USC

Course Outline

Code: ENG451
Title: Concrete Structures and Technology

School: Science & Engineering
Teaching Session: Semester 1
Year: 2019
Course Coordinator: A/Prof Christophe Gerber Email: cgerber@usc.edu.au
Course Moderator: Dr Ayodele Olofinjana Email: aolofinj@usc.edu.au

Please go to the USC website for up to date information on the teaching sessions and campuses where this course is usually offered.

1. What is this course about?

1.1 Description

In this course you will learn to design reinforced concrete members (beams, slabs, etc.) and structures at both service and ultimate limit states, and to detail the reinforcement of these members and structures as per Australian Standard AS 3600. You will also develop a thorough understanding of pre-stressed concrete members and structures.

1.2 Course topics

Use and application of design codes.
Limit state design including load determination.
Application of structural analysis and design of structures.
Introduction to concrete structures and design procedures.
Design of reinforced concrete beams.
Design of reinforced concrete slabs.
Design of reinforced concrete columns.
Design of reinforced concrete footings.

2. What level is this course?

400 level Graduate - Independent application of graduate knowledge and skills. Meets AQF and professional requirements. May require pre-requisites and developing level knowledge/skills. Normally taken in the 4th year of an undergraduate program

3. What is the unit value of this course?

12 units

4. How does this course contribute to my learning?

Specific Learning Outcomes On successful completion of this course you should be able to:	**Assessment Tasks** You will be assessed on the learning outcome in task/s:	**Graduate Qualities or Professional Standards mapping** Completing these tasks successfully will contribute to you becoming:
Competently use and apply design codes e.g. AS/NZS 1170.0, AS/NZS 1170.1 and AS 3600; determine design loads and load combinations for strength and serviceability and understand their importance in limit state design.	Tasks 1, 2 and 3	Empowered.
Accurately and competently explain the nature of concrete and steel and how they work as a composite i.e. reinforced concrete.	Tasks 1, 2 and 3	Knowledgeable.
Competently, adequately and accurately analyse structures to determine the internal actions on structural elements resulting from the application of the design loads in compliance with Australian Standards.	Tasks 1, 2 and 3	Creative and critical thinkers.
Competently design concrete members and structures for durability to various environments including design for fire.	Tasks 1, 2 and 3	Empowered.
Competently design and size reinforced concrete elements for ultimate and serviceability limit states that conform to Australian Standards.	Tasks 1, 2 and 3	Empowered.
Effectively and creatively collaborate with others in a team project environment to design concrete structures (concept to optimised solutions), and produce engineering reports.	Task 2	Engaged. Ethical.
Effectively and clearly communicate (in your group or to an audience) your design procedures, outcomes and recommendations in a manner acceptable to the engineering profession.	Tasks 1 and 2	Ethical Empowered.

5. Am I eligible to enrol in this course?

Refer to the USC Glossary of terms for definitions of "pre-requisites, co-requisites and anti-requisites".

5.1 Enrolment restrictions

You must be enrolled in Program SC383, SC410, SC425, UU301 or XU301

5.2 Pre-requisites

ENG212 and (MEC1201 or ENG225)

5.3 Co-requisites

Nil

5.4 Anti-requisites

CIV3506 and CIV3907

5.5 Specific assumed prior knowledge and skills (where applicable)

N/A

6. How am I going to be assessed?

6.1 Grading scale

Standard – High Distinction (HD), Distinction (DN), Credit (CR), Pass (PS), Fail (FL)

6.2 Assessment tasks

Task No.	Assessment Tasks	Individual or Group	Weighting	What is the duration / length?	When should I submit?	Where should I submit it?
1	Member Design Assignments	Individual	25% (5 x 5%)	Five short design reports of max. 200 words including design of members for limit states and detailing. Word limit excludes calculations, diagrams, sketches & Appendices.	Weeks 3, 4, 6, 10 & 12.	Hardcopy, Lecture room
2	Structure Design Assignments	Group	35% (20% & 15%)	Two design reports of max. 1000 words each including design of structures for limit states, and detailing. Word limit excludes calculations, diagrams, sketches & Appendices.	Week 8 & 11	Hardcopy, Lecture room
3	Final Exam	Individual	40 %	2 hr	Centrally scheduled Exam Period	
			100%			

Assessment Task 1 (a – e): Member design assignments – Design of concrete members to limit states

