**WESTERN UNIVERSITY - FACULTY OF ENGINEERING**

**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

# CEE 4459A – Design of Lateral Load Structural Systems – Course Outline 2025/26

This course covers selected design topics that are needed for engineers to pursue a profession as structural engineers. The course extends students' knowledge and abilities in structural behaviour and design of different lateral load structural systems.

The general objectives are for student to be able to:

- Understand and quantify the behaviour of buildings with lateral resisting systems consisting of shear walls, frames, and wall-frame systems.
- Understand three-dimensional modelling aspects and techniques.
- Design concrete shear walls and rigid frames under lateral loads in accordance with the provisions of CSA standards CAN/CSA A23.3-14.
- Understand Diaphragms behaviour and Design Concrete Diaphragms according to CSA A23.3-14.
- Design masonry shear walls under lateral loads in accordance with the provisions of CSA standards CAN/CSA S304.1-04.
- Introduce students to selected engineering case studies covering modern lateral load structural system of worldwide famous high-rise buildings.

## Calendar Copy:

This course covers the analysis and behaviour of high-rise buildings with lateral resisting systems consisting of shearwalls, rigid frames, and wall-frame systems; design of concrete shearwalls and rigid frames; analysis and design of diaphragms; design of masonry shearwalls under lateral loads. Several case studies developed for some worldwide famous high-rise buildings are discussed during the course. Three-dimensional computer modelling of high-rise buildings are covered.

## Prerequisites:

Completion of year III of the Civil and Environmental Engineering program

## Antirequisites:

None

**Note:** It is the student's responsibility to ensure that all Prerequisite and Corequisite conditions are met or that special permission to waive these requirements has been granted by the faculty.

It is also the student's responsibility to ensure that they have not taken a course listed as an Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

**Contact Hours:**

2 lecture hours per week – attendance is mandatory
2 hours/week Tutorial and office hours - some tutorials are going to be used as lectures and will be announced ahead of time - Tutorials are not mandatory but students seeking assistance with weekly assignments or clarification on lecture material are strongly encouraged to attend.

Contingency plan for an in-person class pivoting to 100% online learning
In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, affected course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL Brightspace for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online as determined by the course instructor.

**Instructor:**

Dr. Ahmed (Mahdy) Hamada, *P.Eng.*, SEB 3117,
email: ahamada2@uwo.ca
Office Hours: By Appointment

**Teaching Assistant:**

To be Provided on OWL Brightspace

**Textbook:**

Prepared class notes should be uploaded to OWL Brightspace and brought to all lectures and tutorial sessions.

Students are responsible for checking the course OWL Brightspace site on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL Brightspace site, they can seek support on the OWL Brightspace Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

**Other references:**

List of books

Concrete Design Handbook (Third Edition) 2014, Cement Association of Canada, Ottawa, ON, Canada

R. G. Drysdale, and A. A. Hamid 2005, Masonry Structures: Behaviour and Design, Canadian Edition - Canada Design Masonry Design Center, Mississauga, ON, Canada

The above references will be on hold in Taylor library, and will be available for one-day borrowing.

**Units:**

Both SI and FPS unit systems may be used in lectures, tutorials and examinations.

**Computing:**

Final project and assignments involve computer modelling of high-rise building using the commercial program ETABS, S-Concrete, MASS, spread sheets, and writing report. The full-versions of software are available for Students and at the PC labs in the engineering building.

**Specific Learning Objectives:**

1. Lateral systems for buildings. At the end of this section, the student should be able to: [PA3, ET3, ITW1, LL2]
   a. Recognize different types of structural systems used to provide lateral resistance for high-rise buildings.
   b. Identify the suitable system for each building.
   c. Understand the interaction between frames and shear walls subjected to lateral load.
   d. Understand three-dimensional modelling aspects and techniques and learn how to model structures using commercial software ETABS.
2. Design of concrete lateral loads structural systems in accordance with the provisions of CSA standards CAN/CSA A23.3-14 [KB4, D4, ET2]
   a. Design of shear walls
   b. Design of rigid frames
   c. Typical reinforcement details for concrete shear walls and rigid frames
3. Analysis and Design of Concrete Diaphragms in accordance with the provisions of CSA standards CAN/CSA A23.3-14: [KB4, D4, ET2]
   a. Understand the design concepts of limit state design method
   b. Understand the Concpet of Strong Diaphragms and Plastic Hinge Locations
   c. Design of Concrete Diaphragms according to CSA A23.3
4. Design of masonry lateral load structural systems in accordance with the provisions of CSA standards CAN/CSA S304.1-04: [KB4, D4, ET2]
   a. Recognize different types of masonry building systems

