

Winter 2024
Design of Structural Steel Components
Department of Civil and Environmental Engineering
CIVE 3205 A & B

Instructor:

Name: Khoo, H.A.
email address: heng.khoo@carleton.ca
office location & phone: Room 3364 ME; (613) 520-2600 Ext. 5798
office hours: Tuesday: 11:30-13:30
Friday: 12:30-14:30

TA(s): TBA

1) Course schedule

Lecture:	(A) Monday/Wednesday: 08:30–10:00	TB 340
	(B) Monday/Wednesday: 13:00–14:30	TB 342
PA:	Tuesday: 14:30-15:30 (Alternate Week)	AT 301

2) Course description

Introduction to CAN/CSA - S16, design and behaviour concepts; shear lag, block shear, local plate buckling, lateral torsional buckling, instantaneous centre, inelastic strength and stability. Design of tension members, axially loaded columns, beams, beam-columns, simple bolted and welded connections

3) Precluded courses: None

4) Prerequisites and recommended knowledge

CIVE 2200 and CIVE 2700. Recommended prerequisite: CIVE 3204.

5) Objectives and Learning Outcomes:

Upon successful completion of this course, students will acquire knowledge on the design of simple steel structural members and different types of connections commonly used in the construction of steel structures. The knowledge and skills gained in this course are essential for students to understand the advanced steel design concepts introduced in other courses.

1. Understand the manufacturing process of structural steel.
2. Know the properties of structural steel and of structural sections.
3. Compute the strength of tension members for all failure modes.
4. Understand gross and net areas, strength reduction due to shear lag.
5. Understand the failure modes and effective length of compression members.
6. Compute the strength of compression members.
7. Understand the failure modes of beams in flexure.
8. Compute the strength of laterally supported and unsupported flexural members.
9. Know failure modes and compute the strength capacity of beam-columns.
10. Compute the strength of bolted connections
11. Compute the strength of welded connections.
12. Be able to use the design aids in the steel handbook to establish trial sizes.
13. Be able to use strength calculations appropriately in design to choose sizes.

6) Graduate Attributes

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. This following list provides the GAs that will be measured in this course, along with the Learning Outcomes that are intended to develop abilities related to these attributes.

GA - Indicator	Assessment
GA4.4 – Design Solution(s)	Details of the design are clearly specified and verified
GA4.6 – Alternative Solution(s) Definition	Solution concepts and ideas are developed, and review of design solutions
GA4.7 – Evaluation Based on Engineering Principles	Design is appraised and reviewed based on engineering principles and on relevant economic, social, environmental and ethical issues

For information on GAs and continual curriculum improvement, visit the [Accreditation section of Engineers Canada website](#).

7) Accreditation Units

Math	Natural Science	Complementary Studies	Engineering Science	Engineering Design
	-	-	50%	50%

8) Text book(s)/References

Text books

1. Kulak and Grondin, (2021). *Limit States Design in Structural Steel*. 11th Edition, Canadian Institute of Steel Construction, Toronto.
2. CISC, (2023). *Handbook of Steel Construction*. 12th Edition-2nd printing, Canadian Institute of Steel Construction.
[CISC, (2021). *Handbook of Steel Construction*. 12th Edition, Canadian Institute of Steel Construction]

CISC Handbook can be purchased with student discount. Promotion ending Jan. 31, 2024. See details in course website.

Reference Texts:

1. *National Building Code of Canada 2020*. National Research Council of Canada
2. Ziemian, R.D. (2010). *Guide to Stability Design Criteria for Metal Structures*. 6th Edition, John Wiley & Sons, Inc., Hoboken, New Jersey.

9) Topics and Tentative Plan

Week	Topic
1	Introduction; Material Properties; Steel Sections
1-3	Tension members; Behaviour and analysis of strength. Design types of section, net area, proportioning.
3-5	Axially loaded compression members (columns): Introduction, Residual stresses. Behaviour of short columns under load. Behaviour of slender columns, elastic and inelastic buckling. Design of columns. Effective length concept; Columns in braced and unbraced frames.
5-7	Flexural Members: Introduction; types of beam sections, support conditions. Ultimate strength of beams in flexure; moment-curvature relationship; load-deflection relationship; local buckling. Ultimate strength of beams in shear. Limitation on deflection. Design of laterally supported beams. Lateral-torsional buckling; Design of laterally unsupported beams.
8-10	Beam-Columns: Ultimate capacity of section. Local buckling. Moment-curvature-axial load relationship. Cross-section strength, equivalent moment factor, overall member strength, lateral-torsional buckling strength.
10-12	Connections: Bolts; high strength bolts; installation of bolts. Strength of bolts and bolted connections. Connection design; double angle beam connections. Welding process; weld classification; welding symbols. Design of welded joints; Strength of welds; Eccentrically loaded connections.
12-13	Connections: Base plate (time permitted) Torsion (time permitted)

- a) PA: (1) Jan. 9, (2) Jan. 23, (3) Feb 06, (4) Feb. 27: Mid-term exam, (5) Mar. 12, (6) Mar. 26, (7) April. 9
 b) Mid-term examination is scheduled for **Feb. 27 during the PA period.**
 c) Lecture in-lieu of PA (1) Jan. 9.

