MASTER OF ENGINEERING

STRUCTURAL ENGINEERING

WELCOME TO THE
M.ENG. PROGRAM

The University of Alberta's Master of Engineering (M.Eng.) course-based programs are valuable for engineers at any career stage wishing to enhance their technical, managerial, and leadership skills. Our students learn from some of the top academics in their fields and train in internationally renowned facilities. Students participate in practical Alberta-focused projects that prepare them to demonstrate their skills and knowledge to potential employers.

M.Eng. students have access to the University of Alberta's Engineering Employment Center resources (job postings, workshops, networking opportunities, career fairs) and benefit from a dedicated student coach, who provides communications support.

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
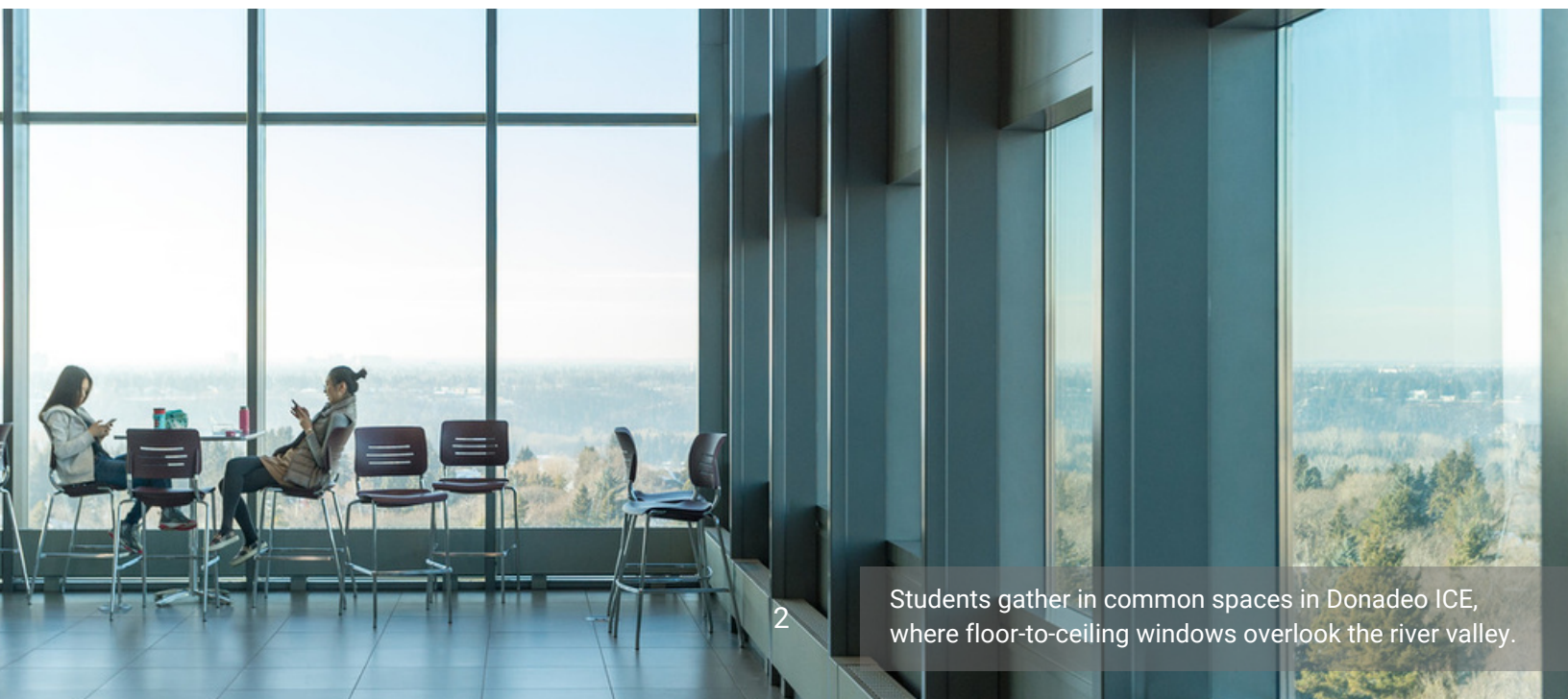
M.ENG.
PROGRAM INFO

PROGRAM
OBJECTIVES

The M.Eng. Program is designed to prepare students for engineering practice in modern Structural Engineering, involving areas of design, analysis, inspection, monitoring, maintenance, and retrofit of civil structures. It will also equip students with the required knowledge, skills, methods, tools, experience, and professional communication capability to contribute to Civil Engineering industry and society at large.

The program prepares the students for an entry career in the Structural Engineering industry.

LEARNING
OUTCOMES

- Gain and apply knowledge of mechanics, analysis, design, and data analytics in engineering practice for a variety of civil structures (e.g., concrete, steel, timber, masonry, and composite).
- Understand and follow national or international standards, codes and industry manuals to design safe and economical structural components (e.g., members, joints) or systems (e.g., buildings, bridges).
- Obtain relevant knowledge about emerging technologies and techniques to manage infrastructure assets in modern society.
- Collaborate effectively with team members on capstone projects and communicate to team members as well as other target audiences.
- Develop the foundational knowledge and awareness for life-long learning to continue professional growth, thus being adaptable to the ever-evolving industry needs.
- Understand ethical and professional responsibilities and make informed judgments considering the impact of engineering solutions in global, economic, environmental, and societal contexts.

Students gather in common spaces in Donadeo ICE, where floor-to-ceiling windows overlook the river valley.

M.ENG.
PROPOSED COURSE SEQUENCE

The length of the program is two years. Students can accelerate the program or prolong it after approval from the M.Eng. Academic Advisor (see program contacts on page 4).

Please refer to the Graduate Handbook for full program policies.

FALL 2023	CIV E 660 (Advanced Structure Analysis) CIV E 670 (Steel Structures) CIV E 789 (Writing/Comm for Engineers)
WINTER 2024	CIV E 665 (Finite Element Method) CIV E 672 (Behaviour and Design of Concrete Members) CIV E 661 (Dynamics of Structures)
FALL 2024	CIV E 662 (Structural Timber Design) **One** 500/600/700-level Engineering or Science elective, *as approved by the M.Eng. Academic Advisor* **Plus two from** CIV E 779 (Machine Learning for Engineers) CIV E 779 (Future Infrastructure Systems)
WINTER 2025	CIV E 900 Directed Research Project (Capstone)

STUDENT SUPPORT

GRADUATE PROGRAM ADVISORS

Trina Cattral – 7-387 Donadeo ICE
Christina Ezekowitz – 7-381 Donadeo ICE
Arlene Figley – 7-389 Donadeo ICE
Ellie Kim – 7-385 Donadeo ICE

Email: cgradvis@ualberta.ca

ASSOCIATE DEAN GRADUATE STUDENTS CEE/MP

Dr. Zaher Hashisho – 7-241 Donadeo ICE
Email: ad.ceegrad@ualberta.ca

STRUCTURES GRADUATE COORDINATOR

Dr. Yong Li – 6-259 Donadeo ICE
Email: yong9@ualberta.ca

M.ENG. ACADEMIC ADVISOR

Dr. Yuntong (Amy) She – 7-259 Donadeo ICE
Email: civmeng@ualberta.ca

STUDENT COACHING SERVICES

The Department of Civil and Environmental Engineering is committed to supporting its M.Eng. students as they move through the program.

Students will be provided career and professional development supports throughout their program to aid them in developing their academic and career goals, recognizing and addressing challenges, and building upon their personal strengths to move past their limitations.

Dr. Robyn Braun will support students with their various writing projects and serve as instructor for the communications course. Dr. Braun will also serve as an additional resource and support for students as they navigate the program, the University, and the city of Edmonton.

Contact Dr. Braun at: robyn4@ualberta.ca

WORKING IN CANADA

INTERNATIONAL STUDENT SERVICES

International Student & Visitor Services (ISVS) provides programs, services and events for U of A international students. Their team of licensed immigration consultants and student advisors supports international students with adjusting to living in Edmonton, immigration and additional support to help international students succeed at the U of A.

You can book time with their team of licensed immigration consultants, who can assist you with study permits and extensions, immigration, and working in Canada. Drop-in appointments are available Monday to Friday (1–3 pm) by visiting the International Services Centre (142 Telus Centre) or book an appointment online at: ualberta.ca/international/about-uai/contact-us/international-services-centre

POST GRADUATION WORK PERMIT

The Post-Graduation Work Permit Program (PGWPP) allows students who have graduated from eligible Canadian designated learning institutions (DLIs) to obtain an open work permit to gain valuable Canadian work experience. Our program also provides academic credentials that are recognized by Alberta licensing organization (APEGA) for students with an undergraduate program in a foreign engineering program.

