UNIVERSITY OF ALBERTA

Department of Civil and Environmental Engineering

CIV E 672 – Behaviour and Design of Reinforced-Concrete Elements (Fall Term, 2014)

Instructor: Dr. Carlos Cruz-Noguez
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Office Hours: Friday 2:00-5:00 pm, or by appointment
Class location and time: NRE 2 090
Teaching Assistants: No
T R 12:30PM - 1:50PM
Website: Bear Tracks
Please visit it the website often -- important course materials and announcements may be posted there

Course Objectives

Understanding the underlying principles in analysis and design of reinforced-concrete elements is critical for structural engineers. This course discusses the behaviour and performance of RC elements under flexural, shear, axial and torsional stresses with the help of research results and test data. The course is taught with the help of both commercial and research-oriented finite-element software for reinforced concrete. At the end of the course, the student will (1) have a working knowledge of the design and analysis procedures for RC members under the framework of the Canadian concrete standards, (2) be able to conduct basic finite-element modeling of common structures, and (3) understand the mechanics and structural principles behind the code provisions, being able to apply the theory in unusual structures or critical elements not covered in the design provisions.

Course Topics

(Topics and emphasis may vary at the instructor's discretion, based on the class progress and time available).

1. Introduction to Reinforced Concrete Design
    - Properties of Concrete and Reinforcement
    - Moment-curvature diagrams
2. Flexure
    - Basic theory
    - Analysis of determinate members
    - Design of determinate members
    - Analysis and Design of Indeterminate beams
3. Shear
    - Basic theory
    - Truss analogy for shear
    - Analysis and design of beams for shear: A23.3 Simplified Method
    - Analysis and design of beams for shear: A23.3 General Method
4. Axial Load I: Short Columns
    - Interaction diagram
    - Uniaxial Bending
    - Biaxial Bending
    - Confinement
5. Axial Load II: Slender Columns and Frames
    - Slender columns in non-sway frames
    - Slender columns in sway frames
6. Torsion
    - Thin-walled tube and space truss analogy
    - Analysis and Design Methods for Torsion
7. Design of D-Regions

Theory
Analysis and Design of Common D-Regions

8. Plastic Analysis in Reinforced Concrete
Theory
Collapse Mechanisms
Nonlinear analysis of RC structures using computers

Suggested textbooks:
Reinforced Concrete, Mechanics and Design, 1st Canadian Edition, MacGregor, J.G and Bartlett, F.M., Prentice Hall, 2000. *(Excellent book for theory and examples, but still refers to the 1994 version of CSA-A23.3.)*
Reinforced Concrete Structures : Design according to CSA A23.3-04, Chaallal O. PUQ, 2010.
(Very good book for examples using the current code—however, it does not cover the theory in depth.)

Required handbook:
Cement Association of Canada (2006 or later) "Concrete Design Handbook", 3rd Edition. This book is bundled with the governing standard for the design of reinforced concrete structures in Canada, CAN/CSA-A23.3-04. *(You are required to obtain this reference for the course. Assignments and examinations will often refer to tables, figures and code provisions from this book.)*

Student Evaluation

Laboratory/Seminar	Laboratory Report	10%
Homework assignments	Number of homework assignments TBD (approximately 5). Late homework assignments will not be accepted, except in well-documented emergencies.	10%
Mid-term	One mid-term test, 3 hours (Oct. 24, 12:30 PM – *preliminary date*) Closed notes, open book. All topics covered before the exam may be included.	30%
Final Exam	3 hours, on the last day of class. (Dec. 3, 2013, 12:30 PM– *preliminary date*) Closed notes, open book. All inclusive. All topics covered from the start of the course may be included.	50%

Attendance & Absences

Regular attendance to the lectures is expected. Missing an examination will automatically result in a mark of zero unless acceptable documentation is presented to justify your absence within one week from the date of the examination. You must obtain approval from the instructor prior to the test if you cannot write it at the scheduled time (an exception can be made in case of a well-documented emergency). If unsure of what constitutes acceptable documentation, please consult with the instructor.

Class behaviour and expectations

Students are required to observe standards of behaviour expected in a university environment and in the profession of engineering. Cell phones, tablets, laptops and all other electronic devices, with the exception of calculators must be off during lectures and examinations. Scientific calculators (programmable and non-programmable) similar to those listed in the website

http://www.engineering.ualberta.ca/CurrentStudents/StudentResources/CalculatorSpecs.aspx are allowed. Neatness while writing assignments and exams is critical; illegible work will not be graded nor marked. Always bring your calculator (not on a phone) to class, as you will be required to perform calculations during the lectures. There is a zero-tolerance policy for late arrivals (more than 10 min) during lecture days – you will be asked to leave.

Academic Integrity

Teamwork is encouraged, but all work submitted for evaluation must be the result of the student's individual effort. Cheating of any kind will constitute a serious instructional offense subject to sanctions that may include failure in the course, suspension from your degree program, and potentially expulsion from the university. More details in http://www.governance.ualberta.ca/CodesofConductandResidenceCommunityStandards/CodeofStudentBehaviour.aspx.

Academic Accommodations

Students requiring special academic accommodations should contact the instructor or a coordinator at the Student Success Centre (http://www.ssds.ualberta.ca/AboutSSDS.aspx) during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist.