

CIV E 672 Behavior and Design of Concrete Members

Winter 2025 - January 06 to April 09

Class time: Thursday 14:00-16:50 Location: GSB 5-11

Instructor:

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DICE 6-255
Office Hours: TBD

Course Description:

*3 (fi) (either term, 3-0-0) Strength and behaviour of simple reinforced concrete members. Relation between results of research and current design specifications. Material properties. Members subjected to flexure, axial compression, combined flexure and axial load, combined flexure and shear, torsion

Course synchronous and asynchronous content delivery schedule:

Lectures and examinations are synchronous. Non-examination course deliverables (assignments, lab deliverables, presentation) are asynchronous.

Land Acknowledgment:

The University of Alberta respectfully acknowledges that we are situated on Treaty 6 territory, traditional lands of First Nations and Métis people.

TA Information:

Hafiz Asher Muhammad (Hafizash@ualberta.ca)

Course Objectives & General Content:

The goal of 672 is to 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).

To achieve this, the course has the following objectives:

1. Review and expand reinforced concrete topics covered at the undergraduate level (e.g. shear design, beam deflections).
2. Introduce new topics in reinforced concrete not typically taught at the undergraduate level (e.g. torsion, strut-and-tie modelling).
3. Encourage the use of reinforced concrete analysis software and research publications to further understanding into the behaviour of reinforced concrete members.
4. Provide background information on how design codes/standards are created and used.

Learning Outcomes:

By the end of this course, students should be able to:

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

Marking Scheme:

Activity	(A)Synchronous	Due/Scheduled	Weight
Homework Assignments	Asynchronous	Posted on each assignment	25%
Lab Deliverables	Asynchronous	Tentatively scheduled for Feb 26 and Mar 20	25%
Presentation (team)	Asynchronous	Presentation (tentative): by March 27, peer review (tentative) by April 7	10%
Final Exam	Synchronous	8:30 am, Thursday April 17 (placeholder time from university, time/date may change depending on what they do prior to formally scheduling exam)	40%

The Faculty recommended grade point average for a 600 level course is 3.3. Instructors have the leeway to deviate from this average and can assign grades based on their own scheme. All grades are approved by the department chair (or delegate). The office of the Dean has final oversight on all grades.

Term Work

All term work solutions will be posted no later than the last day of classes. All term work will be returned to students by the final day of classes, with the exception of major term work due in the last week of classes. The latter will be returned by the day of the final examination or the last day of the examination period if there is no final examination in the course as per university policy; instructors will make accommodations to return these term work. It is the responsibility of the student to pick up all their term work at the specified time and place. Any unreturned term work, shall be retained and then shredded six months after the deadline for reappraisal and grade appeals. Final examinations will be kept for one year as required by university guidelines and the Government of Alberta's Freedom of Information and Protection of Privacy Act.

Additional Notes

Software programs (e.g., spreadsheets) are encouraged for all term deliverables (i.e., everything but the final exam).

Calculator Policy

Approved programmable or approved non-programmable calculators are permitted in examinations. Any calculator taken into an examination must have a sticker identifying it as an acceptable programmable calculator (green sticker) or non-programmable calculator (gold sticker). Students can purchase calculators at the University Bookstore with the stickers already affixed. Calculators purchased elsewhere can be brought to the Student Services where the appropriate sticker will be affixed to the calculator.

Expectations for AI use

In this course, our primary focus is to cultivate an equitable, inclusive, and accessible learning community that emphasizes individual critical thinking and problem-solving skills. To ensure a fair and consistent learning experience for all students, the use of advanced AI tools such as ChatGPT or Dall-E 2 is strictly prohibited for all academic (written/coding/creative/etc.) work, assignments, and assessments in this course. Each student is expected to complete all tasks without substantive assistance from others, including AI tools.

Any use of AI tool in your academic work may result in academic penalties and be considered an act of cheating and a violation as outlined in the relevant sections of University of Alberta (November 2022) [Code of Student Behaviour](#).

Text and References (Mandatory):

None

Text and References (Recommended):

CSA A23.3:24 - Design of Concrete Structures

Reinforced Concrete Design –A practical approach, Brzev and Pao, Pearson, 3rd ed.

Reinforced Concrete, Mechanics and Design, 1st Canadian Edition, MacGregor, J.G and Bartlett, F.M., Prentice Hall, 2000.

Reinforced Concrete Structures, Park and Paulay, Wiley, 1974

NOTE: additional references are cited in lecture notes

Website:

eClass

Previous Examples of Evaluative Materials:

Will be posted on eClass.

