Department of Civil Engineering  
McMaster University  
(Term 2: January – April, 2019)

CIV ENG 3J04  REINFORCED CONCRETE DESIGN

INSTRUCTOR:  Prof. K.S. Sivakumaran, P.Eng., Tel. Ext: 24814, E-mail: civ3j4@mcmaster.ca  
Room: JHE-229, Office Hours: Weekdays (Make appointment via e-mail)

SCHEDULE: Lectures: Room: HH-302 - Tuesday, Thursday & Friday (2:30pm)  
Tutorials: See McMaster Undergraduate Master Course Timetable for your section.  
Labs: See course website for specific dates and times.

Attendance at the lectures, tutorials, and your laboratory session is MANDATORY for this course.

The following activities are prohibited during lectures, tutorials and your lab session: Cell phone use, including texting, e-mails, etc. Audio, video or any other forms of recording. Talking or any other disruptive activities.

COURSE WEBSITE: Follow the links from http://avenue.mcmaster.ca  
[It is each student’s responsibility to check the course website at least on a weekly basis for class handouts and practice problem sets postings, and for any other information update.]

TEACHING ASSISTANTS: (See course website for further information on teaching assistants for the course)

COURSE OBJECTIVES:
The primary objective of this course is to provide background materials to enable a student; [a] to understand the behavior of reinforced concrete structural members (beams, columns, beam-columns, continuous beams and one way slabs), and [b] to successfully design such simple reinforced concrete elements, satisfying strength and serviceability limit states in accordance with CSA-A23.3 "Design of Concrete Structures".

LEARNING OUTCOMES:
- Be able to describe major steps in design process, establish loads, understand uncertainties, and be able to establish design solutions. [Professionalism - Understanding of role of the engineer in society, and protection of public safety, Investigation of the problems - determines appropriate data to use, and estimate uncertainties]
- Be able to describe four stages of flexural behaviour of r/f concrete members, and establish corresponding behaviour, including associated moment resistances and deflections. Be able to use practical guidelines to establish feasible design solutions. [Design - design process and proposed solutions to open ended problems]
- Be able to recognize other possible failure modes in r/f concrete flexural members, and be able to provide feasible design solutions to prevent such failure modes (Anchorage, shear, deflections). [Problem analysis - obtains substantiated conclusions including recognition of the limitations]
- Be able to recognize the failure modes associated with r/f concrete columns and beam-columns and establish corresponding capacities. Be able to establish design solutions for combined loads. [Investigation of the problems - determines appropriate data to use, Determines and employs applicable standards and code of practice]

TEXT BOOKS:
<table>
<thead>
<tr>
<th>Topic Number</th>
<th>Lecture Content</th>
<th>Text Book Chapter</th>
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<tbody>
<tr>
<td>1</td>
<td>INTRODUCTION, DESIGN OF STRUCTURES: Introduction to design process, codes,</td>
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<td>standards &amp; specifications, loads on buildings, design principles &amp; limits</td>
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<td>states design.</td>
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<td>2</td>
<td>MATERIAL PROPERTIES AND PRODUCTS: Mechanical and physical properties of concrete</td>
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<td>and reinforcing steel.</td>
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<td>3</td>
<td>FLEXURAL DESIGN OF BEAMS &amp; ONE-WAY SLABS: Strength, serviceability and design.</td>
<td>3,4,5</td>
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<td>Rectangular beams (singly and doubly reinforced), T-beams, stiffness, cracking</td>
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<td>moment, deflection and crack width calculation, limits and control.</td>
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<td>4</td>
<td>BOND AND ANCHORAGE OF REINFORCEMENT: Development length, hooks for flexural r/f,</td>
<td>9</td>
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<td>stirrups and ties, bar cut-off, code requirements.</td>
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<td>5</td>
<td>SHEAR DESIGN OF BEAMS &amp; ONE-WAY SLABS: beams without and with shear r/f, shear</td>
<td>6</td>
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<td>design according to CSA A23.3, detailing shear r/f.</td>
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<td>6</td>
<td>COLUMNS: Axial and flexural load resistance of short columns, column interaction</td>
<td>8</td>
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<td>diagrams, column design requirements, introduction to biaxial bending and slender</td>
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<td>columns.</td>
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<td>7</td>
<td>ANALYSIS AND DESIGN CONTINUOUS BEAMS AND SLABS: Concepts, load patterns, analysis</td>
<td>10,11</td>
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<td>methods for continuous beams and frames, moment redistribution, reinforcement</td>
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<td>7</td>
<td>(time permitting) OTHER TOPICS OF INTEREST: Torsion, Foundations, Walls, Two-way</td>
<td>7,12,13</td>
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<td></td>
<td>Slabs</td>
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PRACTICE PROBLEM SETS: Practice problems sets will be distributed regularly. Please see the course web-site for the schedule for these problem sets and the associated solutions. The students are strongly encouraged to solve the problems in the practice problems sets prior to the tutorial time. Some of the problems in the sets will be discussed during the tutorial time. Though the course includes regular practice problems sets, the students are strongly encouraged to solve additional problems available in books related to the topics discussed in this course.

IN-TUTORIAL QUIZZES: There will be FOUR quizzes (lasting about 60minutes) conducted during the tutorial time [Please see the course web-site for the schedule]. You must write these quizzes at Registrar’s office assigned tutorial section. During the quiz times, “Concrete Design Handbook” will be permitted, provided nothing written on it. Other books, class notes, and similar items will NOT be permitted. Additional materials may be provided.

Remember! Attendance at the lectures and the tutorials is mandatory for this course. Always bring your calculator and the concrete design handbook to the lectures and the tutorials.

- **Missed Quiz:** Please see McMaster Undergraduate Calendar for relevant policy and procedure. If such a relief is granted students must immediately follow up with their course instructors regarding the nature of the relief. Such a relief may be a makeup quiz arranged during the term, covering course materials discussed in the class up to few days prior to the makeup quiz (essentially, makeup quiz may not be on the same topic as the missed quiz)

Marked quizzes will be returned to students during tutorial period, and left-over quizzes will be brought to the next tutorial time only.
LABORATORY SESSION:
- Attendance at the R/F CONCRETE DESIGN LABORATORY SESSION is mandatory.
- No attendance will result in FAILURE of the course, and alternate date for missed lab can’t be arranged in 2019.
- Due to safety hazards in the laboratory (ADL), each student MUST wear safety boots, safety glasses and hard hat at all times during this lab session.
- Each student will need to participate in one lab session.
- Dates and times for these lab sessions are shown in the course website, and please select one date (and a back up date) most convenient to you.
- Sign-up sheet will be circulated during the week of January 14, 2019, and members will be assigned to lab sessions on first signed basis.
- Each student must prepare their own laboratory report based on this lab session.
- Reports are due ONE week after completion of the lab (due dates are shown along with lab date).
- Detailed instructions about these lab sessions and report requirements will be posted on the course website.

TERM TEST: There will be one term test (two hours) on Friday, March 1, 2019, TIME: 2.30-4.30pm, Location: TBA

FINAL EXAMINATION: There will be a 2½ hour final examination scheduled during the April examination period.

During the Term Test and the Final Examination, “Concrete Design Handbook” will be permitted, provided nothing written on it. Other books, class notes, and similar items will NOT be permitted. Additional materials may be provided during these examinations.

DISTRIBUTION OF MARKS:
Failure to attend the lab session will result in FAILURE of the course, and alternate date for missed lab can't be arranged in 2019.

The performance will be evaluated based on in-class quizzes, the term test, attendance at the lab session and a lab report and the final exam. Each item carries the following weight:

<table>
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<tr>
<th>Quizzes</th>
<th>Term Test</th>
<th>Lab Report</th>
<th>Final Examination</th>
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<tr>
<td>20%</td>
<td>20%</td>
<td>10%</td>
<td>50%</td>
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The final percentage grade will be converted to a letter grade using the Registrar's scale shown in the McMaster Undergraduate Calendar.

POLICY REMINDERS: Students are reminded of the following Policies:
Calculators: Only the McMaster Standard Calculator (Casio fx-991 MS or MS Plus) may be used during tests and examinations.
Adverse Discrimination: "The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem, that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible."
Academic Integrity (Ethics and Dishonesty): "Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at [http://www.mcmaster.ca/senate/academic/ac_integrity.htm](http://www.mcmaster.ca/senate/academic/ac_integrity.htm) . The following illustrates only two forms of academic dishonesty: 1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained. 2. Copying or using unauthorized aids in tests and examinations.
DISPUTE RESOLUTION PROCEDURES FOR QUIZZES AND THE TERM TEST

- It is possible that some students may have disputes related to the marking of their quizzes and the term test.
- Students have **ONE (1) week** to lodge their objections [One week after returning the marked papers].
- Quizzes and the Term test written in pen ONLY will be considered for dispute resolutions.
  - [Hint! **Write the quiz or the term test using pen**]

**Step: 1**  If available, download or view the corresponding official solutions posted in the course website. Compare your solutions to official solutions and the marking scheme (if available).

**Step: 2**  If there are any complaints, all complaints MUST be submitted in writing. Take another clean sheet of paper and write the complaints. [Do NOT write the complaints on the answer book, and in fact do NOT write anything on the marked answer book].

**Step: 3**  Each complaint must indicate the following THREE items.
- [A] Which problem(s) number(s) are you complaining about?
- [B] What is the nature of the complaint (as detailed as possible)
- [C] In your view, how much do you think you should receive for each problem? Tell us, your thoughts.

**Step: 4**  Staple the complaints sheet to the original of your marked quiz or term test answer book(s), and **HAND DELIVER it to the instructor** either during the class or during instructor’s office hours.
  - Do NOT bring it to TA, because the re-marker may be different from the original marker.
  - Do NOT submit to office assistants or anyone else other than the instructor, since it may be easily misplaced and may not reach the instructor.
  - Do NOT leave it in any mail box.
  - We strongly recommend that you make a photo-copy of the whole document prior to such submissions.
  - A remarking request may result in; [a] reduction in marks, [b] no change in marks, [c] an increase in marks.

**Step: 5**  Written responses will be given back to students, and if the student does not agree with the revised mark as well, then, the student may submit the **whole documentation**, including marker’s comments, to the instructor for arbitration.
  - Students have **ONE (1) week** to lodge their arbitration request [One week after returning the re-marked papers].
  - Add additional comments explaining why you want to appeal the re-marking
  - Arbitration by the instructor may involve complete re-marking by the instructor, without any consideration to the previous marking and the resulting arguments.
  - We strongly recommend that you make a photo-copy of the whole document prior to such submissions.
  - An arbitration request to the instructor may result in; [a] reduction in marks, [b] no change in marks, [c] an increase in marks.