CVEN9809

Reinforced Concrete Design

Term 1, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Hamid Valipour	h.valipour@unsw.edu.au	By Appointment	Room 710, Level 7, School of Civil and Environmental Engineering	93856191

School Contact Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

Course Details

Units of Credit 6

Summary of the Course

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; torsion; serviceability; detailing and special provisions for the use of high strength concretes; collapse load methods for the design of regular and irregular slabs.

Course Aims

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
- creative and critical thinking ability to develop and design new types of structural systems based on load path

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Utilize AS 3600 and AS 1170 for the design of complex Reinforced Concrete (RC) structures.	PE2.2, PE2.3
2. Describe and apply advanced RC design principles to the design of complex non-flexural members.	PE1.1, PE1.2, PE1.3, PE1.5
3. Explain nonlinear behaviour and failure theories of concrete.	PE1.1, PE1.2
4. Apply advanced compression-field theory to design of RC members subjected to shear and torsion.	PE1.1, PE1.2, PE2.1, PE2.2
5. Analysis of short- and long-term effects and deflection control of RC structures.	PE1.1, PE1.2, PE2.2

Teaching Strategies

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

Additional Course Information

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)

Assessment

Failure to attend the quiz or failure to submit assignments will result in a mark of zero. In the case of approved special considerations (only for quiz and assignments), the weight of assessment will be added to the other assessments (i.e., quiz and assignments).

Students must achieve a mark of at least 40% in the final examination in order to pass the course.

UNSW has a standard late submission penalty of 5% per day, for all assessments where a penalty applies, capped at five days (120 hours), after which a student cannot submit an assessment, and no permitted variation.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Online short quiz - 1	10%	07/03/2022 07:00 PM	1, 2, 3, 4
2. Assignment-1	15%	05/04/2022 07:00 PM	1, 5
3. Assignment-2	15%	20/04/2022 07:00 PM	1, 3
4. Final Exam	60%	Not Applicable	1, 2, 3, 4, 5

Assessment 1: Online short quiz - 1

Start date: 07/03/2022 06:00 PM
Assessment length: 60 minutes
Submission notes: Short answer Quiz
Due date: 07/03/2022 07:00 PM
Marks returned: 11/03/2022

This assessment contains two questions that involve analysis and design of a RC member using two different methods, i.e. linear elastic analysis and strut-and-tie modelling.

This is not a Turnitin assignment

Additional details

Note: This target assessment timetable is indicative and subject to change. Every effort will be made to inform students of variations to the above program.

Assessment 2: Assignment-1

Start date: 21/03/2022 07:00 AM
Assessment length: 2 Weeks
Due date: 05/04/2022 07:00 PM
Marks returned: 11/04/2022 07:00 PM

The main focus of assessment 2 is the short- and long-term deflection control of RC/PT members.

Emphasis is placed on cracked/uncracked sections and the effect of shrinkage and creep on deflection of RC/PT beams.

This is not a Turnitin assignment

Assessment 3: Assignment-2

Start date: 05/04/2022 07:00 AM
Due date: 20/04/2022 07:00 PM
Marks returned: 26/04/2022 07:00 PM

In this assignment, students are required to analysis and design RC slabs using yield line theory. Furthermore, ability of students for desing of RC beams subjected to torsion is assessed.

This is not a Turnitin assignment

Assessment 4: Final Exam

Assessment length: 2 hours

Students are required to answer two questions (2 hour exam) that involve different aspects of reinforced concrete design such as deflection and crack control, strut-and-tie modelling, linear stress analysis/design and plastic design of RC structures.

This is not a Turnitin assignment

Hurdle requirement

A mark of at least **40% in the final examination** is required before the class work is included in the final mark.

If students receive <40% in the final exam, their final mark in the subject is the same as final exam mark.

