Course Info:
Meeting Times and Location: Monday - 11.35 – 14.25
https://learnaboutstructures.com/
Course Webpage: The course materials will be available on BrightSpace. All students are responsible for ensuring that they are correctly registered through Brightspace and that they are receiving messages properly through their official university email address. Students are responsible for checking the Brightspace course management site and their official email account frequently. The announcement function in Brightspace will be used to send out any updates with important information related to the course.

Class Description:
Prerequisites: CIVE 2200 and MATH 1004

Tentative Lecture Schedule:
Week 1-2: Introduction to structural analysis; Classification of structures; General description of plane frame; Joints; Supports; Stability; Determinacy; Equilibrium. Plane trusses; Analysis of statically determinate trusses. (Chapter 1-3 - [B1]; Chapter 1-3 - [B2])
Week 3: Analysis of determinate beams and frames. (Chapter 4 - [B1]; Chapter 4 - [B2])
Week 4: Deflections; Moment area theorems; The virtual work method (Chapter 7,8 - [B1]; Chapter 5 - [B2])
Week 5: Influence lines for statically determinate structures (Chapter 6 - [B1]; Chapter 6 - [B2])
Week 6: Approximate indeterminate frame analysis; (Chapter 12 - [B1]; Chapter 7 - [B2])
Week 7: Analysis of statically indeterminate structures by the force method; (Chapter 9 - [B1]; Chapter 8 - [B2])

Week 8: Fall BREAK, no classes

Week 9: The slope deflection method (Chapter 10 - [B1]; Chapter 9 - [B2])

Week 10: The moment distribution method (Chapter 11 - [B1]; Chapter 10 - [B2])

Week 11-14: Introduction to matrix structural analysis (Chapter 14 - [B1]; Chapter 11 - [B2])

Course Objectives
- To understand the important structural analysis concepts of elasticity, equilibrium, and compatibility.
- To learn and perform structural analysis using different methods, including the methods of equilibrium and the methods of work and energy.
- To understand and evaluate the concepts of structural stability and determinacy.
- To understand and perform analysis of structures subject to live and moving loads using influence lines.
- To determine structural displacements due to applied forces, temperature changes, member distortions and support movements using virtual work and energy methods.
- Understand and perform the analysis of statically indeterminate structures using a flexibility (force, compatibility) method.

Learning Outcomes:
This course requires the student to demonstrate competence in the following areas:

1. Draw complete free body diagrams involving the applied loads and reactions for planar beam, frame and truss structures.
2. Understand the concepts of boundary conditions, constraints and compatibility, and the implications for forces and displacements in structures.
3. Determine the reactions acting on planar, statically determinate, beam, frame and truss structures using equilibrium methods.
4. Determine the reactions acting on planar, statically determinate, beam and frame structures using the method of virtual work (virtual displacement).
5. Understand the effect of distributed loads acting on sloping frame members, and to understand the different load specifications and their implications.
6. Understand the concept of equilibrium as applied to portions of structures.
7. Draw complete free body diagrams of portions of planar beam, frame and truss structures.
8. Understand the relationships between external forces and internal shear forces, bending moments and normal forces in planar beam and frame structures.
9. Draw clear and accurate shear force, bending moment and normal force diagrams for planar beam and frame structures.
10. Use knowledge of loads and member end forces to determine the external reactions acting on planar beam and frame structures.
11. Use shear force and bending moment diagrams to determine loads and reactions acting on planar beam and frame structures.
12. Perform equilibrium checks to partially evaluate the correctness of a structural analysis.
13. To be able to classify a planar truss as either simple, compound or complex.
14. Determine all of the member forces for statically determinate trusses using the method of joints and the method of sections.
15. Formulate statically determinate truss analysis problems in matrix form and solve the resulting sets of equations.
16. Draw influence lines for statically determinate, planar, beam, frame and truss structures.
17. Use influence lines to determine extreme structural responses for planar structures subjected to moving and live loads.
18. Understand the concept of statical determinacy and stability and be able to evaluate a planar structure for stability and determinacy.
19. Determine displacements due to loads, temperature changes and member distortions in planar trusses using the method of virtual work.
20. Determine displacements due to loads in planar beam and frame problems using direct energy methods.
21. Determine displacements due to loads, member distortions, temperature changes and support movements in planar beam, frame and compound frame-truss problems using the method of virtual work.
22. Determine the reactions acting on statically indeterminate, planar beam, frame and truss structures using a flexibility (force) method.
23. Determine all of the internal member end forces acting on statically indeterminate, planar beam and frame structures using the method of slope-deflection (a stiffness, or displacement method).
24. Determine the reactions in a statically indeterminate beam or frame structure from the loads and member end forces.

