SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

Trimester 1, 2020

CVEN9806 PRESTRESSED CONCRETE

COURSE DETAILS

Units of Credit	6		
Contact hours	4 hours per week		
Class	Monday	6pm to 8pm	**CE101**
	Thursday	6pm to 8pm	**CE101**
Lecturer	**Associate Professor Mario M. Attard**		
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Online Coordinator	**Dr. Xiaojun Chen**		
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INFORMATION ABOUT THE COURSE

Introduction to Prestressed Concrete:

Methods of Prestressing. Forces Imposed by Prestressing (Straight, Draped And Kinked Tendon Profiles). Load Balancing. Introductory Examples. Design Requirements: Strength and Serviceability. Material Properties.

Design for Serviceability:

Stress limits. Serviceability criteria. Determination of prestress and eccentricity. Cable profiles. Short-term deflection calculations. Losses of prestress.

Design for Strength:

Limit State Design. Rectangular Stress Block. Ultimate Moment Capacity. Effect of Non-Prestressed Steel. Ductility. Transfer Strength. Design for Shear. Effect of Prestress on Shear. Flexure-Shear and Web-Shear Cracking. Stirrup Design.

Statically Indeterminate Beams:

Introduction to Continuous Prestressed Concrete Beams; Secondary Moments; Method of Equivalent Loads; Load Balancing; Practical Tendon Profiles; Moment Redistribution; Secondary Effects at Ultimate;

End Block Design:

Bursting and Spalling Forces in Post-Tensioned End-Blocks; Single and Multiple Anchorages; Design and Analysis; Transmission Lengths in Pretensioned Members;

This course will also provide you with opportunities to develop the following **graduate attributes**:

- the capacity for analytical and independent critical thinking;
- skills related to lifelong learning, such as self-reflection (ability to apply theory to practice in familiar and unfamiliar situations); and
- collaborative and teamwork skills.

HANDBOOK DESCRIPTION

Introduction to Prestressed Concrete Structural Elements. Design for serviceability. Design of Super-T pretensioned bridge girders. Design for strength. Statically indeterminate beams. Design of Post-tensioned beam and slab elements. Use of design package RAPT. Behaviour and design of two-way slabs. End block design.
Refer to Online Handbook available at:

http://www.handbook.unsw.edu.au/postgraduate/courses/2020/CVEN9806.html

OBJECTIVES

- Establish the philosophies and principles of the structural design of prestressed concrete.
- Present techniques for proportioning and detailing simple structural members in prestressed concrete.
- Develop an insight into the behaviour of prestressed concrete structural members both at service loads and overloads.
- To give you an opportunity to develop and reflect on graduate attributes such as critical thinking and problem solving, lifelong learning skills and collaborative skills.

TEACHING STRATEGIES

The teaching strategies that will be used include:

- **Lectures** that will focus on the development and application of generalised problem-solving processes for the stress, strain and deformation analysis of structures. Lectures will also emphasise the relationship of the content to engineering practice and will provide an opportunity for reflection on learning. The lectures are recorded and should be available on the Moodle course page.
- **Moodle Learning Course Page** provides a step by step guide on the course. There is a discussion forum to help provide interaction and help from your peers. Links to video recordings and learning modules to help you learn the solution techniques for many of the subject areas.
- **Recorded lectures** will be uploaded to help students to revise. Please note that the recorded lectures are **NOT** substitutes for attending lectures or reading the lecture notes. The quality of the recorded lectures can be poor and are not professional produced. The pace of the recorded lectures can seem very slow because the lecturer is expecting students to take notes in the class and is adjusting their pace accordingly.

Suggested approaches to learning in this course include:

- Regular participation in lectures and class problem sessions. *Review lecture and class problem material. Follow worked examples. Reflect on class problems and quizzes.*
- Complete all the required tasks in the Moodle course page for this course.
- Weekly reading and recording of your learning.
- Appropriate preparation for class problem activities.
- Planning your time to achieve all assessment requirements (see assessment).
- We encourage you to work with your peers. A good way to learn the material is in small study groups. Such groups work best if members have attempted the problems individually before meeting as a group. A valued and honest collaboration occurs when, for example, you “get stuck” early on in attacking an exercise and go to your classmate with a relevant question. Your classmate then has the opportunity to learn from your question as well as help you. You then bring something to the collaboration. You can learn too from last year’s problem sets and quizzes if used as a check or corrective when you seem to have hit a dead end.
- Students who perform poorly in the quizzes are strongly encouraged to discuss their progress with the lecturers during the Term. Please do not suffer in silence – seek the help at an early stage! We would like you to make most of this learning process and receive a high grade in the course.