To work in Canada after you graduate, you must apply for a work permit under the Post-Graduation Work Permit Program (PGWPP). Check the University's ISVS and the Government of Canada websites for more information about the post-graduation work permit program.

Our program's learning outcomes are inline with Engineers Canada competencies and professional development hours count towards yearly professional requirements.

UNIVERSITY OF ALBERTA RANKINGS

	WORLD	CANADA
ACADEMIC RANKING OF WORLD UNIVERSITIES	91	4
QUACQUARELLI SYMONDS	111	4
TIMES HIGHER EDUCATION	118	6

WELCOME
HOME

Edmonton is Alberta's capital city and is one of the sunniest cities in Canada with an average of 2,300 hours of sunshine per year. The river valley that winds through the city has more than 160 kilometres of maintained pathways and 20 major parks.

HOUSING

You may choose from many housing options for students, both on campus and around Edmonton. International Student Services has online resources for finding a place to live, including temporary accommodations when you first arrive.

EXCEPTIONAL
PUBLIC SCHOOLS

Our Kindergarten through grade 12 public school system is one of the best in Canada. Alberta's students rank No. 2 in the world for reading and science and in the top 12 for math.

UNIVERSAL
HEALTH CARE

Alberta Health Services provides health care to all Albertans in hospitals, at the doctor's office, and on the Internet. 811 is a telephone service providing free 24/7 nurse advice and general health information for Albertans.

COMMUNITY

More 150 neighbourhood community leagues provide plenty of opportunities to participate in social and recreational activities and get to know your neighbours.

Plus farmers' markets offer small agricultural producers the opportunity to sell fresh produce, including meat and vegetables that are grown in the Edmonton area. The city supports community gardens for those who want to grow their own food but need the space to do it.

TRANSPORTATION
BUS, BIKE, TRAIN

Public transit buses and Light Rail Transit (LRT) connect the city along with well-maintained bike lanes and paths.

Maps, schedules and fare info at: edmonton.ca/edmonton-transit-system-ets

LET'S TALK

INDUSTRY
NETWORKING MIXER

Academic knowledge is only part of the equation when preparing students for the workforce. Therefore, we commit to helping our students develop communication skills and professional networks.

In February 2023, the Department of Civil and Environmental Engineering and the School of Mining and Petroleum hosted a networking mixer for our Master of Engineering students. The mixer was part of an ongoing program to support grad students by providing communications training and professional development opportunities.

The mixer, held at the prestigious Royal Glenora Club in Edmonton's River Valley, brought together about 100 grad students and more than a dozen industry representatives for three hours of speakers, professional networking, and delicious food.

Structural engineer at DIALOG and UofA graduate Cam Franchuk gave an inspirational talk reflecting on what he's learned over his 21 years as an engineer. He gave practical advice about lifelong learning and getting your boots muddy, but a recurrent and appropriate overarching theme was the importance of communication. After his presentation, each industry representative came to the podium to introduce themselves, their company, and their work. The last part of the evening was dedicated to mingling and conversation between industry professionals and students.

Our students prepared for the event with a mock mixer training workshop earlier in the week. Dr. Robyn Braun, the Department's Instructor of Communications, and consultants from WorkSpark covered professional dress, conversation starters, handshakes, introducing yourself, and following up after the event.

The mixer and preparation workshop are just part of the support we provide graduate students to help them develop as professional engineers in Canada.

M.Sc. students Aisha Elgarhy, Veronica Wambura, and Syeda Narmeen Zehra at the graduate networking mixer.
Photo: Heather Egger

BENEFITS OF **NETWORKING**

Career opportunities Networking allows students to connect with potential employers, learn about job opportunities, and gain insights into the engineering profession.

Industry insights By connecting with professionals in their field, students can stay up-to-date with industry news and developments, helping them make informed career decisions.

Mentorship Networking provides students with the opportunity to connect with experienced professionals who can offer guidance and support as they navigate their career path.

Collaboration Working with others can help graduate students develop new skills, gain experience, and expand their engineering knowledge.

Personal development Networking helps students develop essential skills such as communication, teamwork, and interpersonal competence. By attending events, meeting new people, and building relationships, students develop confidence and expand their professional network.

Our department supports students with opportunities to develop professional communication skills and access to career resources.

We support our students in developing effective communication, teamwork, and adaptability through industry networking events, experiential learning opportunities, and professional development.

Through our professional development and communications support team, we help students develop their resumes, practice interviewing skills, and connect with potential employers. We also provide students with access to job fairs, networking events, and other professional development opportunities to help them build relationships and make valuable industry connections.

INSTRUCTOR OF **COMMUNICATIONS**

Dr. Robyn Braun – 7-240 Donadeo ICE
Email: robyn4@ualberta.ca

WORKSPARK **CONSULTING**

Professional development workshops in resume writing and networking
Web: workspark.ca

COURSE
INFO

CIV E 660
ADVANCED STRUCTURE ANALYSIS

COURSE
OBJECTIVES

This course provides the students with advanced skills in structural analysis.

LEARNING
OUTCOMES

- Describe the general procedure for computer-aided structural modeling and analysis;
- Derive element stiffness matrix using the strong form formulation for frame-type elements;
- Analyze statically determinate and indeterminate structures subjected to loads, thermal effects, and support movement using direct stiffness method;
- Handle special constraints (e.g., from member rigidity assumptions) in structural analysis;
- Analyze structures using energy methods and derive element stiffness matrix using the weak form formulation;
- Analyze building frame structures using some approximate methods;
- Implement simple structural analysis programs

CIV E 661
DYNAMICS OF STRUCTURES

COURSE
OBJECTIVES

This course introduces the students to the dynamics of single and multiple degrees of freedom systems, Time step methods, Modal and response spectrum analysis for earthquake loading, Random vibration analysis, Dynamic wind loading analysis, and Dynamics of foundations.

LEARNING
OUTCOMES

- Formulate the Equation of Motion (EoM) of Single Degree of Freedom (SDOF) systems and solve it using various methods (e.g. classical solution, Fourier series, and Duhamel's Integral) for simple loading cases (e.g., free vibration, harmonic loading, periodic loading, and simple arbitrary loading);
- Apply the SDOF system concepts to formulate various applications (e.g., eccentric mass shakers, vibration measurement devices, force transmission and base excitation);
- Apply numerical methods for numerical response evaluation of linear/nonlinear systems under more complex loading;
- Formulate earthquake response of linear systems and analyze them using response spectra;
- Formulate the EoM of Multi Degree of Freedom Systems (MDOFs) and solve it using modal analysis for various loading cases (e.g., free vibration, harmonic loading, and seismic loading).
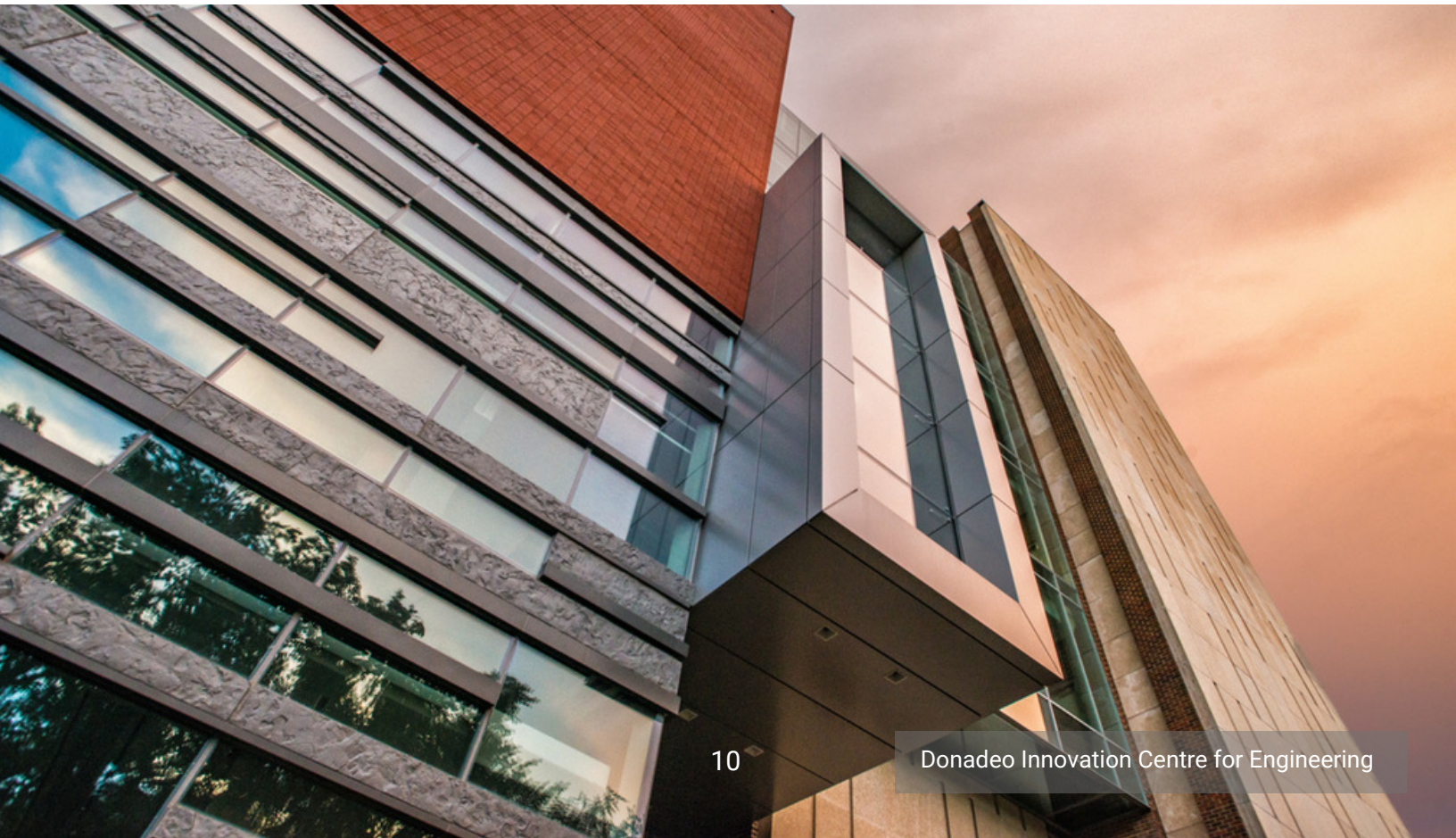
COURSE
INFO

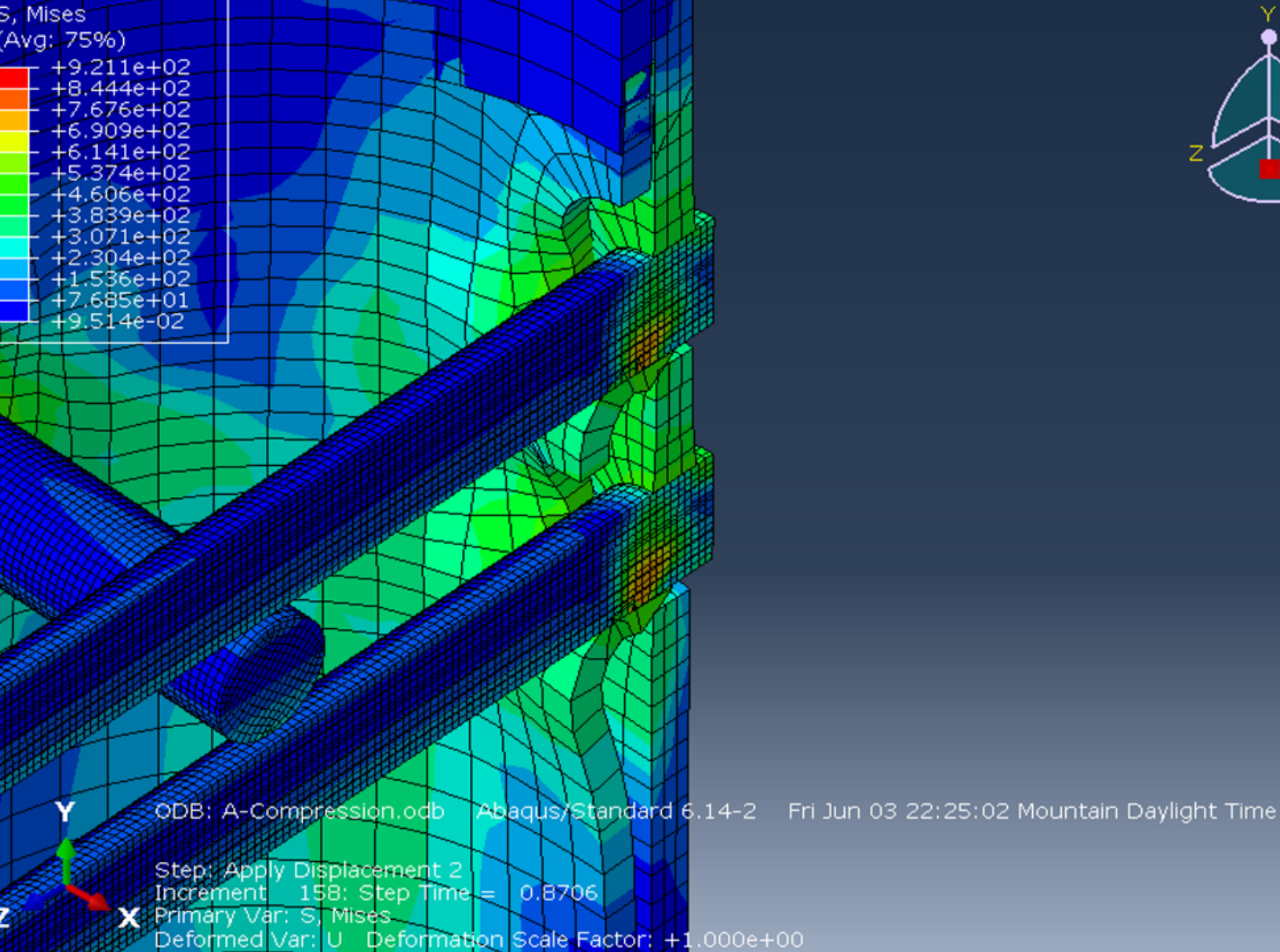## CIV E 662
STRUCTURAL TIMBER DESIGN

COURSE
OBJECTIVES

This course provides the students with the required skills and tools to analyze and design timber structures.

LEARNING
OUTCOMES

- Describe how physical and mechanical properties of wood are affected by environmental factors and growth characteristics in wood.
- Recognize and understand the attributes of various traditional and modern structural wood products and systems.
- Design timber members and timber-concrete composite members under bending action.
- Design timber members subjected to axial load and combined axial and bending actions.
- Design light and heavy timber connections with mechanical fasteners.
- Design light wood frame and mass timber lateral load resisting systems.

Donadeo Innovation Centre for Engineering

S, Mises
(Avg: 75%)
+9.211e+02
+8.444e+02
+7.676e+02
+6.909e+02
+6.141e+02
+5.374e+02
+4.606e+02
+3.839e+02
+3.071e+02
+2.304e+02
+1.536e+02
+7.685e+01
+9.514e-02

ODB: A-Compression.odb   Abaqus/Standard 6.14-2   Fri Jun 03 22:25:02 Mountain Daylight Time

Step: Apply Displacement 2
Increment   158: Step Time =   0.8706
Primary Var: S, Mises
Deformed Var: U   Deformation Scale Factor: +1.000e+00

CIV E 665
INTRODUCTION TO THE FINITE ELEMENT METHOD

COURSE
OBJECTIVES

This course provides the students with the required skills to use and apply the finite element analysis method to linear and nonlinear problems of elastic structures. Students will use Python and ABAQUS for their analysis.

LEARNING
OUTCOMES

- Define and describe the finite element analysis method
- Differentiate between solid, beam, and shell elements
- Describe the use of isoparametric formulation
- Differentiate between linear, quadratic, full and reduced integration solid elements
- Compare the stiffness matrix of simple elements between hand calculations and those of a finite element analysis software
- Model a physical problem using a finite element analysis software

COURSE
INFO

COURSE
OBJECTIVES

This course covers several of the same topics covered in undergraduate structural design courses in civil engineering degree programs. However, the emphasis is on the true structural behaviour to provide insight into the assumptions and limitations of the provisions of design standards. This allows student to gain a better understanding of the performance objectives of the standard and avoid the pitfalls of using it simply as a checklist of requirements to fulfill. It also allows the development of skills to address situations that are beyond the limits of what is explicitly covered by the standard. The course ties regularly into Standard S16 of the Canadian Standards Association, the national standard of Canada for the design of steel buildings, although other codes and standards are also referenced as needed.

LEARNING
OUTCOMES

- Account for probability and utilise the philosophy of limit states design in the establishment of appropriate resistance factors for specific steel design scenarios, and estimate the probability of failure of a structural component when given sufficient data;
- Design steel tension members by assessing the capacities of potential failure modes;
- Evaluate the elastic torsional capacity and understand the torsional behaviour of thin-walled open steel sections;
- Determine the design capacity of steel columns and other compression members for a variety of cross-sectional shapes;
- Understand lateral-torsional buckling behaviour of steel beams for a variety of geometries and bracing conditions, and utilise the concepts of interaction buckling when evaluating lateral-torsional buckling capacity; and
- Determine the design loads on steel frame members, accounting for second-order effects, and the capacity of steel beam-columns (under combined compression and flexure) with doubly-symmetric cross-sections.
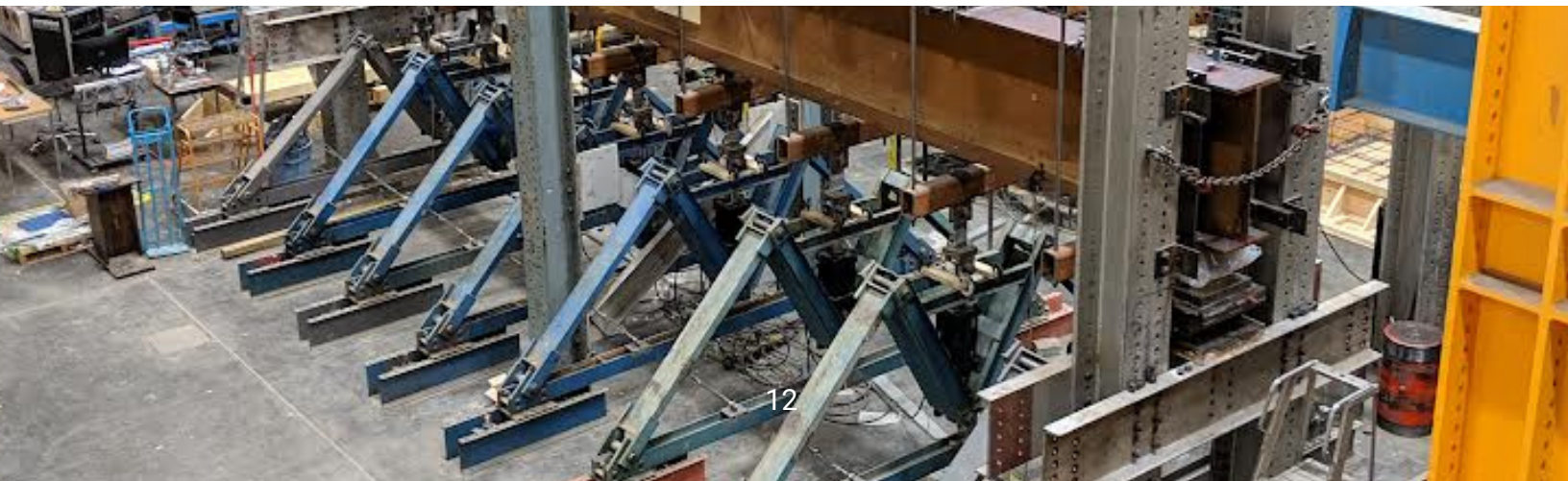
Lateral-torsional buckling of I-shaped welded steel girders

CIV E 672
BEHAVIOUR AND DESIGN OF CONCRETE MEMBERS

COURSE OBJECTIVES

This course help students understand the fundamental behaviour of reinforced concrete as well as the processes used in reinforced concrete design according to CSA A23.3:19 (Design of Concrete Structures), including strength and behaviour of simple reinforced concrete members, relation between results of research and current design specifications, material properties, as well as members subjected to flexure, axial compression, combined flexure and axial load, combined flexure and shear, torsion.

LEARNING OUTCOMES

- Use first principle approaches to develop moment-curvature responses for flexural members and use these responses to evaluate deflections.
- Use provisions and understand some limitations of CSA A23.3 for the flexural, shear, axial, and torsion design of concrete elements.
- Use strut-and-tie models to design common disturbed regions in concrete elements.
- Link research outcomes to design standards with attention to CSA A23.3

CIV E 676
BEHAVIOR AND DESIGN OF MASONRY STRUCTURES

COURSE OBJECTIVES

This course provides the students with the required skills and tools to analyze and design masonry structures.

LEARNING OUTCOMES

- Define reinforced and unreinforced masonry, and their advantages and limitations for infrastructure applications
- Identify the masonry material properties that are relevant for a civil engineer
- Discuss the different testing standards used for masonry materials
- Proportion blocks, mortar, grout, and reinforcing bars in masonry elements to resist axial loads, bending moments, and shear forces, while meeting serviceability conditions such as cracking and deflections
- Explain the seismic provisions in the NBCC and apply them to the design of masonry materials and systems
- Design lateral load resisting systems for wind and earthquake forces using reinforced masonry

CIV E 779
FUTURE INFRASTRUCTURE SYSTEMS IN SMART, SUSTAINABLE, AND RESILIENT CITIES

COURSE OBJECTIVES

This highly interdisciplinary course is intended for senior year undergraduate students and graduate students. The course will introduce various emerging concepts and technologies in the context of smart and sustainable cities and provide an overview of future cities and their main components, such as Future Infrastructure Systems, Future Energy Systems, and Future Mobility Systems. With a particular emphasis on the Future Infrastructure Systems and their sustainability and resiliency, this course will cover various related topics in the context of such as sensing technologies, data analytics, AI, as well as interdependencies, operation, management, and decision-making for/of Future Infrastructure Systems.