   b. Recognize different types of masonry construction
   c. Design of masonry Shear walls
5. Case studies of high-rise buildings [LL1, LL2]
   a. Study and analyze several case studies developed for some worldwide famous high-rise buildings.
   b. Examine several case studies in which some critical engineering decisions and judgement must be made
6. Engineering Final Project [ITW3, PA3, D4, ET3, CS3, PR3, LL1, IESE1]

The instructor may expand or revise material presented in the course as appropriate.

**General Learning Objectives:**

E = Evaluate, T = Teach, I =Introduce

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|---|---|---|---|---|---|
| Knowledge Base | T (A) | Individual Work | E (A) | Ethics and Equity | - |
| Problem Analysis | T/E (A) | Team Work | E (A) | Economics and Project Management | - |
| Investigation | - | Communication | E(A) | Life-Long Learning | I (A) |
| Design | T/E (A) | Professionalism | I (A) | | |
| Engineering Tools | T/E(A) | Impact on Society | I (A) | | |

**Accreditation Unit**

Engineering Science = 25%, Engineering Design = 75%

**Evaluation:**

The final mark will be determined as follows:

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|---|---|
| Assignments | 30% |
| 2 Quizzes | 40% |
| Group Project – Max. 3 Students/group (Building Analysis & Design) | 30% |
| Total | 100% |

Project breakdown

Layout of Suggested Structural System 5%

Final Project Portfolio:
- Cover Letter 10%

- Design Brief 10%
- Calculations 20%
- Drawings 20%
- Oral discussion & Defence of design 35%

**Notes**

**Oral discussion and Defence of design**

Each group will give a 5 to 10 mins. presentation on their project followed by an oral discussion and defence of the design. Each student is required to be fully aware of all aspects of the final project, such as analyses, design, and drawings. Some of the questions shall be asked individually to any of the group members, and others to the whole group.

**Final Project Portfolio**

Cover letter and Design Brief

The length of the final design brief shall not exceed 10 typed pages (font size 12, double spaced). Suggested contents are: Cover Letter, Executive Summary; Introduction, Design Criteria, particulars of design/analysis, and Recommendations (or Conclusions). The Design Criteria would include the design standards and technical references used; the particular design criteria adopted also must be indicated succinctly. The particulars of design/analysis would summarize the rationale behind the various design decisions. The evaluation of the final design brief shall be based on the format, layout, completeness, technical content and use of English.

Calculations

Calculations must be well organized, clear, complete, and done on calculation paper. Each calculation page shall be dated, and shall indicate the name or initials of the person who performed the calculations. A final calculation set, which must be current, checked and indexed, shall be submitted with the final design brief. The evaluation of calculations will be based on their clarity, completeness, technical content, originality, and accuracy.

Drawings

Each student is required to prepare a set of drawings. Each drawing shall be dated, and shall indicate the name or initials of the person who did the drawing. The evaluation of drawings will be based on their technical content, clarity, completeness, and quality of drafting.

Students who have failed this course previously must repeat all components of the course. **No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted.**

**Quizzes and Examination:**

Two one-hour quizzes will be scheduled during the course. The quizzes are OPEN BOOK. These quizzes are *tentatively* scheduled for Thursdays, October 16 (Location TBA) and November 13 (Location TBA) at same time of tutorials.

**Assignments:**

Each student must turn in the solution of the assignment at 5:00 pm Friday Afternoon electronically on OWL Brightspace. Hardcopy submissions are not accepted unless permission is granted by the instructor. Late assignment will be accepted till 5:00 pm on the Monday following the submission date and have to be submitted directly to the instructor. Late assignments will be marked out of 80% of the total mark. Extensions are to be negotiated with the course instructor, not the teaching assistants.