Goal:	Competently explain, demonstrate and apply concrete design procedures to structural concrete members to the adequate limit states (strength, serviceability, etc.) in compliance with AS/NZS 1170.0, AS/NZS 1170.1, and AS 3600, and competently produce detailing of the members (includes specifications).
Product:	Brief design reports of the design for limit states and detailing of concrete members.
Format:	You determine the relevant limit state conditions of structural concrete members, design these members to these limit states, explain the key design aspects and provide the detailing of these members. You complete your designs (**5% each**) in compliance with AS 3600 for the following members: 1a) Singly reinforced beam, 1b) Doubly reinforced beam, 1c) Shear design of a reinforced beam, 1d) Slab, 1e) Column, You present your designs in short reports of max. 250 words each or equivalent (word count excludes sketches, diagrams, calculations & Appendices). Your reports adhere to the conventions of engineering reports and are ready for review by a senior professional engineer. If relevant, you may include captioned diagrams, tables of data, graphs, photographs, etc. Calculations **must be strictly handwritten** and must be in appropriate significant figures and with correct units throughout the reports. The detailing of your designs is complete with correct specifications, dimensions and units (neat hand sketches are acceptable). You may collaborate with peers to complete Task 1. Such collaboration will be clearly stated on the task coversheet. You also provide your details (names and student number) and signature on the cover page of each report. A coversheet template will be available on Blackboard
Criteria:	• Correct choice of design methods and codes. • Correct application of design methods and procedures through the correct use of formulae and codes to analyse and design a concrete member to limit states. • Inclusion of all workings showing a logical sequence to the problem solution and presentation of design calculations to a professional engineering standard. • Report format and presentation to a professional engineering standard.

Generic skill assessed	**Skill assessment level**
Problem solving	Graduate
Applying technologies	Graduate
Communication	Graduate

Engineers Australia competencies assessed in this task
1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. 2.1 Application of established engineering methods to complex engineering problem solving.

Assessment Task 2(a & b): Structure design assignments – Design of concrete structures to limit states

Goal:	Effectively and professionally collaborate with your peers to undertake the detailed engineering design of concrete structures or aspects of these to relevant limit states and in compliance with Australian Design Codes: AS/NZS 1170.0, AS/NZS 1170.1, and AS 3600, and competently produce detailing of the structures (includes specifications).
Product:	Design reports of the structural design and detailing of concrete structures to limit states.
Format:	Engineers work in teams on design projects! Task 2 is a challenging design project that will allow you to demonstrate your (structural) design abilities by competently producing the design of the structure of a concrete building, and will contribute to further developing and improving your collaboration skills (*professional soft skills*). In your group (**4 members**), you collaborate to design the structural elements of a concrete building in compliance with AS 3600: Concrete structures: **2a) Girder design and detailing (20%),** **2b) Slab design and detailing (15%).** To complete both 2a and 2b, your team engineers and designs a structural solution for the floor of a concrete building. Your design solution is the most adapted to the requirements of the building structure and use. Your design must comply with AS 3600 and your detailing must adhere to the industry best practice. Note further details will be provided on Blackboard and/or in class Your group collaborates to produce two design reports of maximum 1000 words each or equivalent each (word count excludes sketches, diagrams, calculations & Appendices). Your reports adhere to the conventions of professional engineering reports. They present your designs in a format that is ready for review by a senior professional engineer, detailing your calculations (scanned copies of hand calculations are acceptable) and presenting your solutions in appropriate significant figures and correct units throughout. They also provide the detailing of your designs complete with correct specifications, dimensions and units. If relevant, you may include captioned diagrams, tables of data, graphs, photographs, etc. All drawings and detailings (shop drawings) are prepared with AutoCAD or an equivalent CAD program and placed in an Appendix. The names and student numbers of all team members are listed on the cover page of each report and each team member **must** sign the cover page. The contributions of each team member will also be clearly stated on the coversheets. Coversheet templates will be available on Blackboard. Note, as part of your group work, you may also be required to actively participate to the Peer Assessment, review, feedback and debriefing activities.
Criteria:	• Correct choice of design methods and codes. • Correct application of design methods and procedures through the correct use of formulae and codes to analyse and design concrete structures to limit states. • Inclusion of all workings showing a logical sequence to the problem solution to allow a professional review (and sign-off) of the design. • Presentation of design calculations and drawings to a professional engineering standard. • Acting professionally by functioning in teams when carrying out the designs and writing up the reports. You are awarded an individual grade for each Task. Upon request individual marks can be moderated with an algorithm that uses the Reviewer's mark for the task plus a rating of your

	contribution by your group peers (a self and peer assessment based evaluation). Marks are recorded and made available to you on Blackboard.

Generic skill assessed	**Skill assessment level**
Collaboration	Graduate
Organisation	Graduate
Communication	Graduate
Problem solving	Graduate
Applying technologies	Graduate

Engineers Australia competencies assessed in this task
2.1 Application of established engineering methods to complex engineering problem solving. 3.2 Effective oral and written communication in professional and lay domains. 3.6 Effective team membership and team leadership.