LEARNING OUTCOMES

- Identify the main components of future infrastructure systems and their roles in smart, sustainable, resilient cities;
- Apply recent advances in emerging technologies such as sensing, data analytics, and AI for FIS;
- Monitor, assess, and manage the next generation infrastructure systems;
- Describe interdependencies and the requirements of resiliency of FIS; and
- Adapt existing infrastructure structure systems to future cities in the context of sustainability and resiliency in the face of climate change.

CIV E 779
FUTURE INFRASTRUCTURE SYSTEMS IN SMART, SUSTAINABLE, AND RESILIENT CITIES

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LEARNING
OUTCOMES

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- Adapt existing infrastructure structure systems to future cities in the context of sustainability and resiliency in the face of climate change.

COURSE
INFO

CIV E 779
MACHINE LEARNING FOR CIVIL ENGINEERS

COURSE
OBJECTIVES

The course will give engineering students the necessary knowledge to develop and implement machine learning algorithms to solve their engineering problems. The course content includes: fundamentals of machine learning; supervised learning and unsupervised learning; regression and classification; practical application of machine learning to engineering problems.

LEARNING
OUTCOMES

- Understand the fundamentals of machine learning
- Implement machine learning algorithms in Python
- Apply machine learning techniques to engineering problems

CIV E 789
WRITING/COMMUNICATION SKILLS FOR ENGINEERS

COURSE
OBJECTIVES

This course introduces M.Eng. students to the development of standard documents used in an engineering career, as well as the fundamentals of technical writing and communication, and of effective professional communication.

LEARNING
OUTCOMES

- Communicate effectively and respectfully in diverse settings, in person and via standard business documents, such as email.
- Identify and abide by the rules of plagiarism and academic and professional standards of communication.
- Evaluate their own writing process and institute changes when necessary.
- Solicit and provide actionable feedback on writing and other forms of communication.
- Recognize and produce standards for specific technical documents.
- Research and consider the context, audience, and purpose of their writing projects.
- Write a thesis statement and organize their writing at various levels, from document-level through to sentence structure.
- Identify active and passive voice, and use each appropriately.
- Recognize and evaluate rhetorical devices, strategies, and techniques.

COURSE
INFO

CIV E 900
CAPSTONE DIRECTED RESEARCH PROJECT
STRUCTURES SECTION

COURSE
OBJECTIVES

The Department of Civil and Environmental Engineering offers the capstone project course to graduate students in the Structural Engineering stream. The course gives advanced topics on the design of steel and reinforced concrete under gravity and lateral loads using the limit states design method. Furthermore, the introduction to structural design in accordance with the National Building Code of Canada (NBCC) and CSA S6 is given.

Students are expected to complete design projects as part of this course using the knowledge they have gained throughout their undergraduate and graduate program. The project may involve the detailed design of a building, a bridge, or an industrial structure, which will be completed in a group of three to four students. Each group will submit a professional report on the structural design of the structure together with design drawings at the end of the term and make an oral presentation to a group of industry leaders.

The detailed design of structures requires teamwork, creativity, making design assumptions and completing the structural design based on a synthesis of technical knowledge acquired in structural engineering courses. Course lectures focus on structural systems, seismic load calculation, bridge design, and advanced structural steel design.

LEARNING
OUTCOMES

- Participate and contribute effectively to team activities
- Understand various structural systems and load-resisting of a structure (vertical and horizontal)
- Compute loads on structures based on the National Building Code of Canada and CSA S16 and other relevant codes and standards
- Introduction to structural analysis and design, detailing, and construction software (capabilities and limitations)
- Identify and describe seismic load paths and load-resisting systems in structures
- Design structure(s) to meet defined specifications based on information synthesized from advanced analyses and relevant codes and standards
- Identify the governing failure modes and design of members and their connections
- Understand construction engineering and installation sequence based on codes and standards

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