Steel Structures (CIV ENG 4N04)  
Course Outline, Fall 2017

Teaching Staff  
**Lecturer:** Dr Lydell Wiebe ([wiebel@mcmaster.ca](mailto:wiebel@mcmaster.ca), JHE 333, [@LydellWiebe](https://twitter.com/LydellWiebe))  
Office Hours: appointments preferred, but drop-ins often accepted

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Office Hours: TBD

Communication  
**Lectures:** Mondays, Wednesdays, and Thursdays 1:30-2:20 in MDCL 1309  
**Tutorials:** Wednesdays 2:30-4:20 in HH 102, UH 112, or T13 106  
**Website:** On Avenue to Learn ([http://avenue.mcmaster.ca](http://avenue.mcmaster.ca)). Please sign up immediately because important information and course documents will be posted there. It is your responsibility to check the course website regularly.  
**Email:** You can expect a response from TAs within 1 business day, or from the instructor within 3 business days.

Accessibility  
Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail [sas@mcmaster.ca](mailto:sas@mcmaster.ca). For further information, consult McMaster University’s [Policy for Academic Accommodation of Students with Disabilities](http://www.mcmaster.ca/students/academic/academic-accommodation).

Course Overview  
**Learning Outcomes**  
When you have successfully completed this course, you will be able to:  
- identify key elements of steel structures, such as braces, columns, and beams [CEAB Indicator 1.4]  
- calculate the forces in these members using fundamental principles of engineering statics, including strategies for solving trusses and for drawing shear force and bending moment diagrams [CEAB Indicator 1.3]  
- describe the limit states of these elements and their connections using words, sketches, and calculations [CEAB Indicators 1.4 and 7.1]  
- navigate the CISC Handbook of Steel Construction [CEAB Indicator 1.4]  
- apply this fundamental and specialized engineering knowledge to solve unfamiliar problems in steel design [CEAB Indicator 3.2]  
- design steel elements using the current Canadian steel specification, S16-14, to resist the loading conditions specified by the current National Building Code of Canada, NBC 2015 [CEAB Indicators 1.4 and 2.3]  
- identify the assumptions that are required to design these elements and the limitations of the equations that are used for analysis and design [CEAB Indicators 2.1 and 2.3]  
- integrate the design of individual structural elements into a larger project, and communicate the design, including its context and limitations, using writing and drawings [CEAB Indicators 2.3 and 7.1]  
If you achieve these objectives, you will be able to contribute meaningfully to the work that structural engineers do, whether in a design office or in academia.
Course Outline and Approximate Schedule

Structures
- The Structural Design Process
- How Structures Work
- Loads on Structures
- Limit States Design
- P-A Effects
- Research in Earthquake Engineering

Steel Members
- Tension
  - Member Response
  - Bolted Connections
  - Prying Action
  - Welded Connections
- Compression
  - Global Buckling
  - Local Buckling
  - Column Base Plates
- Flexure
  - Local Buckling
  - Braced Flexural Behaviour
  - Lateral-Torsional Buckling
  - Beam Connections
- Combined Loading

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topics (subject to change without notice)</th>
<th>Due Dates (subject to change without notice)</th>
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<tbody>
<tr>
<td>Sep 4</td>
<td>Structural Design</td>
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<tr>
<td>Sep 11</td>
<td>Load Paths for Gravity and Lateral Loads</td>
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<tr>
<td>Sep 18</td>
<td>Lateral Loads, Limit States Design</td>
<td>Sep 22: Assignment 1</td>
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<td>Sep 25</td>
<td>Tension Members: Failure Surfaces</td>
<td>Sep 29: Assignment 2</td>
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<td>Oct 2</td>
<td>Tension Members: Bolted Connections</td>
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<td>Oct 9</td>
<td><strong>Midterm Recess: No Lectures or Tutorial</strong></td>
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<tr>
<td>Oct 16</td>
<td>Bolts in Tension and Shear</td>
<td>Oct 20: Assignment 3</td>
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<tr>
<td>Oct 23</td>
<td>Introduction to Welding</td>
<td><strong>Oct 25: Midterm Exam</strong></td>
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<td>Oct 30</td>
<td>Fillet Welds and Shear Lag in Welded Connections</td>
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<td>Nov 6</td>
<td>Compression Members</td>
<td>Nov 7: Assignment 4</td>
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<td>Nov 13</td>
<td>Flexural Members</td>
<td>Nov 14: Assignment 5</td>
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<tr>
<td>Nov 20</td>
<td>Shear and Deflections in Beams</td>
<td>Nov 21: Assignment 6</td>
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<td>Nov 27</td>
<td>Combined Axial and Flexural Loading</td>
<td>Dec 1: Assignment 7</td>
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<td>Dec 4</td>
<td>Course Wrap-Up</td>
<td>Dec 6: Project, Assignment 8</td>
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The figure and table above summarize the structure of the course. The first 2-3 weeks will focus on aspects of structural design that are common to all materials: how structures carry loads, how to calculate those loads using the National Building Code of Canada (NBC 2015), and the principles of Limit States Design.

The majority of the course will be spent on the behaviour and design of individual steel members according to the Canadian steel specification S16-14. We will start by discussing the behaviour and design of steel members in tension, including bolted and welded connections for such members. Next, we will consider the behaviour of steel members in compression. Bending members, which carry loads through a combination of tension and compression, will be our next topic. Finally, we will study situations with combined flexural and axial loading. As time permits, we will also discuss P-Delta effects and current research in earthquake engineering.

**Modifications**
The lecture and assessment schedule may be adjusted by the university or the instructor during the term. If this happens, the class will be given reasonable notice, an explanation, and an opportunity to comment, although the instructor will not necessarily make changes in response to comments received. It is your responsibility to stay informed of changes by attending all lectures and by checking the course website at least weekly.

**Required Background:** Structural Analysis (3G03 or 3G04), Civil Engineering Materials & Design (3P04)

**Graduate Attributes and CEAB Indicators**
Through this course, you will develop in the following graduate attributes and indicators:

1. A knowledge base for engineering (Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.)
   1.3 Competence in Engineering Fundamentals
   1.4 Competence in Specialized Engineering knowledge

2. Problem analysis (An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.)
   2.1 Demonstrates an ability to identify reasonable assumptions (including identification of uncertainties and imprecise information) that could or should be made before a solution path is proposed.
   2.3 Obtains substantiated conclusions as a result of a problem solution including recognizing the limitations of the solutions.

3. Investigation (An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.)
   3.2 Selects appropriate model and methods and identifies assumptions and constraints.

7. Communication Skills (An ability to communicate complex engineering concepts within the profession and with society at large. Such abilities include reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.)
   7.1 Demonstrates an ability to respond to technical and non-technical instructions and questions.
Books
**Required:** *Handbook of Steel Construction, 11th Edition, 3rd Revised Printing.* Canadian Institute of Steel Construction, Markham ON. **If you use an earlier printing, you are responsible for the changes published by the CISC.**

**Recommended:** Kulak GL, Grondin GY. 2016. *Limit States Design in Structural Steel. 10th Ed.* Canadian Institute of Steel Construction, Markham ON.

Both of the above books are available from the CISC’s Amazon storefront. The discount codes that are available on the course website expire on September 30, 2017.

**Recommended:** Metten AWF, Driver RG. 2015. *Structural Steel for Canadian Buildings. 3rd Ed.* Structured Solutions.

Assessment

**Components**

Final Exam (Date TBA) 50%
- Limited Open Book CISC handbook and specified documents only
- McMaster Standard Calculator (Casio fx-991) only

Midterm Exam *(October 25 during Tutorial Time)* 25%
- Limited Open Book CISC handbook and specified documents only
- McMaster Standard Calculator (Casio fx-991) only

Design Project & Assignments 25%
- There will be approximately 8 assignments throughout the term, worth a total of 20% of your final grade. These assignments will include both individual (80% of each assignment) and group work (20% of each assignment) components. Most assignments will involve phases of the design project, which encompasses the design of a low-rise steel structure. All group members will receive the same grade for the group work portion only. The final group project report will be worth 5% of your final grade. It will include structural drawings and a discussion of the selected design solutions.

The final percentage grade will be converted to a letter grade using the scale specified in the McMaster calendar *(http://academiccalendars.romcmaster.ca/index.php)* under General Academic Regulations.

**Bonus Opportunity**

I strongly encourage you to get involved in extracurricular activities that broaden your life experience. For an extra 2% of your final grade, please email me a link to a video that you make, which shows you participating in at least one extracurricular activity this term and explaining how that activity is helping you to develop skills that will make you a better engineer. The video must be posted publicly online, with your name and “McMaster” included on the page, and available to be linked from other social media accounts (e.g. mine, McMaster Engineering, your activity). Therefore, it should be of a quality that you would like to be seen by prospective employers and other students. I reserve the right to assess whether your activity and video qualify for the bonus, so if you have any questions, please ask me before preparing your video. The deadline to submit your video is Friday, November 24. Some of my favourites from last year can be found through my Twitter account *(@LydellWiebe)* on January 25, 2017. If you are looking for a way to get involved, check out the booths on campus this week, or drop by the Student Success Centre in Gilmour Hall 110.

**Late Submissions**

If an assignment will be accepted after the regular deadline, the deadline for late submissions will be listed on the assignment. A deduction of 20% will apply (e.g. a student who scores 80% on the assignment will receive 60% if it is submitted late).

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1 For each student, a non-zero midterm exam grade will be replaced with the final exam grade if it is to that student’s benefit.
Missed Term Work
The University’s policy on missed term work is available at http://academiccalendars.mcmaster.ca/index.php, under the section General Academic Regulations. If you are unable to complete your term work for any reason, please contact the course instructor to discuss your situation as soon as possible. The McMaster Student Absence Form (MSAF) will only be accepted if you email the course instructor within one week after the due date of the assignment. When accommodations are made, they will be confirmed by email from the course instructor; any grades that are missing on the course website will be counted as zero when calculating your final grade unless you have received email confirmation otherwise. As the midterm exam is worth 25% of the final grade, students who miss the midterm must report to the Faculty Office; an MSAF is not sufficient. The weight of any missed term work will normally be deferred to the final exam.

Discussions of Feedback
You are encouraged to discuss the feedback that you receive on any assessment with your TAs or the course instructor. If you believe that you have received an incorrect grade on any piece of assessment, you must return it to the person who marked it, together with a written explanation of why you believe the grade was incorrect, within one week of the day that the assessment was returned. This may result in the grade increasing, decreasing, or remaining the same.

Academic Integrity
You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour 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 types of academic dishonesty please refer to the Academic Integrity Policy, located at http://www.mcmaster.ca/academicintegrity. The following illustrates only three 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. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

In this course, most assignments will have slightly different numerical questions for each group member. Discussing your solution technique with your group members is encouraged, but copying some or all of the solution from another student who has the same numerical problem as you is considered an example of academic dishonesty.

Human Rights and Equity
Under the Ontario Human Rights Code and McMaster policy, you have a right to an environment that is free of discrimination and harassment. If you have any concerns, please do not hesitate to contact me or a human rights officer (http://hres.mcmaster.ca/).

Laboratory Safety
Students are required by University policy to comply with all University health, safety and environmental programs. It is your responsibility to understand McMaster University Workplace and Environmental Health and Safety Policy, which is available at http://www.workingatmcmaster.ca/med/document/Lab-Safety-Handbook-1-36.pdf. It is also your responsibility to follow any specific Standard Operating Procedures that may be provided for some of the experiments and the laboratory equipment. The safety requirements for all Civil Engineering laboratories are listed below. Students who do not comply with health and safety requirements will not be allowed to participate in the lab.

- Glasses or safety glasses/goggles must be worn in the lab at all times
• Contact lenses are not to be worn in the lab.
• No short (i.e., above the knee) pants or skirts are permitted in the lab—lab coats must be worn over top of your clothing in these instances.
• Closed-toe shoes must be worn at all times.
• No loose clothing allowed.
• Long hair must be tied back.
• Gloves must be worn when working with hazardous chemicals (as indicated by the laboratory instructor).

In addition, the following instructions have been provided specifically for this course by the Applied Dynamics Laboratory manager, Kent Wheeler:

• **PPE Required:** During the lab, students are required to wear Green Patch safety boots, hard hats, and safety eye-glasses at all times. Students supply their own safety boots. Hard hats and safety-glasses are available in the lab. Prescription eye-glasses are only considered as safety glasses if they have side shields.
• Maintain a safe distance from the universal tester while the sample is being loaded.
• No one will create a situation that could compromise or jeopardize the safety of themselves or anyone else in the lab. Obey all instructions given to you by the Teaching Assistant and/or lab technical staff.
• These safety requirements are emphasized (1) through a pre-lab form which each student must sign, (2) through lab work instruction sheets, and (3) instructor/TA/technicians check each student to ensure they are wearing the above items.
• Prior to each lab, students are verbally reminded that they should wear the above safety equipment at all times, and in addition lab specific safety instructions are given to students by the instructor/TA/technicians.
• Failure to comply with safety rules, will result in the individual student being denied access to the lab and given a “did not complete” grade for the lab session.

**Professional Class Conduct**

My goal in every class is to provide the best possible environment for everyone in the class to become competent structural engineering professionals. In order to do this, I expect you to treat meetings of this class as you would treat meetings that with your supervisor in an engineering design office. This includes the following expectations:

• **Arrive on time.** Plan for the possibility of transport delays. But if you are late, minimize the disruption you cause by quickly and quietly finding a seat near the aisle.
• **Come prepared to work.** Expect to participate actively in every class, check the course website before coming, and bring a calculator with you.
• **Be quiet during class.** If you have a question, please raise your hand so that I can answer it for everyone.
• **Turn off all electronic devices, including cell phones and mp3 players, during class.** Do not check emails, text people, etc. during class.
• **Do not use a laptop unless you are taking notes on it.** I will check.
• **Avoid eating during class.** If you must eat, choose something that you can eat quietly and that is not smelly.
• **Do not leave the room during class except to go to the washroom.** If you must leave, minimize your disruption by doing so quickly and quietly.

If you are disrupting the class, after a warning, I may have to ask you to leave the class and possibly to meet with the Chair of the Department if the behaviour persists.

If you are bothered by the behaviour of other students, please let me know so that I can address your concerns quickly.