

WESTERN UNIVERSITY - FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

CEE 4459A – Design of Lateral Load Structural Systems – Course Outline 2023/24

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 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:

TBA

Textbook:

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

Students are responsible for checking the course OWL site (<http://owl.uwo.ca>) 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 site, they can seek support on the OWL 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:
 - 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
 - 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:
 - a. Understand the design concepts of limit state design method
 - b. Understand the Concept 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:
 - 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
 - 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

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

General Learning Objectives:

E = Evaluate, T = Teach, I =Introduce

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

Evaluation:

The final mark will be determined as follows:

Assignments	40%
2 Quizzes	30%
Group Project – Max. 3 Students/group (Building Analysis & Design)	30%
Total	<hr/> 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 Wednesdays, October 25 (Elborn College 2168) and November 15 (Elborn College 2168) 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. 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.

Use of English:

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 with the exception of 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.

Cheating:

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

Attendance:

Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Accessibility:**Religious Accommodation**

When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at

<https://multiculturalcalendar.com/ecal/index.php?s=c-univwo>

Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/AcademicAccommodation_disabilities.pdf

Conduct:

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Please turn off your cell phone before coming to a class, tutorial, quiz or exam. On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct: 3

<http://www.uwo.ca/univsec/board/code.pdf>

Sickness and Other Problems:

For work totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf.

The Student Medical Certificate is available at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

If you miss the Final Exam, please contact Western Engineering Undergraduate Services as soon as possible. They will assess your eligibility to write the Special Examination.

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (e.g., more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

Academic Policies:

The website for Registrarial Services is <http://www.registrar.uwo.ca>.

In accordance with policy,

https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf,

the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner

Scholastic offences are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in 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>).

Support Services:

Please visit the Western Engineering Undergraduate Services webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: <https://www.eng.uwo.ca/undergraduate/index.html>

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) for a complete list of options about how to obtain help.

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 sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (<https://learning.uwo.ca>) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: <https://www.uwo.ca/se/digital/>.

Additional student-run support services are offered by the USC, <https://westernusc.ca/services/>.

Notices:

Students are responsible for regularly checking their UWO-account email, OWL, and notices posted outside the Civil and Environmental Engineering Department Office.

Course Breakdown:

Engineering Science = 25 AU's, Engineering Design = 75 AU's

Consultation:

Students are encouraged to discuss problems with their Teaching Assistants and/or Instructor in tutorial sessions. Office hours will be arranged for the students to see the Instructor and Teaching Assistants. Other individual consultation can be arranged by appointment with the

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

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.

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

A. GENERAL REGULATIONS & PROCEDURES

1. All first-year students will report to the Undergraduate Services Office by submitting the Academic Consideration Request Form, for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting Academic Consideration Request Form. Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.

5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM/MIDTERM TESTS

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.

2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test and request relief through the Academic Consideration Request Form. If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.

3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).

4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to report your absence using the Academic Consideration Request Form and request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.

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 "Application for a Special Exam" form. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (prior to the due date of the assignment).
2. Be prepared to submit the Academic Consideration Request Form and provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. 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.
 - i) 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.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, you must provide the doctor with a Student Medical Certificate to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

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

H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

Calendar References: Check these regulations in your 2023 Western Academic Calendar available at www.westerncalendar.uwo.ca

Absences Due to Illness:

https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_13_5

Academic Accommodations for Students with Disabilities:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10 **Academic Accommodations for Religious or Holy Days:**

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16 **Course Withdrawals:**

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75 **Examinations:**

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=#SubHeading_78 **Scheduling of Term Assignments:**

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78 **Scholastic Offences:**

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20 **Student Medical Certificate:**

<https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf>

Engineering Academic Regulations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Li ve&ArchiveID=#Page_86

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Add Deadlines:

First term half course (i.e. "A" or "F") September 15, 2023

Full courses and full-year half course (i.e. "E", "Y" or no suffix) September 15, 2023

Second term half course (i.e. "B" or "G") January 16, 2024

Drop Deadlines:

First term half course without penalty (i.e. "A" or "F") November 13, 2023

Full courses and full-year half courses without penalty (i.e. "E", "Y" or no suffix) November 30, 2023

Second term half or second term full course without penalty (i.e. "B" or "G") March 7, 2024

Contact Information:

Undergraduate Services Office: SEB 2097 Phone: 519-661-2130 E-mail: engugrad@uwo.ca

Chemical & Green Process Engineering: TEB 477 Phone: 519-661-2131 E-mail: cbeugrad@uwo.ca

Civil Engineering: SEB 3005 Phone: 519-661-2139 E-mail: civil@uwo.ca

Computer, Electrical, Mechatronics Systems & Software Engineering TEB 279 Phone: 519-661-3758 E-mail: eceugrad@uwo.ca

Integrated Engineering ACEB 2410 Phone: 519-661-6725 E-mail: engceli@uwo.ca

Mechanical Engineering: SEB 3002 Phone: 519-661-4122 E-mail: mmeundergraduate@uwo.ca