Assessment Task 3: Final exam

Goal:	Demonstrate the competencies and skills to compliantly design structural concrete elements to design limit states.
Product:	Final exam (Sequenced solutions to problems showing all workings).
Format:	The final exam assesses the material covered in the course (lectures, tutorials and assignments) and the self-study material (e.g. prescribed reading). The exam will require that you solve a number of typical concrete design problems similar to the Lecture examples, Tutorial problems and/or those you undertook in your design projects. The exam is partially open book (full details of what may be taken into the exam venue will be explained in class during the semester and posted on Blackboard).
Criteria:	• Appropriateness and correctness of design solutions; • Correct use of design methods and codes; • Inclusion of all workings showing a logical sequence to the problem solution. • Demonstration of adequate and competent application of design process through use of correct formulae; and • Competent and accurate explanation of design aspects and phenomena.

Generic skill assessed	**Skill assessment level**
Applying technologies	Graduate
Problem solving	Graduate
Organisation	Graduate

Engineers Australia competencies assessed in this task
1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. 2.1 Application of established engineering methods to complex engineering problem solving.

7. What are the course activities?

7.1 Directed study hours

13 x 2hr Lectures
13 x 2hr Tutorials

7.2 Teaching semester/session(s) offered

Sippy Downs: Semester 1

.3 Course content

Teaching Week / Module	What key concepts/content will I learn?	What activities will I engage in to learn the concepts/content?	
		Directed Study Activities	**Independent Study Activities**
Week 1	Introduction and overview of concrete design. • Concrete structures; • Australian Design Code: AS 3600: Concrete structures; • Properties of concrete; • Properties of steel; • Durability of concrete structures including fire resistance. Design of reinforced concrete beams – Singly reinforced beams (SRB).	Lecture Tutorial ***Form groups for Task 2***	Textbook: Chapters 1-2. Codes: AS1170.0, AS1170.1, AS1170.2, and AS 3600 Sections 1-5. Textbook: Chapter 3. Code: AS 3600 Section 8.
Week 2	Design of reinforced concrete beams – Singly reinforced beams (SRB) (cont'd). **Beam fabrication (TBC).**	Lecture Tutorial	Textbook: Chapter 3. Code: AS 3600 Section 8.
Week 3	Design of reinforced concrete beams – Doubly reinforced beams (DRB).	Lecture Tutorial **Task 1a due by/at the <u>start</u> of the Lecture**	Textbook: Chapter 3. Code: AS 3600 Section 8.
Week 4	Design of reinforced concrete beams – Flanged beams. Review of structural analysis and design. Methods of structural analysis as per AS 3600.	Lecture Tutorial **Task 1b due by/at the <u>start</u> of the Lecture**	Textbook: Chapters 4 and Section 9.2. Code: AS 3600 Sections 2, 6 & 8.
Week 5	Design of reinforced concrete beams – Design for shear.	Lecture Tutorial	Textbook: Chapter 6. Code: AS 3600 Section 8.
Week 6	Design of reinforced concrete beams – Design for serviceability (SLS). **Beam Testing (TBC).**	Lecture Tutorial **Task 1c due by/at the <u>start</u> of the Lecture**	Textbook: Chapters 5. Code: AS 3600 Section 8.5.
Week 7	Guest Lecture and Tutorial (TBC)	Lecture Tutorial	SRIA documents (TBC) Textbook: Chapter 8. Code: AS 3600 Section 13.
Week 8	Design of reinforced concrete slabs – Design for strength and serviceability of one-way and two-way slabs.	Lecture Tutorial **Task 2a due by/at the <u>start</u> of the Lecture**	Textbook: Chapter 9. Code: AS 3600 Section 9.
Week 9	Design of reinforced concrete slabs – Design for strength and serviceability of two-way slabs (cont'd).	Lecture Tutorial	Textbook: Chapter 9. Code: AS 3600 Section 9.

Week 10	Design of reinforced concrete columns – Design for strength.	Lecture Tutorial **Task 1d due by/at the start of the Lecture**	Textbook: Chapter 10. Code: AS 3600 Section 10.
Week 11	Design of reinforced concrete columns – Design for strength (cont'd).	Lecture Tutorial **Task 2b due by/at the start of the Lecture**	Textbook: Chapter 10. Code: AS 3600 Section 10.
Week 12	Design of reinforced concrete footing and foundation – Design for strength.	Lecture Tutorial **Task 1e due by/at the start of the Lecture**	Textbook: Chapters 12. Code: AS 3600 Section 13.
Week 13	Revision and summary	Lecture Tutorial	

Please note that the course activities may be subject to variation.