Marking Scheme:

Mid-term Exam (35%): All topics covered until the end of the week before the exam will be included. Missing mid-term exam will automatically result in a mark of zero for that component unless acceptable documentation is presented to justify your absence within three days of the date of the mid-term exam. The instructor will decide what documentations are acceptable. You must obtain approval prior to the mid-term exam if you cannot write the mid-term exam at the scheduled time (except in cases of unexpected emergencies). If unsure of what would be proper documentation for the given circumstances, please consult with your instructor.

The midterm exam is scheduled to take place on Friday, November 3rd from 2:35 pm – 5:25 pm. The midterm exam location is the same room as the lab sessions, Azrieli Theatre 101 (AT 101).

Assignments (15%): 4 assignments will be posted and due on the following dates (see below). It is each student’s responsibility to ensure that their work is legible and neat, otherwise, points may be deducted. Submission of the assignments will be done in person through the submission of physical assignments copies in the assignment box located in front of the Department of Civil & Environmental Engineering (Mackenzie Building, 3rd floor, 4th module). While it is permitted and recommended to discuss and work through the assignments with colleagues to enhance your learning, it is crucial that
assignments are completed individually. Attempting assignments individually is the only way to have an opportunity to test your understanding and practice for the midterm and the final exam. Feedback will be provided directly on the assignment. **No assignment solutions will be posted.**

<table>
<thead>
<tr>
<th>Assignments</th>
<th>Posted Date</th>
<th>Due Date (at 4:00 pm)</th>
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<tbody>
<tr>
<td>Assignment 1</td>
<td>Oct. 2</td>
<td>Oct. 16</td>
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<tr>
<td>Assignment 2</td>
<td>Oct. 16</td>
<td>Oct. 30</td>
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<td>Assignment 3</td>
<td>Nov. 6</td>
<td>Nov. 20</td>
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<tr>
<td>Assignment 4</td>
<td>Nov. 20</td>
<td>Dec. 8</td>
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**Assignment Tokens**
As of the first day of class, each student will be given three (3) “assignment tokens”. Each token allows for a one-time 24-hour extension of any assignment of their choosing without penalty. Tokens may be combined for a single assignment (e.g., using two tokens for a 48-hour extension). Tokens may not be transferred to other students. No additional tokens will be given.

**Final Exam (50%):** The final exam has not yet been scheduled. You will be notified of the date, time and location through the university once SES makes the exam schedule available.

**NOTE:** A final course grade of D- or better must be obtained in order to pass the course. All components of the course must be fulfilled; otherwise, students may receive an F as a final mark. This is also valid for students who are taking the course for the second time.

**Grade Appeals**
All appeals of grades assigned in this course must be made within 7 calendar days of the grade being made available. Note that an appeal may result in a reduction or an increase in grade.

**Graduate Attribute Data Collection**
The Canadian Engineering Accreditation Board (CEAB) requires graduates of undergraduate engineering programs to possess 12 attributes. Courses in all four years of our programs evaluate students' progress towards acquiring these attributes. Aggregate data (typically, the data collected in all sections of a course during an academic year) is used for accreditation purposes and to guide improvements to our programs. Some of the assessments used to measure GAs may also contribute to final grades; however, the GA measurements for individual students are not used to determine the student's year-to-year progression through the program or eligibility to graduate.

**COURSE POLICIES**

**Academic Integrity:**
Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensure that a degree from Carleton University is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. Carleton University’s Policy on Academic Integrity (http://www.carleton.ca/studentaffairs/academic-integrity) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic
offences. It is your responsibility to be familiar with these policies. Any students who do not act with academic integrity will face severe consequences including immediate referral to Associate Dean of Student Affairs.

**Email Policy**
Effort will be made to reply to emails as soon as possible, but please expect a possible delay of up to 48 hours for a response. Emails will not be answered during weekends or holidays.

For enquiries regarding assignments and problems seen during laboratory sessions, please contact the respective TA.

**Missed Term Work**
Students who claim illness, injury, or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for alternate arrangements with the instructor and in all cases. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. Consult [Section 4.4 of the University Calendar](https://carleton.ca/registrar/deferral). Students missing deadlines or exams due to an illness must submit a Self-declaration for Academic Considerations Form to the instructor no later then 3 days after any missed course work or examination.

If an absence or missed deadline is deemed justified:

**Assignments**: the weight of a justified missed assignment will be transferred onto the remaining assignments.

**Midterm exam**: the weight of a justified missed midterm will be transferred onto the final exam.

**Final exam**: the student will have to consult the academic secretariat of the faculty for the procedure to follow. The student will need to submit the self-declaration form in addition to a deferral application (carleton.ca/registrar/deferral) to the Registrar’s Office no later than 3 days after the scheduled examination date.

**Copyright**
Classroom teaching and learning activities, including lectures, discussions, presentations, etc., are copyright protected and remain the intellectual property of the instructor. All course materials, including PowerPoint presentations, outlines, and other materials, are also protected by copyright and remain the intellectual property of the instructor. Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s). Students are not permitted to upload these copyrighted course materials to any online repositories.
Learning and Working Environment
The University and all members of the University community share responsibility for ensuring that the University’s educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the Department of Equity and Inclusive Communities at equity@carleton.ca.