10) Evaluation and Marking Scheme

PA and Homework (5 PA/Assignment)	20%
Mid-Term Exam (Feb. 27)	30%
Final Exam:	50%

- Students will be assigned the grade F (Failure) if the term work of at least 40% [20 out of 50], and PA and Assignment of at least 50% [10 out of 20] have not been achieved.
- A minimum mark of 40% (20 out of 50) in the final exam is required to pass the course.
- Both mid-term and final exams are open book (all written and printed materials). No electronic device other than the calculator is allowed.

a) Self-Declaration form and deferred term work (including mid-term exam)

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 making alternate arrangements with the instructor and in all cases. This must occur no later than three (3) days after the term work was due. 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](#).

b) Final Examination

- Final exams are for evaluation purpose and will not be returned to students.

ii) Students who are unable to write the final examination because of a serious illness/emergency or other circumstance beyond their control may apply for accommodation by contacting the Registrar's office. Consult the [Section 4.3 of the University Calendar](#).

c) Late Submission Policy

PA/Assignment due date is strict. Some parts of PA and Homework may be due at the end of the PA session. The rest normally due a week later. Late submissions of PA/Assignments will be given zero. 10 % deduction if PA and Homework assignments handed in that are not stapled.

11) Academic dates

Students should be aware of the academic dates (eg. last day for academic withdrawal) posted on the Registrar's office web site <https://carleton.ca/registrar/registration/dates/academic-dates/>

12) Academic Integrity and Plagiarism

- a) Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: <https://carleton.ca/engineering-design/current-students/fed-academic-integrity> Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or, expulsion.
- b) One of the main objectives of the Academic Integrity Policy is to ensure that **the work you submit is your own**. As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source. Examples of violations of the policy include, but are not limited to:
 - 1. any submission prepared in whole or in part, by someone else;
 - 2. using another's data or research findings without appropriate acknowledgement;
 - 3. submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own; and
 - 4. failing to acknowledge sources of information through the use of proper citations when using another's work and/or failing to use quotations marks.
- c) You may discuss with others, but you are required to submit your own work for PA/Homework. You shall not complete the submitted work collaboratively.

13) Copyright

The materials (including the course outline and any slides, posted notes, videos, labs, project, assignments, quizzes, exams and solutions) created for this course and posted on this web site are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s).

The partial notes supplied on the website are intended to serve as complement and not replacement to regular class attendance. The author does not guarantee these notes to be 100% error free. Every effort will be made to identify the error and correct it during class

14) 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.

15) Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an 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 (LD), 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. Please consult the [PMC website](#) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

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](#).

16) 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: <https://carleton.ca/engineering-design/current-students/undergrad-academic-support/undergraduate-advisors/>.

17) Student Mental Health and Wellness

As a university student you may experience a range of mental health challenges that can significantly impact your academic success and overall well-being. Carleton's [Wellness Services Navigator](#) is designed to help students connect with mental health and wellness resources.

If you need to talk to someone from the department for more information and support with connecting to resources, you can contact the following faculty members, depending on your program. Or contact the department at or CEEUGChair@cunet.carleton.ca.

ACSE: Prof. [Scott Bucking](#)

Email: scott.bucking@carleton.ca, Office: 5209 Canal Building

CIVE: Prof. [Heng Khoo](#)

Email: heng.khoo@carleton.ca, Office: 3364 Mackenzie

ENVE: Prof. [Shoeleh Shams](#)

Email: shoeleh.shams@Carleton.ca, Office: 4242 Mackenzie

Here is a list of on-campus and off-campus recourses:

- a) **Carleton's Wellness Desk:** Located at [204A MacOdrum Library](#), is a space for students to learn about resources, connect with our Wellness Coordinator, and decompress during stressful times of the year. You can pop into the Wellness Desk any time during its hours of operation – no appointments necessary! <https://wellness.carleton.ca/mental-health/wellness-desk/>
- b) **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. For more information, please see <https://carleton.ca/health/>
- c) [Emergencies and Crisis](#) and [Emergency Numbers](#)
- d) **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/>
- e) **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. More information is available <https://students.carleton.ca/services/empower-me-counselling-services/>
- f) **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. More information can be found at: <https://walkincounselling.com/>
- g) **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/>
- h) **Distress and Crisis Ontario,** Available for chat 2 pm – 2 am EST. <https://www.dontario.org/>

- i) **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/>.

17) Other Notes

- I. Cell phones and pagers must be turned off for in person class
- II. All email correspondence has to originate from the Carleton email account. I will only response to the Carleton email account