8. What resources do I need to undertake this course?

Please note that course information, including specific information of recommended readings, learning activities, resources, weekly readings, etc. are available on the course Blackboard site. Please log in as soon as possible.

8.1 Prescribed text(s)

Please note that you need to have regular access to the resource(s) listed below as they are required:

Author	Year	Title	Publisher
Loo, Y. C. & Chowdhury, S. H.	2018	Reinforced and Prestressed Concrete (3rd edition)	Cambridge University Press, Melbourne. ISBN: 9781108405645

Design codes:

Australian Standard **AS1170.0** Structural design actions - General principles.
Australian Standard **AS1170.1** Structural design actions - Permanent, imposed and other actions.
Australian Standard **AS1170.2** Structural design actions - Wind actions.
Australian Standard **AS 3600-2018**: Concrete structures.
Note all Australian Standards can be downloaded freely via the Library web site. Ask a Librarian if you require any assistance.

8.2 Specific requirements

N/A

9. Risk management

Health and safety risks for this course have been assessed as low.

It is your responsibility as a student to review course material, search online, discuss with lecturers and peers, and understand the health and safety risks associated with your specific course of study. It is also your responsibility to familiarise yourself with the University's general health and safety principles by reviewing the online Health Safety and Wellbeing training module for students, and following the instructions of the University staff.

10. What administrative information is relevant to this course?

10.1 Assessment: Academic Integrity

Academic integrity is the ethical standard of university participation. It ensures that students graduate as a result of proving they are competent in their discipline. This is integral in maintaining the value of academic qualifications. Each industry has expectations and standards of the skills and knowledge within that discipline and these are reflected in assessment.

Academic integrity means that you do not engage in any activity that is considered to be academic fraud; including plagiarism, collusion or outsourcing any part of any assessment item to any other person. You are expected to be honest and ethical by completing all work yourself and indicating in your work which ideas and information were developed by you and which were taken from others. You cannot provide your assessment work to others. You are also expected to provide evidence of wide and critical reading, usually by using appropriate academic references.

In order to minimise incidents of academic fraud, this course may require that some of its assessment tasks, when submitted to Blackboard, are electronically checked through SafeAssign. This software allows for text comparisons to be made between your submitted assessment item and all other work that SafeAssign has access to.

10.2 Assessment: Additional requirements

Eligibility for Supplementary Assessment

Your eligibility for supplementary assessment in a course is dependent of the following conditions applying:

a) The final mark is in the percentage range 47% to 49.4%
b) The course is graded using the Standard Grading scale
c) You have not failed an assessment task in the course due to academic misconduct

10.3 Assessment: Submission penalties

Late submission of assessment tasks will be penalised at the following maximum rate:

- 5% (of the assessment task's identified value) per day for the first two days from the date identified as the due date for the assessment task.
- 10% (of the assessment task's identified value) for the third day
- 20% (of the assessment task's identified value) for the fourth day and subsequent days up to and including seven days from the date identified as the due date for the assessment task.
- A result of zero is awarded for an assessment task submitted after seven days from the date identified as the due date for the assessment task.

Weekdays and weekends are included in the calculation of days late.
To request an extension, you must contact your Course Coordinator and supply the required documentation to negotiate an outcome.

10.4 Study help

In the first instance, you should contact your tutor, then the Course Coordinator. Additional assistance is provided to all students through Academic Skills Advisers. To book an appointment or find a drop-in session go to Student Hub.

Contact Student Central for further assistance: +61 7 5430 2890 or studentcentral@usc.edu.au

10.5 Links to relevant University policy and procedures

For more information on Academic Learning & Teaching categories including:

- Assessment: Courses and Coursework Programs
- Review of Assessment and Final Grades
- Supplementary Assessment
- Administration of Central Examinations
- Deferred Examinations
- Student Academic Misconduct
- Students with a Disability

Visit the USC website:
http://www.usc.edu.au/explore/policies-and-procedures#academic-learning-and-teaching

10.6 General Enquiries

In person:

- **USC Sunshine Coast** - Student Central, Ground Floor, Building C, 90 Sippy Downs Drive, Sippy Downs
- **USC SouthBank** - Student Central, Building A4 (SW1), 52 Merivale Street, South Brisbane
- **USC Gympie** - Student Central, 71 Cartwright Road, Gympie
- **USC Fraser Coast -** Student Central, Student Central, Building A, 161 Old Maryborough Rd, Hervey Bay

Tel: +61 7 5430 2890

Email: studentcentral@usc.edu.au