Did you know that the University of Alberta has various low-to-no-cost services to help students succeed? Visit <http://www.deanofstudents.ualberta.ca/> for information about the academic, wellness, and various other support services available to U of A students. It's never too early or too late to seek help!

CivE 672 Content and Tentative Schedule (Last updated Jan 6, 2025)

Notes:

- Course schedule and lecture topics subject to change over the course of the term based on our progress.
- Updated course schedule(s) may be posted to eClass during term and supersede this schedule.
- **Lab session(s) may change from scheduled because of lab scheduling and external factors. In the event that there is a major issue with lab planning and tests are suspended an alternative will be presented.**
- Office hours will be scheduled via eClass poll.
- Deliverables (teamwork and individual assignments) due dates/times will be posted when deliverables are assigned. Assignment solutions will be made available ASAP after the due date/time.

Week	Date	Lecture Topics	Notes:
1	January 9	L0 – Course Introduction L1.1 – Concrete introduction L1.2 – Concrete materials L1.3 – Reinforcement materials	No office hours this week.
2	January 16	L1.2 – Reinforcement materials (<i>cont.</i>) L2.1 – Flexure theory and moment curvature	Office hours begin partway through week
3	January 23	L2.2 – Flexural design philosophies, ULS, and practical considerations L2.3 – Serviceability criteria (crack control, deflections from effective moment of inertia)	Confirm teammates before this lecture
4	January 30	L2.3 – Serviceability criteria (crack control, deflections from effective moment of inertia) (<i>cont.</i>) L2.4 – Deflections from first principles	
5	February 6	L3.1 – Shear philosophies and the general method for one-way shear design L3.2 – Torsion design using the simplified method	
6	February 13	L3.2 – Torsion design using the simplified method (<i>cont.</i>) L3.3 – Strut-and-tie modelling	
7	February 20	READING WEEK No classes this week	
8	February 27	Placeholder for Lab Test 1 L3.3 – Strut-and-tie modelling (<i>cont.</i>)	Lab Test 1 ~ 2/3 of class time
9	March 6	Placeholder for Lab Test 2 L4.1 – Column cross-sectional response, interaction diagrams, and confinement	Lab Test 2 ~ 1/3 of class time
10	March 13	L4.2 – Column member design and analysis including non-sway and sway systems L5.1 – Plastic analysis and moment redistribution	
11	March 20	L5.1 – Plastic analysis and moment redistribution (<i>cont.</i>) L5.2 – Yield line theory	
12	March 27	L6 – Introduction to concrete repair	
13	April 3	L7 – Concrete Anchorage (<i>time permitting</i>)	Doug Absent M-W this week
EXAM PERIOD	April 11-26	Final exam (date/time TBD and scheduled by the university)	

University and faculty policies



Respect and professionalism



The Faculty of Engineering is committed to fostering and protecting an equitable, inclusive, and respectful work and study environment in line with University of Alberta policies and professional engineering industry standards.

The faculty prepares students to uphold industry standards to become a Professional Engineer (P.Eng). Therefore, respect, professionalism, and accountability must be upheld within the Faculty of Engineering and the University of Alberta.

Academic integrity and student conduct

The University of Alberta is committed to the highest standards of academic integrity and honesty, as well as maintaining a learning environment that fosters the safety, security, and the inherent dignity of each member of the community, ensuring students conduct themselves accordingly. Students are expected to be familiar with the standards of academic honesty and appropriate student conduct, and to uphold the policies of the University in this respect.

Students are particularly urged to familiarize themselves with the provisions of the [Student Academic Integrity Policy](#) and the [Student Conduct Policy](#), and avoid any behaviour that could

potentially result in suspicions of academic misconduct (e.g., cheating, plagiarism, misrepresentation of facts, participation in an offence) and non-academic misconduct (e.g., discrimination, harassment, physical assault). Academic and non-academic misconduct are taken very seriously and can result in suspension or expulsion from the University.

All students are expected to consult the [Academic Integrity website](#) for clarification on the various academic offences. All forms of academic dishonesty are unacceptable at the University. Unfamiliarity of the rules, procrastination or personal pressures are not acceptable excuses for committing an offence. Listen to your instructor, be a good person, ask for help when you need it, and do your own work – this will lead you toward a path to success. Any academic integrity concern in this course will be reported to the College of Natural and Applied Sciences. Suspected cases of non-academic misconduct will be reported to the Dean of Students. The College, the Faculty, and the Dean of Students are committed to student rights and responsibilities, and adhere to due process and administrative fairness, as outlined in the [Student Academic Integrity Policy](#) and the [Student Conduct Policy](#). Please refer to the policy websites for details on inappropriate behaviours and possible sanctions.

The College of Natural and Applied Sciences (CNAS) has created an [Academic Integrity for CNAS Students](#) eClass site. Students can self-enroll and review the various resources provided, including the importance of academic integrity, examples of academic misconduct & possible sanctions, and the academic misconduct & appeal process. Students can also complete assessments to test their knowledge and earn a completion certificate.

"Integrity is doing the right thing, even when no one is watching." – C.S. Lewis

The Faculty of Engineering expects an environment free of harassment, discrimination, and bullying. We encourage you to talk to the [Office of Safe Disclosure and Human Rights](#) about experiences, questions, or concerns. Additional resources and support for students are attached below.

Engineering students studying in the province of Alberta must also follow the [Code of Ethics](#) set by the Association of Professional Engineers and Geoscientists of Alberta (APEGA).

Course outline policies, course requirements, evaluation and grading information can be found in the [University Calendar](#).



Safety during learning activities



In all Faculty of Engineering courses, labs, seminars or other learning activities, safety is of paramount importance. In some cases, laboratory work in a program requires high standards for risk management to keep potential hazards safely under control.

Anyone found to be unable to function safely in the class, lab, seminar or other learning activity may be asked to leave or be removed for their and the safety of other participants and instructors in alignment with the [Student Academic Integrity Policy](#) and [Student Conduct Policy](#). As members, or prospective members, of the engineering profession, it is your responsibility to identify and inform the proper authorities of unsafe work.

Audio and video recording



Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan.

Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Only those items specifically authorized by the instructor may be brought into the exam facility. Students must not bring any unauthorized electronic device into an examination room, including cell phones or other devices.



Student services and support

Health & Wellness Support

Counselling and Clinical Services

Free, short-term, appointment-based counselling and psychiatric services. Also offers drop-in workshops. Book an initial consultation. Visit uab.ca/CCS to learn more.

Wellness Supports Social Workers

Free one-on-one support for students in the areas of housing, finances, academics, personal wellness, life skill development, family dynamics, system navigation, and any area of life where there is a desire to invite change. Visit uab.ca/wellness to learn more.

Sexual Assault Centre

Free, anonymous, and confidential drop-in counselling. Visit uab.ca/UASAC to learn more.

The Office of Safe Disclosure & Human Rights (OSDHR)

The OSDHR advises confidentially on sensitive issues you may not feel comfortable solving on your own. Contact the OSDHR if you want to get help or to make a report while keeping your privacy. Visit uab.ca/OSDHR to learn more.

HIAR (Helping Individuals at Risk)

If you're worried about someone, contact HIAR, who can help assess risk and connect individuals to support. Learn more at uab.ca/HIAR.

Immediate External Supports

Health Link Alberta: 811
Suicide Crisis Helpline: 988



Academic support



Academic Success Centre

Access to a variety of services to maximize your academic success. Learn more at uab.ca/ASC.



Accessibility Resources

Connects students with disabilities to accommodations. Learn more at uab.ca/Access under accommodations + accessibility.



Decima Robinson Support Centre

Academic support for 100- or 200-level introductory calculus, linear algebra and statistics courses. Visit uab.ca/DSC to learn more.



Engineering Student Success Centre

The Faculty of Engineering provides drop-in tutoring for first-year courses. Visit uab.ca/ESSC to learn more.



Office of the Student Ombuds

Call for complex problems and conflict mediation. Learn more at uab.ca/ombuds.



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Financial support



Student Service Centre

For awards and other funding support. Learn more at uab.ca/ask.



Campus Food Bank

The Campus Food Bank Society is an independent charity supporting University of Alberta students, faculty, staff, and alumni for up to five years. For additional information visit their website at campusfoodbank.com.



GENERAL COURSE INFORMATION

Attendance: Regular attendance in lectures is expected but attendance is not recorded. It is your responsibility to catch up on missed material.

Course materials: Blank (i.e. unannotated) course materials are posted to eClass prior to class. Please download and browse materials from eClass before lectures. Annotated materials are posted to eClass once ready (typically by the end of the Monday following the lecture). Though annotated files are posted on eClass, you are encouraged to make your own notes that suit your style.

Course delivery: All components of the course (lectures, exam) are delivered in-person. Unless there is an emergency (e.g., global pandemic), lectures will only be delivered in-person and are not recorded.

“Audio or video recording of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Recorded material is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the instructor.” (§23.4(2)).

COMMUNICATION POLICIES

eClass Announcements: Weekly course announcements will be made via eClass during the term, typically on the first working day of the week. These announcements typically contain the following details:

- Planned topics for lectures
- Notice of due dates for course deliverables
- What was posted on eClass over the previous week
- Office hours for the week, highlighting departures from typical office hours
- Other relevant course information for that week

Special announcements may also be made at any time via eClass during the term. Topics of these announcements vary but have typically involved:

- Specific details on a test
- Urgent announcements (e.g., critical typos, unforeseen events (e.g. cancelling a lecture))

E-mail: I respond to email periodically during working hours (9:00 am – 5:00 pm). Responses on evenings/weekends/holidays will be delayed (likely until the next working day). Though I try to reply quickly, do not rely on email for urgent assistance (for example, the day an assignment is due, or the day before the exam), as I may be unable to answer your email in time since I may be stuck in a meeting or otherwise. **IMPORTANT:** *Structural analysis/design concepts are often very difficult to explain over email. Detailed technical questions are best explained live during seminar sessions or office hours.*

OFFICE HOURS AND ADDITIONAL ASSISTANCE

Regular office hours begin during the week of January 13. Regular office hours will be indicated on the CivE 672 eClass page once known. A survey will be available on eClass early in term to establish a best-case scenario for office hours. Deviations from regular office hours will be announced on eClass. Office hours are held in person in my office (DICE 6-255) unless otherwise indicated. **Use your office hours, they were created with you in mind!**

Assistance outside of office hours during working hours is available. Contact the instructor by email for a 5-15 min appointment. Be understanding that I have many commitments such as meetings (and you have other courses/research work/job) so it may take effort to find a time that works. You may drop by my office for an impromptu meeting but understand that I may be unavailable (in a person meeting, in the lab, or off campus).

You may also reach out to the course TA with questions about course concepts or deliverables but be aware that TAs have limits on their working hours. TA contact information will be posted to eClass and they will be introduced to you during lecture.

COURSE DELIVERABLES AND ASSESSMENT

Academic Honesty: Lack of knowledge of academic honesty policies is not a reasonable explanation for a violation. **Cheating has no place in the engineering profession** (the APEGA code of ethics is available online). The Student Academic Integrity Policy is also easily accessible online (<https://www.ualberta.ca/en/dean-of-students/policies/student-conduct-and-accountability/student-conduct/academic/index.html>). Misconduct in assignments will be treated seriously according to Faculty of Engineering and University of Alberta policies.

Final exam (40%, individual):

- The final exam will take place in person during the university final exam period.
- Final exams are scheduled by the university (not the instructor). Exam date and time will be conveyed once the instructor receives confirmation that the exam is set.
- Specific details (e.g., length, format, topics covered, study aids) will be announced via the CivE 672 eClass page in advance of the exam test.

Assignments (25%, individual):

- There will be five (5) assignments over the term with only the top 4 assignments considered when calculating your final grade. The 4 considered assignments are weighted equally.
- The 'dropping the lowest assignment' approach is intended to help students who are unable to perform effectively for part of the course (e.g., they get sick for a few days). See 'other factors' section for longer duration events.
- Assignments are completed individually and have similar format to course example sets. Discussion and collaboration on assignments is encouraged but everyone must submit their own version of assignments.
- Assignments will be distributed and submitted via eClass.
- More information on assignment formatting requirements, submission requirements, and a general marking scheme for assignments will be posted on eClass as "*Assignment Requirements*" in advance of the first assignment being posted.
- Assignment solutions are posted as soon as possible after the assignment is due.

Lab Deliverables (25%, team):

- Lab deliverables will be completed in **teams of up to 4**.
- Physical testing labs are planned for this year of CivE 672. These labs involve testing concrete beams to failure to understand their response.
- Two lab deliverables will be associated with these labs with the first having 1/3 the weighting (i.e., 8.33% of the course weight) while the second having 2/3 the weighting (i.e., 16.67% of the course weight). More specifics on the lab deliverables (e.g., scope, evaluation) will be presented later in term.
- **NOTE: In the event that the physical labs are cancelled a substitute deliverable with similar scope and intent will be used.**

Presentation (10%, team):

- Presentation completed using the same team as the lab deliverables
- The project will comprise a recorded video presentation assessed by your peers. Students will give presentations on a topic related to reinforced concrete following formats common in both academic conferences and industry 'lunch and learn' type presentations.
- Presentation details (e.g., length etc.) will be released in early February.

OTHER FACTORS:

- eClass may not calculate marks properly based on weightings given in the syllabus. If there is a discrepancy, the approach used in the syllabus governs.
- No 'makeup' or 'extra credit' assignments, quizzes, or other deliverables are available.
- Requests for extensions on deliverables (assignment, project) will be denied regardless of reason out of fairness to your peers. This will allow assignment solutions to be posted as soon as possible to help with study. If there are extenuating circumstances (e.g., prolonged illness), see the next point.
- In case of extenuating circumstances (e.g., prolonged illness), that affect your performance in multiple courses and multiple deliverables (for instance, if you miss more than one assignment deadline due to extenuating circumstances) contact student services <https://www.ualberta.ca/engineering/student->

[services/index.html](#) for advice when well enough to do so. In lieu of extensions/makeups, accommodations such as course weighting adjustments for students facing extenuating circumstances will be made following best practice guidance from the department and the Faculty of Engineering.

- Aside from extreme circumstances (see previous policy), all students are evaluated using the same marking scheme. A student that continues to argue for a separate marking scheme will be reported to their supervisor or graduate chair as appropriate if the instructor feels that the student is attempting to gain an unfair advantage over their peers.
- If a student misses the final exam, the student can apply for a deferred exam. Read university and Faculty of Engineering procedures for deferred exams for more information on this process.
- Quality control (assignment, lab deliverable, presentation) marks will be posted on eClass once available. Quality assurance (exam) marks will not be posted on eClass; reviewing exams for educational purposes can be scheduled during May 2025.
- The faculty recommended course GPA has an average of 3.3 but may be as high as 3.4 or as low as 3.2. The passing grade for a graduate course is a C+. In percentage terms, the minimum passing percentage is historically 65%, B-tier grades are historically in the 70s, and A-tier grades are 80+. Deviations of 2-3% from this threshold can be expected each year.

DELIVERABLE DUE TIMES AND EXPECTATIONS

It is the student's responsibility to ensure that they submit deliverables to eClass before the due date/time. Ignorance of this responsibility is not a valid reason for missing a deadline.

Submission deadlines and penalties:

- Deliverables submitted in advance of the due date/time may be edited/resubmitted at any time until the due date/time without consequence.
- Deliverables submitted late but within one hour of the due date/time will be accepted with penalty. Deliverables submitted during this hour are penalized 0.5% of their total value per minute late – to a minimum of 0%. For instance, a student who submits an assignment that would earn 80% without penalty 16 minutes late would receive 72% on the assignment.
- Students will not be able to submit deliverables once they are more than one hour late. Students will receive a zero on the assignment.

The time the deliverables is submitted is based on when it was uploaded to eClass or emailed to me/TA (only email files if requested or if you are running into problems submitting via eClass). 'date modified' file timestamps on .pdf (or other format) files are easy to fake and cannot be used to argue that a late deliverable was completed in advance of the deadline.

It is also the student's responsibility to ensure that files are uploaded properly to eClass. This means:

Responsibility	How to check/corrective action	Consequences if corrective action not taken
Ensure the correct file is submitted (<i>i.e., don't submit an assignment from another class</i>).	Download the file you submitted off of eClass and open it. If it is not correct, revise your submission and submit the correct file.	Student receives a zero on the assignment.
Ensure all pages are included	Download and view the uploaded file. If not all pages are included, revise your submission and submit the file with all pages included.	Markers can only mark uploaded pages. For instance, If you uploaded 4 out of 6 pages the marker will only mark the 4 uploaded pages.
Ensure files upload properly (<i>for instance, don't show up as blank pages</i>)	Download and view the uploaded file. If it is not correct, revise your submission and submit the file again. If the issue persists, email the assignment to the instructor but ensure this email is sent prior to the assignment deadline.	Markers only mark pages that they can assess. For instance, if 4 out of 6 pages are blank, the marker will only mark the 2 pages uploaded properly.
Ensure files can be read by TA/instructor (<i>i.e., not blurry, cut off, or otherwise difficult to read</i>)	Download and view the uploaded file to check clarity and if information was cut off. Tidy responses if messy. If a photo is blurry, try different lighting and focus options to get a clearer image.	Makers only mark information they can see. Blurry/difficult to read files will be penalized as noted in the <i>Assignment Policies</i> document.