrete
- develop the ability for analytical and independent critical thinking and creative problem solving

- develop skills related to lifelong learning, such as self-reflection (ability to apply theory to practice in familiar and unfamiliar situations); and
- acquire the skills for effective collaboration and team-work
- creative and critical thinking ability to develop and design new types of structural systems based on load path

TEACHING STRATEGIES

The teaching strategies that will be used and their rationale. Give some suggested approaches to learning in the course.

Approaches to learning;

Private Study	• Review lecture material and textbook • Do set problems and assignments • Join Moodle discussions of problems • Reflect on class problems and assignments • Download materials from Moodle • Keep up with notices and find out marks via Moodle
Lectures	• Find out what you must learn • See methods that are not in the textbook • Follow worked examples • Hear announcements on course changes
Assessments	• Demonstrate your understanding of the principles of structural design • Demonstrate your knowledge and skills in design of reinforced concrete • Demonstrate higher understanding and problem solving

EXPECTED LEARNING OUTCOMES

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

Learning Outcome		**EA Stage 1 Competencies**
1.	demonstrate an understanding of fundamental and advanced concepts in structural concrete and apply the knowledge of structural design practice	*PE1.1, PE1.2, PE 1.3, PE1.5*
2.	Fluently use the Australian standards (e.g. AS3600 and AS1170) and other structural concrete design resources and develop skills for application of systematic reinforced concrete design processes	*PE2.2, PE2.3*
3.	communicate your design in written and graphical form and develop skills in effective teamwork	*PE3.2, PE3.6*

For each hour of contact it is expected that you will put in at least 1.5 hours of private study.

COURSE PROGRAM

Term 1 2020

Date	Topic	Lecture Content	Reading/Demonstration Content
19/02/2020 (Week 1)	**Introduction**	Non-linear aspects of concrete and reinforcement; failure theories and surfaces.	Textbook: Chap. 1
26/02/2020 (Week 2)	**Linear stress analysis**	Revisit Mohr circle; 2D stress state; design of RC membranes by linear stress analysis	Additional notes provided. One screencast to be provided
04/03/2020 (Week 3)	**Strut-and-tie modelling:** Part 1	Terminology, definitions & principles of strut & tie modelling	Textbook Sections: 7.1 to 7.5 + Additional Notes provided
11/03/2020 (Week 4)	**Strut-and-tie modelling:** Part 2	Design of non-flexural members according to AS3600-2018	Textbook Sections: 7.6 to 7.8
18/03/2020 (Week 5)	**Design for serviceability:** Part 1	Introduction to time effects; design procedures; serviceability limit states; cracked section analysis; deflection control	Textbook Sections: 1.10; 3.3.1 to 3.3.5 + Additional notes to be provided Two video recorded demonstration to be provided
23/03/2020 (Week 6)		***Non-teaching week for all courses.***	
01/04/2020 (Week 7)	**Design for serviceability:** Part 2	Deflection by refined calculations; tension chord model; crack width calculations and crack control.	Textbook Section: 3.3.6 + Additional notes to be provided One video recorded demonstration to be provided
08/04/2020 (Week 8)	**Collapse load: Yield Line method**	Principles, upper-bound methods; yield line theory	Additional notes to be provided
15/04/2020 (Week 9)	**Introduction to CFT and MCFT**	Design of reinforced concrete members for shear and torsion AS3600-2018	+ Additional notes provided. Two video recorded demonstrations to be provided.
22/04/2020 (Week 10)	**Detailing of RC structure/columns**	Continuity of load paths; connections and joints; special provisions for HSC columns.	Textbook: Chap 8 & Section 5.7+ Additional notes provided.
29/04/2020 (Week 11)	**Recap the subject content**	***Make up week for courses affected by Public Holidays***	No face to face lecture. A screencast to be provided

Note: *This target timetable (topic to be covered in each week) is indicative and subject to change. Every effort will be made to inform students of variations to the above programme.*

ASSESSMENT

As a PG design subject, the focus is on works practiced in industry and the subject assessment is set to match these skills and meet the learning outcomes. This course will be assessed on students' demonstrated knowledge on the topics being taught; including strut-and-tie modelling, collapse load method, design of reinforced concrete members subject to shear and torsion, deflection and crack control in reinforced concrete structures and design of RC membrane using linear stress analysis.

Students who perform poorly in the assignments and demonstrations are recommended to discuss progress with the course coordinator during the semester.

The Final Examination is worth 60% of the Final Mark if class work/assignment is included and 100% if assignment marks is not included. The class work/assignments are worth 40% of the Final Mark if included. A mark of at least 35% in the final examination is required before the mark of assignments is included in the final mark. Otherwise, the final grade in the subject will be based on the performance in the final exam.

The formal exam scripts will not be returned but students are permitted to view the marked script.

