# CVEN9809

## Reinforced Concrete Design

Term One // 2021

School of Civil and Environmental Engineering // UNSW Engineering

# 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

## Credit Points 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. demonstrate an understanding of fundamental and advanced concepts in structural concrete and apply the knowledge of structural design practice | PE1.1, PE1.2, PE1.3, 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 |

## Teaching Strategies

Approaches to learning;

| | |
|---|---|
| **Private Study** | Review lecture material and textbook<br><br>Do set problems and assignments<br><br>Join Moodle discussions of problems Reflect on class problems<br><br>Download materials from Moodle<br><br>Keep up with notices and find out marks via Moodle |
| **Lectures** | Find out what you must learn<br><br>See methods that are not in the textbook<br><br>Follow worked examples<br><br>Hear announcements on course changes |
| **Assessments** | Demonstrate your understanding of the principles of structural design<br><br>Demonstrate your knowledge and skills in design of reinforced concrete<br><br>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 Moodle quiz will result in a mark of zero.

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

## Assessment Tasks

| Assessment task | Weight | Due Date | Student Learning Outcomes Assessed |
|---|---|---|---|
| Online short answer Quiz - 1 | 10% | 08/03/2021 08:00 PM | 1, 2 |
| Final Exam | 60% | Not Applicable | 1, 2 |
| Online short answer Quiz -2 | 15% | 05/04/2021 08:00 PM | 1, 2 |
| Online short answer Quiz -3 | 15% | 26/04/2021 08:00 PM | 1 |

## Assessment Details

**Assessment 1: Online short answer Quiz - 1**

**Start date:** 08/03/2021 06:00 PM

**Length:** 30 minutes

**Details:**

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

**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.

**Submission notes:** Short answer Quiz

**Turnitin setting:** This is not a Turnitin assignment

**Assessment 2: Final Exam**

**Start date:** Not Applicable

**Length:** 2 hours

**Details:**

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. The exam will be held during the final examination period at the end of the term.

**Additional details:**

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

**Turnitin setting:** This is not a Turnitin assignment

**Assessment 3: Online short answer Quiz -2**

**Start date:** 05/04/2021 06:00 PM

**Length:** 30 minutes

**Details:**

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.

**Turnitin setting:** This is not a Turnitin assignment

**Assessment 4: Online short answer Quiz -3**

**Start date:** 26/04/2021 06:00 PM

**Length:** 30 minutes

**Details:**

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

**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.

**Turnitin setting:** This is not a Turnitin assignment

### Attendance Requirements

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

## Course Schedule

View class timetable

### Timetable

| Date | Type | Content |
|---|---|---|
| O Week: 8 February - 12 February | | |
| Week 1: 15 February - 19 February | Lecture | **Introduction:** Non-linear aspects of concrete and reinforcement; failure theories and surfaces |
| | Blended | Watch the YouTube Video on Flexural Strength of RC Members and Rectangular Stress Block in AS3600-2018 |
| Week 2: 22 February - 26 February | Lecture | **Linear stress analysis**: Revisit Mohr circle; 2D stress state; design of RC membranes by linear stress analysis |
| | Blended | **After the lecture watch**<br><br>- Lecture summary (Screencast)<br><br>- Demonstration-1 (Screencast)<br><br>- Demonstration - 2 (Screencast) |
| Week 3: 1 March - 5 March | Lecture | **Strut-and-tie modeling (Part 1):** Terminology, definitions & principles of strut & tie modelling |
| Week 4: 8 March - 12 March | Lecture | **Strut-and-tie modeling (Part 2):** Design of non-flexural members according to AS3600-2018 |
| Week 5: 15 March - 19 March | Lecture | **Design for serviceability (Part 1):** Introduction to serviceability limit states; cracked/uncracked section and deflection control; |
| | Blended | **After the lecture watch**<br><br>- YouTube Video - Deemed to comply deflection control of one-way slabs |

| | | |
|---|---|---|
| | | - Youtube Video - Short-term deflection calculations using simplified method (Middle tier approach)URL |
| Week 6: 22 March - 26 March | Fieldwork | Flexibility week. No lecture. |
| Week 7: 29 March - 2 April | Lecture | **Design for serviceability (Part 2):** Deflection by refined calculations; crack width calculations and crack control. |
| | Blended | **After the lecture watch**<br><br>YouTube Video - Shrinkage strain and creep coefficient values |
| Week 8: 5 April - 9 April | Lecture | **Collapse load: Yield Line method:** Principles, upper-bound methods; yield line theory |
| | Blended | **After the lecture, download and watch the videos**<br><br>- https://www.dropbox.com/s/w703lzjntlg9xl3/CVEN9809%205%20%281%20of%203%29.wmv?dl=0<br><br>- https://www.dropbox.com/s/xbojq9uuq3x281x/CVEN9809%205%20%282%20of%203%29.wmv?dl=0 |
| Week 9: 12 April - 16 April | Lecture | **Introduction to CFT and MCFT:** Design of reinforced concrete members for shear and torsion AS3600-2018 |
| | Blended | **Before the lecture watch**<br><br>- YouTube Video - Revisiting shear design according to AS3600-2018<br><br>- YouTube Video - Shear design of reinforced concrete/prestressed concrete according to AS3600-2018<br><br>- Demonstration (Screencast) - Shear + torsion design example |
| Week 10: 19 April - 23 April | Online Activity | **Detailing of RC structure/columns:** Continuity of load paths; connections and joints; special provisions for HSC columns<br><br>**Download and watch the video and the powerpoint presentations** |

| | | |
|---|---|---|
| | | - https://www.dropbox.com/sh/hvia90ji9y7jp22/AADQ9E2iUIz4h95l56-jWff9a?dl=0 |

# 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.

## Course Evaluation and Development

## Submission of Assessment Tasks

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

## 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

Key UNSW Dates - eg. Census Date, exam dates, last day to drop a course without academic/financial liability etc.

**Final Examinations:**

Final exams in Term 1 will be held online between 30th April - 13th May inclusive. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

**Supplementary Examinations:**

Supplementary Examinations for Term 1 2021 will be held on 24th - 28th May inclusive should you be required to sit one. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

**ACADEMIC ADVICE**

For information about:

- Notes on assessments and plagiarism;
- Special Considerations: student.unsw.edu.au/special-consideration;
- General and Program-specific questions: The Nucleus: Student Hub
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC/SURVSOC/CEPCA

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

Synergies in Sound 2016

## 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 | ✓ |
| 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 | |