**Participation:**

Participation will be assessed based on class attendance, participation in lectures and tutorials and completion of short in-class assessments.

**Course**

**I. Missed/Late Accommodation Policy:**

1. Students missing a test/assignment/lab or examination you will report the absence by submitting Academic Consideration Request form through STUDENT ABSENCE PORTAL.
2. Documentation must be provided as soon as possible.

**II. Exam Accommodation:**

1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department and the Associate Dean and in order to apply you must submit an the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
   PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

## III. Late Assignments:

1. Students must advise the course instructor if they are having difficulty completing an assignment on time (prior to the due date of the assignment).
2. Students should be prepared to submit the Academic Consideration Request Form and provide documentation if requested to do so by the course instructor (see reverse side for information on documentation).
3. If granted an extension, a revised due date should be established with the course instructor. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4. This course has 10 assignments with only 8/10 assignments counted towards your final grade. Academic consideration will not be granted for missed assignments. If students miss 2/10 assignments, the remaining 8 assignments will be used in the calculation of the final grade. If students miss more than 2 assignments, they will receive a grade of zero on each missed assignment.
5. This course employs flexible deadlines for assignments. The assignment deadlines can be found above in the course outline. For each assignment, students are expected to submit the assignment by the deadline listed. Should illness or extenuating circumstances arise, students are permitted to submit their assignment up to 72 hours past the deadline without academic penalty. Should students submit their assessment beyond 72 hours past the deadline, a late penalty of XX% per day will be subtracted from the assessed grade. As flexible deadlines are used in this course, requests for academic consideration will not be granted. If you have a long-term academic consideration or an accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week prior to the posted deadline.
6. Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

## IV. Medical Accommodation:

1. Requests for Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
2. Requests for academic consideration must include the following components:
    a. Self-attestation signed by the student (*This is only accepted for the first/one absence*)
    b. Medical note
    c. Indication of the course(s) and assessment(s) affected by the request
    d. Supporting documentation as relevant
3. Requests without supporting documentation are limited to one per term per course.

4. **Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.**
5. Once the request and supporting documents have been received and reviewed, appropriate academic consideration, if granted, shall be determined by the instructor in consultation with the academic advisor, in a manner consistent with the course outline. Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements. Some forms of academic consideration, such as arranging Special Examinations, assigning a grade of Incomplete, or granting late withdrawals without academic penalty, may only be granted by the Academic Advising office of the Faculty of Engineering.

## V. Religious Accommodation:

When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or (b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

## VI. Academic Integrity:

In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit Academic Integrity Western Engineering for more information

## VII. Academic Offences:

Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university.

Scholastic Discipline for Undergraduate Students & Cheating, Plagiarism and Unauthorized Collaboration: What Students Need to Know

Students must write their reports, essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (http://www.turnitin.com). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

## VIII. Faculty of Engineering AI Policy:

The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. However, the use of GenAI tools in any assignment or contribution during the course will have to be disclosed, as a resource.

GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use. If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

## IX. Use of English Policy:

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work except for the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

## X. Accessibility:

Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the Accessibility Western University for information on accessibility-related resources available at Western.

Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit Academic Support & Engagement -Academic Accommodation.

## XI. Inclusivity, Diversity, and Respect:

The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing. Please visit the Office of Equity, Diversity and Inclusion.

## XII. Health and Well-Being:

- Health & Wellness Services – Students - Offers appointment-based medical clinic for all registered part-time and full-time students.
- Mental Health Support - Provides professional and confidential services, free of charge, to students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.
- Crisis Support - For immediate assistant, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click here.
- Gender-Based Violence and Survivor Support - Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, here. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

**Important Contacts:**

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| Engineering Undergraduate Services | SEB 2097 | 519-661-2130 | engugrad@uwo.ca |
| Civil & Environmental Engineering | SEB 3005 | 519-661-2139 | civil@uwo.ca |
| Office of the Registrar/Student Central | WSSB 1120 | 519-661-2100 | |

**Important Links:**

- WESTERN ACADEMIC CALENDAR
- ACADEMIC RIGHTS AND RESPONSIBILITIES