Additional details

Note: Please refer to final exam timetable to be released by school.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

Date	Topic	Lecture Content	Reading/Demonstration Content
16/02/2022 (Week 1)	**(1) Introduction** **(2) Linear stress analysis**	Non-linear aspects of concrete and reinforcement; failure theories and surfaces. Revisit Mohr circle; 2D stress state; design of RC membranes by linear stress analysis.	Textbook: Chap. 1 Watch the pre-recorded lecture-1 **before** attending Week 1 lecture Watch the flexural design/RSB video Additional notes are provided. Three screencasts are provided. Watch after Week 1 lecture
23/02/2022 (Week 2)	**(3) Strut-and-tie modelling:** Part 1	Terminology, definitions & principles of strut & tie modelling	Textbook Sections: 7.1 to 7.5 + Additional notes are provided
02/03/2022 (Week 3)	**(4) Strut-and-tie modelling:** Part 2	Design of non-flexural members according to AS3600-2018	Textbook Sections: 7.6 to 7.8
09/03/2022 (Week 4)	**(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 are provided Two video recorded demonstration are provided. Watch after Week 4 lecture
16/03/2022 (Week 5)	**(6) 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 are provided One video recorded demonstration is provided. Watch after Week 5 lecture
23/03/2022 (Week 6)		***Non□teaching week for all courses.***	
30/03/2022 (Week 7)	**(7) Collapse load-Yield Line method**	Principles, upper-bound methods; yield line theory	Additional notes are provided
06/04/2022	**(7) Collapse load-Yield Line method**	Principles, upper-bound methods; yield line theory	

(Week 8)	**(cont')** **(8) Introduction to CFT and MCFT**	Design of reinforced concrete members for shear and torsion AS3600-2018	Additional notes provided.
13/04/2022 (Week 9)	**(9) Shear-Torsion Design provisions (AS3600-2018 models)**	Design of reinforced concrete members for shear and torsion AS3600-2018	Additional notes are provided. Watch video recorded shear design based on AS3600 **before** the lecture A video recorded demonstration and a screencast demonstration are provided. Watch the two demonstrations after the lecture
20/04/2022 (Week 10)	**(10) Detailing of RC members/High-strength concrete columns** **(non-examinable)**	Continuity of load paths; connections and joints; special provisions for HSC columns.	Textbook: Chap 8 & Section 5.7+ Additional notes are provided.

Resources

Prescribed Resources

Course materials:

All lecturer notes, demonstrations, lecture summaries and solution to past exam papers and assignments are available on Moodle.

Text Book:

Foster, Kilpatrick and Warner, Reinforced Concrete Basics, 3rd Edition, Pearson Prentice Hall, 2021. Available at UNSW Bookstore or Pearson: http://www.pearson.com.au/

The digital version of textbook is also viewable on Vital Source

References:

- AS3600-2018, “Concrete Structure”, Standards Australia, 2018.

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.

Recommended Resources

Additional references:

- 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.

Submission of Assessment Tasks

Please refer to the Moodle page of the course for further guidance on assessment submission.

UNSW has a standard late submission penalty of:

- 5% per day, for all assessments where a penalty applies, capped at five days (120 hours), after which a student cannot submit an assessment, and no permitted variation.

Academic Honesty and 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 Information

Final Examinations:

Final exams in T1 2022 will be held online between 29th April - 12th May inclusive, and supplementary exams between 23rd - 27th May inclusive. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

ACADEMIC ADVICE

- Key Staff to Contact for Academic Advice (log in with your zID and password): https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw
- Key UNSW Dates - eg. Census Date, exam dates, last day to drop a course without academic/financial liability etc.
- CVEN Student Intranet (log in with your zID and password): https://intranet.civeng.unsw.edu.au/student-intranet
- Student Life at CVEN, including Student Societies: https://www.unsw.edu.au/engineering/civil-and-environmental-engineering/student-life
- Special Consideration: https://student.unsw.edu.au/special-consideration
- General and Program-Specific Questions: The Nucleus: Student Hub
- 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

Image Credit

Mike Gal.

CRICOS

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Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering 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	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in 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	