

School of Civil and Environmental Engineering UNSW Engineering

# **CVEN9809**

**Reinforced Concrete Design** 

Term 1, 2023



# **Course Overview**

# **Staff Contact Details**

#### Convenors

Name	Email	Availability	Location	Phone
Hamid Valipour	<u>h.valipour@unsw.edu.au</u>	By Appointment	Room 710, Level 7, School of Civil and Environment al Engineering	93856191

## **School Contact Information**

<u>Engineering Student Support Services</u> – 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 an 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. Design complex Reinforced Concrete (RC) structures using AS 3600 and AS 1170	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

Learning Outcome	EA Stage 1 Competencies
5. Analyse 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		
-	<ul> <li>Do set problems and assignments</li> <li>Join Moodle discussions of problems</li> <li>Reflect on class problems and assignments</li> </ul>		
	Download materials from Moodle		
	<ul> <li>Keep up with notices and find out marks via Moodle</li> </ul>		
Lectures	<ul> <li>Find out what you must learn</li> </ul>		
	<ul> <li>See methods that are not in the textbook</li> </ul>		
	Follow worked examples		
	Hear announcements on course changes		
Assessments	<ul> <li>Demonstrate your understanding of the principles of structural design</li> </ul>		
	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 answer Quiz - 1	10%	07/03/2023 07:00 PM	1, 2, 3, 4
2. Assignment 1	15%	03/04/2023 07:00 PM	1, 5
3. Assignment 2	15%	21/04/2023 07:00 PM	1, 3
4. Final Exam	60%	Not Applicable	1, 2, 3, 4, 5

## Assessment 1: Online short answer Quiz - 1

Start date: 07/03/2023 06:00 PM Assessment length: 60 minutes Submission notes: Short answer Quiz Due date: 07/03/2023 07:00 PM Deadline for absolute fail: 07/03/2023 7:00 PM

This assignment 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: 13/03/2023 07:00 PM Assessment length: 3 Weeks Due date: 03/04/2023 07:00 PM Deadline for absolute fail: 08/04/2023 07:00 PM The main focus of assignment 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

#### 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 3: Assignment 2**

Start date: 07/04/2023 07:00 PM Assessment length: 2 weeks Due date: 21/04/2023 07:00 PM Deadline for absolute fail: 26/04/2023 07:00 PM

In this assignments students are required to analysis and design RC slabs using yield line theory.

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

#### **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	Торіс	Lecture Content	Reading/Demonstration Content
13/02/2023	(1) Introduction	Non-linear aspects of concrete and reinforcement: failure theories	Textbook: Chap. 1
(Week 1)		and surfaces.	Watch the pre-recorded lecture-1
			before attending Week 1 lecture
			Watch the flexural design/RSB video
		Revisit Mohr circle; 2D stress state; design of RC membranes	
	(2) Linear stress analysis	by linear stress analysis.	Additional notes are provided.
			Three screencasts are provided. Watch after Week 1 lecture
20/02/2023	(3) Strut-and-tie	Terminology, definitions &	Textbook Sections: 7.1 to 7.5 +
(Week 2)	modelling: Part 1	principles of strut & tie modelling	Additional notes are provided
27/02/2023	(4) Strut-and-tie	Design of non-flexural members	Textbook Sections: 7.6 to 7.8
(Maak 2)	modelling: Part 2	according to AS3600-2018	
(VVEEK 3)	(5) Design for	Introduction to time offects: decign	Taythack Sactions: 1 10: 2 2 1 to
00/03/2023	(5) Design for	procedures: serviceshility limit	$3.35 \pm \text{Additional potes are}$
(Week 4)	1	states; cracked section analysis; deflection control	provided
			Two video recorded
			demonstration are provided.
			Watch after Week 4 lecture
13/03/2023	(6) Design for	Deflection by refined calculations;	Textbook Section: 3.3.6 +
(Week 5)	serviceability: Part	tension chord model; crack width	Additional notes are provided
			One video recorded
			demonstration is provided. Watch after Week 5 lecture
20/03/2023		Non teaching week for all	
(Week 6)		courses.	
27/03/2023	(7) Collapse load-	Principles, upper-bound methods	Additional notes are provided
(Week 7)	Yield Line method	yield line theory	
03/04/2023	(8) Collapse load-	Principles, upper-bound methods;	
	Yield Line method	yield line theory	

(Week 8)	(cont')		
	(9) Introduction to CFT and MCFT	Design of reinforced concrete members for shear and torsion AS3600-2018	Additional notes provided.
10/04/2023	(10) Shear-Torsion	Design of reinforced concrete	Additional notes are provided.
(Week 9)	Design provisions (AS3600-2018 models)	AS3600-2018	Watch video recorded shear design based on AS3600 <b>before</b> the lecture A video recorded demonstration and a screencast demonstration are provided. Watch the two
			demonstrations after the lecture
17/04/2023	(11) Detailing of RC members/High-	Continuity of load paths; connections and joints; special	Textbook: Chap 8 & Section 5.7+ Additional notes are provided.
(vveek 10)	columns		
	(non-examinable)		

View class timetable

# Timetable

Date	Туре	Content
Week 4: 6 March - 10 March	Assessment	Online short answer Quiz - 1: Short answer Quiz
Week 8: 3 April - 7 April	Assessment	Assignment 1
Week 10: 17 April - 21 April	Assessment	Assignment 2

# 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 2023 will be held on campus between the 28th of April and the11th of May, and Supplementary Exams between the 22nd of May and the 26th of May. 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): <u>https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw</u>
- <u>Key UNSW Dates</u> 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): <u>https://intranet.civeng.unsw.edu.au/student-intranet</u>
- Student Life at CVEN, including Student Societies: <u>https://www.unsw.edu.au/engineering/civil-and-environmental-engineering/student-life</u>
- Special Consideration: https://student.unsw.edu.au/special-consideration
- General and Program-Specific Questions: The Nucleus: Student Hub
- Book an Academic Advising session: https://unswengacademicadvising.as.me/schedule.php

# Disclaimer

This course outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up to date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies.

## **Image Credit**

Mike Gal.

# CRICOS

CRICOS Provider Code: 00098G

## 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	1	
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	1	
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	1	
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		