We will strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space which we work in will be safe for everyone. Please be considerate of everyone’s personal beliefs, choices, and opinions.

Engineering Academic Advising
The Engineering Academic Support Service assists undergraduate engineering students with course selection, registration, and learning support from first-year through to graduation. Academic Advisors Contact can be found here.

Academic Accommodations
For an academic accommodation request, the processes are as follows:

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with learning disabilities, psychiatric/mental health disabilities, attention deficit hyperactivity disorder (ADHD), autism spectrum disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca. You should request your academic accommodations in the Ventus Student Portal, for each course at the beginning of every term. For in-term tests or midterms, please request accommodations at least two (2) weeks before the first test or midterm. For final exams, the deadlines to request accommodations are published in the University academic calendars for both undergraduate and graduate students.

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the Senate Policy on Accommodation for Student Activities (PDF).
**Pregnancy Obligation:** Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the Student Guide to Academic Accommodation (PDF).

**Religious Obligation:** Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the Student Guide to Academic Accommodation (PDF).

**Survivors of Sexual Violence:** As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton’s Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit the Sexual Violence Prevention & Survivor Support.

**Public Health Measures**

If you are feeling sick, please stay home. If you require assistance due to missing a lecture while recovering from an illness, please contact a colleague or the course instructor. You will not be penalized for staying home if you are feeling unwell. Remaining vigilant and not attending work or school when sick or with symptoms is critically important for the wellbeing of your peers and Carleton University staff. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In the event that the course instructor falls ill prior to a scheduled lecture, an announcement will be made on Brightspace and the in-person lecture will be canceled. A recorded lecture will be posted on Brightspace shortly afterwards.

**Student Mental Health and Wellness**

University students may experience a range of mental health challenges that can significantly impact academic success and overall well-being. Carleton’s Wellness Services Navigator is designed to help students connect with mental health and wellness resources. If a student needs to talk to someone from the department for more information and support with connecting to resources, they can contact the following faculty members, or contact the department at CEEUGChair@cunet.carleton.ca

**ACSE:** Prof. Scott Bucking Office: 5209 Canal Building

**CIVE:** Prof. Heng Khoo Office: 3364 Mackenzie

**ENVE:** Prof. Shoeleh Shams Office: 4242 Mackenzie

The following is a non-exhaustive list of available on- and off-campus resources:

1. Carleton’s Health and Counselling Services: To book an appointment contact the main clinic by calling (613) 520-6674. If urgent, let the Patient Care Coordinator know or go in person to the main clinic (2500 Carleton Technology and Training Centre Building) and indicate that they are in crisis and need to speak to someone right away. [https://carleton.ca/health/](https://carleton.ca/health/)
2. **Good2Talk (1-866-925-5454):** Good2Talk is a free, confidential helpline providing professional counselling and information and referrals for mental health, addictions and well-being to post-secondary students in Ontario, 24/7/36 [https://good2talk.ca/](https://good2talk.ca/)

3. **Empower Me:** Undergraduate students have access to free counselling services in the community through Empower Me, either in person, by telephone, video-counselling or e-counselling. This free service is accessible 24/7, 365 days per year. Call 1-844-741-6389 (toll free) to make an appointment with a counsellor in the community. [https://students.carleton.ca/services/empower-me-counselling-services/](https://students.carleton.ca/services/empower-me-counselling-services/)

4. **The Walk-In Counselling Clinic** (off-campus community resource): The walk-in Counselling Clinic have offices in various locations across Ottawa and the greater Champlain region that are open 7 days a week. Individuals will be assisted, with no appointment, on a first-come, first-serve basis during the Walk-in Counselling Clinic hours. The Walk-in Counselling Clinic offers services in many languages and is free and confidential. [https://walkincounselling.com/](https://walkincounselling.com/)

5. **Distress Centre of Ottawa and Region:** Available 10am-11pm, 7 days/week, 365 days/year. Distress Line: 613-238-3311, Crisis Line: 613-722-6914 or 1-866-996-0991, Text: 343-306-5550. [https://www.dcottawa.on.ca/](https://www.dcottawa.on.ca/)

6. **Distress and Crisis Ontario,** Available for chat 2 pm – 2 am EST. [https://www.dcontario.org/](https://www.dcontario.org/)

7. **BounceBack Ontario** (Toll-Free: 1-866-345-0224) is a free skill-building program managed by the Canadian Mental Health Association (CMHA). It is designed to help adults and youth 15+ manage low mood, mild to moderate depression and anxiety, stress or worry. Delivered over the phone with a coach and through online videos, you will get access to tools that will support you on your path to mental wellness. [https://bouncebackontario.ca/](https://bouncebackontario.ca/)