Note: *Subject coordinator reserves the right to adjust final marks by scaling if agreed by the HoS.*

	Assessment	**Rationale and assessment criteria**
1.	Assignment 1	This individual assignment contains 1 question covering the linear stress analysis method and its application for design of RC membranes. The main objective is it to encourage students engage with the subject content as soon as possible and develop an understanding about advanced concepts and advanced design of RC structures.
2.	Assignment 2	This assignment contains 2 questions, on short-term deflection control and strut-&-tie modelling and design of non-flexural members. The main objective of this group assessment is to provide opportunities for students to reinforce their knowledge and understanding of advanced reinforced concrete design under ultimate and service loading condition. Emphasis is placed on design of non-flexural RC members under ultimate limit state and deflection control of the slabs and beams under short-term service loads according to AS3600-2018 provisions.
3.	Assignment 3	This individual assignment contains 2 questions covering topics on shear/torsional design of RC members and yield line analysis/design of RC members. The main objective is to provide opportunity for students to learn and practice principles of yield line theory and shear/torsion design of RC beams according to AS3600-2018.
4.	Final exam	The main objective of this individual assessment covering the entire subject contents is to provide opportunities for students to demonstrate their knowledge and understanding of advanced reinforced concrete design and higher skills in using Australian standard AS3600-2018.

Details of each assessment component, the marks assigned to it, the criteria by which marks will be assigned, and the dates of submission are set out below.

Important Note: *Assignments must be submitted online via the assignment submission links to be provided on Moodle. Assignments must be submitted by 6:00 pm of the due dates.*

Supplementary Examinations for Term 1 2020 will be held on Monday 25th May – Friday 29th May (inclusive) should you be required to sit one. You are required to be available during these dates. Please do not to make any personal or travel arrangements during this period.

PENALTIES

Late submission of assignments will be penalised at the rate of 10% per day after the due time and date have expired.

ASSESSMENT OVERVIEW

Item	Length	Weighting	Learning outcomes assessed	Assessment Criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
1. Assignment-1 (Individual)	Less than 2 weeks	10%	Application of systematic design processes and ability for analytical thinking in the context of structural design.	Understanding fundamentals of limit states and application of linear stress analysis for design of RC membranes	08/03/2020	11/03/2020	13/03/2020
2. Assignment-2 (Group)	Less than 3 weeks	15%	Develop team work skills & effective communication in structural design practice and developing skills for confident use of Australian standards for ultimate and serviceability states	Ability for analytical thinking and understanding of advanced reinforced concrete design with emphasis on short-term deflection control and application of strut-&-tie modelling for design of non-flexural members	05/04/2020	10/04/2020	15/04/2020
3. Assignment-3 (individual)	Less than 3 weeks	15%	Demonstrate an understanding about design of RC members for shear and/or torsion and principles of yield line theory for analysis and design of slabs	Students understanding of the application of MCFT for shear/torsional design of RC according to AS3600-2018 and also develop an understanding about yield line theory and its application for design of slabs	03/05/2020	07/05/2020	10/05/2020
4. Final exam	2 hours	60%	Demonstrate an overall understanding of advanced concepts in structural concrete and fluent use of Australian standards for familiar and unfamiliar situations	The entire subject content on analysis and design of RC structures under service and ultimate loading conditions are assessed.	Please see final examination timetable		

Note: *This target timetable for submission of assignments is indicative and subject to change. Every effort will be made to inform students of variations to the above submission deadlines.*

RELEVANT RESOURCES

Text Book: Foster, Kilpatrick and Warner, *Reinforced Concrete Basics*, 2nd Edition, Pearson Prentice Hall, 2010. [ISBN 9781442538450]

Available online at:

UNSW Bookstore:

https://www.bookshop.unsw.edu.au/details.cgi?ITEMNO=9781442538450

or

Pearson:

http://www.pearson.com.au/Catalogue/TitleDetails.aspx?isbn=9781442538450

General References:

- AS3600-2018, "Concrete Structure", Standards Australia, 2018.
- Park and Paulay, Reinforced Concrete Structures, Wiley, NY, 1975.
- Park and Gamble, Reinforced Concrete Slabs, 2nd Edition, John Wiley and Sons, New York, 2000.
- FIB Model Code, 2010, Federation International du Beton, Vol. 1 & Vol 2 (fib Bulletins 65 and 66).

Note: Other references may be given as required reading for each topic. These will usually be contained in technical journals and available via the library or made available via Moodle.

Access to Australian Standards:

Australian Standards may be accessed through the UNSW Library as follows:

1. Go to the UNSW library home page at: **http://www.library.unsw.edu.au/**
2. Click on the "**Database**"
3. Search for and Click on the "**Australian Standards: SAI Global**"
4. You need to enter your UNSW student ID and password
5. Enter the Standard desired (for example enter 3600 to search for AS3600) into the search field.

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

https://student.unsw.edu.au/dates

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

https://student.unsw.edu.au/plagiarism

ACADEMIC ADVICE

(Formerly known as Common School Information)

For information about:

- Notes on assessments and plagiarism,

- School policy on Supplementary exams,
- Special Considerations: student.unsw.edu.au/special-consideration
- Solutions to Problems,
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC.

Refer to Academic Advice on the School website available at:

https://www.engineering.unsw.edu.au/civil-engineering/student-resources/policies-procedures-and-forms/academic-advice

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership