

UNIVERSITY OF WATERLOO
Department of Civil and Environmental Engineering

CIV. E. 413: Structural Steel Design

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Textbook: Civ. E. 413 Notes, L. Xu, University of Waterloo (available at W Store).

Course Objective:

The primary objective of the course is to provide students an introduction and a solid background in the principles of limit states design for structural steel. Emphasis will be placed on behaviour and design of steel members for buildings. Bases of the criteria given in the *CSA S16-2019* will be studied. All of the design examples and assignments will comply with the specifications of *CSA S16-2019 Design of Steel Structures*.

Course Outline (including brief reviews of content taught in CivE 310):

Introduction, Structural Safety and Loads

Introduction, load effect vs. resistance, calibration and ϕ factors, load combinations and limit states

Material Properties of Structural Steel

Hot-rolled vs. cold formed, ductility, toughness, steel types, and structural steel shapes

Tension Members

Gross and net area concepts, shear lag (bolted connections and welded connections), bolt patterns, holes, distance, etc., bearing and block tear out with bolts

Connections

Bolts, welds, load transfer mechanism, and simple connections.

Axially Loaded Compression Members

Columns, residual stresses, local buckling limits, effective lengths and column base plates

Beams

Types and failure modes / limit states, classes 1, 2, 3, 4 for cross-sections, laterally-supported vs. laterally-unsupported; introduction to plastic design and other criteria for beams: shearing, deflection, web crippling, web overall buckling and bearing plates

Plate Girders

Design for bending: flange selection, design for shear: web selection and stiffener requirements

Beam-Columns

Combined action of tension and bending, combined action of compression and bending, capacity of cross-section, member in-plane buckling and member out-of-plan buckling.

Design for Structural Stability

Stability analysis of unbraced steel frames, $P-\Delta$ and $p-\delta$ effects, effects of column initial imperfections, bracing member design

Assignments:

There will be six assignments. In order to prepare you for the engineering practice, only clean and neat assignments are allowed for submission. Sloppy and/or late assignments will be returned with zero mark, and late assignments will not be accepted. Assignments must be completed individually. Assignments will be submitted electronically to Crowdmark as directed by the course TA.

Office Hours:

Instructor and TA online office hours will be announced later.

Grading:

The final grade will be assessed based on the combination of Assignments and Exams:

- Assignments 20%
- Mid-term exam: 30%
- Final Exam: 50%

Further Reading:

- ◆ Handbook of Steel Construction, 12th Edition, Canadian Institute of Steel Construction.
- ◆ Limit States Design in Structural Steel by Kulak and Grondin, 11th Edition, CISC.

Other Information

***Online Purchase of Handbook of Steel Construction, 12th Edition, Canadian Institute of Steel Construction with Student Discount**

The 12th edition of the handbook is available to purchase on Amazon with student discount a student discount code. Student discount codes will be distributed

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. (Refer to www.uwaterloo.ca/academic-integrity/ for more information.)

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, (<https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70>). When in doubt contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity (www.uwaterloo.ca/academic-integrity/) to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean.

For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, (<https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71>) For typical penalties check Guidelines for the Assessment of Penalties (<https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties>)

Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) (<https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72>).

Note for Students with Disabilities: AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.