EXPECTED LEARNING OUTCOMES

At the end of this course, if a student has attended the lectures reflective on the presented material and participated in the classes, it is expected that they will be able to proportion the dimensions of simple structural prestressed concrete members such as simply supported beams, continuous beams, one-way slabs and two-way slabs. They should be able to proportion reinforcement for flexural and shear strength and be able to check deflections and detail to control cracking. In particular the learning outcomes are:

LO1. Be familiar with the types of prestressed concrete members, their fabrication, design and use.
LO2. Be familiar with the Australian Standard for Prestressed Concrete Design AS3600.
LO3. Proportion the dimensions of simple structural prestressed concrete members such as simply supported beams, continuous beams, one-way slabs and two-way slabs.
LO4. Proportion reinforcement for flexural and shear strength.
LO5. Be able to use the software package RAPT for the design of prestressed concrete continuous beams and slabs.
LO6. Perform a literature review, plan and carry out a small project
LO7. Work effectively in a team.

These learning outcomes map to Engineers Australia Stage 1 Competencies 1.1 & 1.2

1.1. Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.

1.2. Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.

Self-centred and self-directed learning (expectations of the students):

In addition to the class problem sessions, you are expected to commit **6 - 8 hours per week** (1.5 hours for each hour of contact) to independent learning and general problem solving.

ASSESSMENT

Assessment will be based on **completion of online Moodle modules, one major assignment** and **a final exam**. These components will address problems consistent with those you are likely to face as a professional Civil/Environmental Engineer.

- The **online Moodle modules** are learning modules to help you learn the solution strategies for the major topics. The assessment is based on completion of the modules.
- The final exam is given because the course learning outcomes include a significant level of technical learning that can be effectively assessed in an exam environment and because exams have high reliability. It is primarily designed to align with UNSW graduate attributes 2 and 3.
- *A mark **of at least 40%** in **the final examination** is required before the class work (hand-in quizzes and online tasks) is included in the final mark.* The formal exam scripts will not be returned but you are permitted to view the marked script.

The relative value of each of the assessable tasks is as follows:

Item & Length	Marks	Due Date	Marks Returned	Criteria & & Learning Outcomes Assessed
Online Learning Modules **(2 weeks to complete)**	15%	8th March 15th March 22nd March 29th March 12h April	Immediate but uploading to the gradebook will be at the end of week 10.	These are Open book online learning modules which are done either at home, library or on campus. The online modules are open on Monday morning on the date specified. Marks are awarded for completing the module. The topics covered in each online quiz are listed on the Moodle course page. **LO1** to **LO4**.
Major Assignment	25%	Week 9 6pm Thursday 16th April	2 weeks after submission.	The assignment is undertaken in groups. The assignment will be given out early in the Term. This team project is a core part of this course. Engineering design is normally a team-based activity, and the team project helps students to learn to do design in a team-based environment. Broadly, the assessment criteria are teamwork, coherent application of formal design processes, and the quality of the design. **LO5 to LO6.**
Final Examination	60%*	Final Examination Period		The final exam is a 2hr Open Book examination. The exam covers all the worked covered during the Term. Marks are awarded for correct answers and there are marks for getting the method correct. **LO1** to **LO4**.

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

The examinations and online modules show evidence of application of theoretical concepts to solving problems. There are no exemptions from any part of this assessment.

Note: The course coordinator reserves the right to adjust the final scores by scaling if agreed to by the Head of School.

***Supplementary Examinations for Term 1 2020** will be held on Monday 25th – 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

10% of the full mark will be deducted for late submission for each business day that the assignment or online quiz is submitted late unless approval has been given by the lecturer.

COURSE PROGRAM

Week	Topic	Assessment Given Out	Submission Date
1 - 17th Feb	**Introduction to Prestressed Concrete** **Design for Serviceability Part 1** Nedim Dajanovic Precast Concrete Manufacturing - General		
2 – 24th Feb	**Design for Serviceability Part 2** **Prestressed Hollow Core Plank Example** Nedim Dajanovic Production TRAPEZ. Beams	Major Assignment On-Line Module 1	8th March
3 – 2nd March	**Losses** Nedim Dajanovic Production of GIRDERS **Design of Pretensioned Girder Bridges** Kenny Luu - MUgroup	On-Line Module 2	15th March
4 – 9th March	**Flexural Strength -** Limit State Design **Transfer Strength -** Limit State Design Nedim Dajanovic Lifting activity & Design background	On-Line Module 3	22nd March
5 – 16th March	**Shear Strength -** Limit State Design Nedim Dajanovic PSC - Flooring System	On-Line Module 4	29th March
6 – 23rd March	**Non-Teaching Week**		
7 – 30th March	**Continuous Beams** Load Balancing & Practical Tendon Profiles	On-Line Module 5	12th April
8 – 6th April	**Design of Post-Tensioned Members using RAPT** Haydn Kirrage - APSPT Aaron Jamalzadeh - Teletraining		
9 – 13th April	**Monday Public Holiday - Easter Monday 13th April** **Design of Post-Tensioned Slabs** **End Block Design**		Major Assignment 16th April 6pm
10 – 20th April	**Revision**		
	No Class		

RESOURCES

Reference

Gilbert, Mickleborough and Ranzi, Design of Prestressed Concrete to AS3600-2009, Second Edition, CRC Press, 2015.

Additional Readings

Gilbert and Mickleborough, The Design of Prestressed Concrete, Unwin Hyman, London, 1990.
Standards Australia, Australian Standard for Concrete Structures, AS3600
Warner, RF, Foster, SJ, and Kilpatrick AE, "Reinforced Concrete Basics", Pearson, 2007
Warner, Rangan, Hall and Faulkes, Concrete Structures.
Warner and Faulkes, Prestressed Concrete, Longman, 1989.
Nilson, A.H., Design of Prestressed Concrete, John Wiley and Sons, 1978.
Lin, T.Y., Design of Prestressed Concrete Structures, John Wiley, 1963.

American Concrete Inst ACI318-89, Building Code requirements for Reinf. Conc.
Cement and Concrete Association of Australia, Concrete Design Handbook, 1990. Cement and Concrete Association of Australia, Concrete Design Workshop Worked Examples, 1990.
Nawy, Edward G., Prestressed Concrete – A Fundamental Approach, Fourth Edition Pearson Education Inc., 2003
Loo, Yew-Chaye and Chowdhury, Sanaul Huq, Reinforced and Prestressed Concrete, Analysis and Design with emphasis on application of AS3600-2009, Cambridge University Press, 2010

Industry Websites

http://www.vsl.com VSL Prestressing (Aust.) Pty Ltd
http://www.apspt.com.au/ Australian Prestressing Services
http://www.raptsoftware.com/ RAPT Software
www.nationalprecast.com.au National Precast Concrete Association Australia
www.precastnz.org.nz Precast New Zealand Inc.
www.pci.org Precast/Prestressed Concrete Institute – USA
www.precast.org National Precast Concrete Association - USA
www.britishprecast.org British Precast Concrete Federation
www.cpci.ca Canadian Precast/Prestressed Concrete Institute
www.cpi-tv.com Concrete Plant International – the Concrete channel

Technology Enabled Learning and Teaching Website and Login to Moodle

http://telt.unsw.edu.au/
https://moodle.telt.unsw.edu.au/login/index.php

Pearson MasterEngineering

http://www.pearsonmylabandmastering.com/northamerica/masteringengineering/

UNSW Library Database

Access Engineering – platform of e-books, videos and interactive tables and graphs.
Look at the Curriculum Map and select "Strength of Materials"

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

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

https://my.unsw.edu.au/student/resources/KeyDates.html

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

COURSE EVALUATION AND DEVELOPMENT

The School of Civil and Environmental Engineering evaluates each course each time it is run through (i) the UNSW MyExperience Surveys, and (ii) Focus Group Meetings.

As part of the MyExperience process, your student evaluations on various aspects of the course are graded; the Course Coordinator prepares a summary report for the Head of School. Any problem areas are identified for remedial action, and ideas for making improvements to the course are noted for action the next time that the course is run.

Focus Group Meetings are conducted by the four Year Managers (academic staff) for any students who wish to attend, in each year of the civil and/or environmental engineering programs. Student comments on each course are collected and disseminated to the Lecturers concerned, noting any points which can help improve the course.

ACADEMIC ADVICE

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