This course provides an introduction to wind effects on structures, including both quasi-static and dynamic approaches to the prediction of wind loads on structures, and how these are implemented using both the National Building Code of Canada (NBCC) and ASCE 7-16. The general objectives of the course are for the student to become able to:

- assess the wind climate and predict design wind speeds using extreme value theory from historical wind speed records;
- describe the mean and turbulent wind structure of the atmospheric boundary layer over different terrain;
- describe the aerodynamic forces acting on bluff bodies and the factors that affect them;
- calculate the wind loads acting on a structure using either quasi-static or dynamic approaches, and to select an appropriate method to use given a particular class of structure;
- assess the impact of internal pressures on external wind loads; and
- apply the quasi-static approach as implemented in both the NBCC and ASCE 7-16 to a simple structure.

**Calendar Copy:**
An introduction to wind effects on structures. Topics covered include wind climate, the atmospheric boundary layer and its description, bluff body aerodynamics and aeroelastic effects, quasi-static and dynamic approaches to wind loads on structures, internal pressures, and code approaches to wind loads on structures. (0.5 course)

**Prerequisites:**
CEE 2224 and SS 2141A/B, or their equivalents

**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/week;
Depending on the exact situation prevailing for the Winter term, lectures will either be delivered synchronously using Zoom or in-person as per the lecture schedule on the Office of the Registrar’s website. In the case of synchronous lectures delivered using Zoom, these will also be recorded and posted to the course OWL site for students to review in their own time. Attendance/review of lecture material and self-study should take approximately five hours per week.
2 tutorial hours/week. A 2-hour tutorial session will be delivered synchronously through Zoom each week during the scheduled tutorial hours until such time as we are allowed to revert to in-person tutorials. Tutorials are not mandatory but students seeking assistance with weekly assignments or clarification on lecture material are strongly encouraged to attend. The link to the Zoom meeting will be posted to the course OWL site.

**Instructor:**
Dr Craig Miller, P.Eng., SEB 2084, email: cmiller@eng.uwo.ca.

Administrative Assistant: Sandra McKay (smckay@uwo.ca)

**Textbook:**
There is no specific textbook for this course.

Prepared class notes, organized by topic, will be posted to the course OWL site prior to the start of that topic.

**Other References:**


*Advanced Structural Wind Engineering*, edited by Yukio Tamura and Ahsan Kareem, Springer, 2013 (advanced text, available online through Western Libraries - see course OWL site for details on how to access).

Links to other useful background material may be posted to the course OWL site.

**Computing:**
Students will be required to use portable computers during tutorials. Some assignments will require the use of additional software available through site licences held by the University of Western Ontario, and in particular the use of the numerical computing environment software MATLAB.

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

**Specific Learning Objectives:**

1. **Introduction [KB4]**
   a) Recognize the various components of the Davenport wind loading chain, and quantify their individual contributions to the wind loads acting on a structure
2. Wind Climate [KB4]
   a) Describe the features of the general atmospheric circulation
   b) Differentiate between the different types of wind storms likely to be of interest to a designer, including extra-tropical and tropical cyclones, thunderstorms, and tornadoes
   c) Derive a wind rose for a specific site using historical wind speed records
   d) Calculate the design wind speed for a given return period from historical wind speed records using extreme value theory

3. Atmospheric Boundary Layer (ABL) [KB4]
   a) Calculate gradient and geostrophic wind speeds from atmospheric pressure distributions
   b) Derive the theoretical mean velocity distribution within the ABL
   c) Compare the theoretical and 'power law' velocity distributions
   d) Quantify the turbulent structure of the ABL in space and time using empirical data for different terrain
   e) Calculate boundary layer growth due to abrupt changes in terrain and how this impacts design wind speeds for a specific site
   f) Determine the relationship between gust and mean wind speeds - gust factor approach
   g) Discuss the qualitative differences in wind structure for different storms i.e. thunderstorms, hurricanes and tornadoes

4. Bluff Body Aerodynamics [KB4, I3, ITW2]
   a) Describe the basic flow pattern about simple structural shapes, such as flat plates and rectangular bodies, in both uniform and boundary layer flows
   b) Identify and quantify the factors that affect the flow patterns and resulting forces acting on simple structural shapes
   c) Quantify the effects of turbulence on the mean and fluctuating forces acting on simple shapes, and how these effects are captured through of an aerodynamic admittance function
   d) Recognize the impact of other aeroelastic phenomena, such as vortex shedding, galloping and flutter, and the conditions under which these effects may be significant

5. Quasi-static and Dynamic Approaches to Wind Loads [KB4]
   a) Derive the quasi-static loading equation, and recognize the conditions under which this approach can be used to calculate the wind loads on a simple structure
   b) Describe the underlying theory behind the dynamic approach to wind loads, and importance of the resonant response in the calculation of wind loads on several classes of structure, including tall buildings and long-span bridges
   c) Calculate the response of a simple single-degree of freedom structure using the dynamic approach to wind loads

6. Internal pressures [KB4]
   a) Recognize the impact of internal pressures on the net wind loads acting on a structure, and determine the particular combinations of positive and negative external and internal pressures that lead to the worst case load effects

7. Codification of Wind Loads using either the NBCC or ASCE 7-16 [KB4, I3, ET2, ITW2]
   a) Calculate external design pressures using either the NBCC or ASCE 7-16 simple procedures including exposure, gust and pressure factors
   b) Calculate internal design pressures using either the NBCC or ASCE 7-16 provisions
   c) Calculate design wind loads and structural load effects for low-rise buildings
   d) Calculate peak wind pressures for cladding/envelope design
   e) Recognize the structure types where explicit dynamic analyses are required for wind load effects using either the NBCC or ASCE 7-16

The instructor may expand on material presented in the course as appropriate.
**General Learning Objectives:**

E=Evaluate, T=Teach, I=Introduce; (I)=Introduction, (D)=Developing, (A)=Advanced Level

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<tr>
<th>Knowledge Base</th>
<th>T(A)</th>
<th>Engineering Tools</th>
<th>T(A)</th>
<th>Impact on Society</th>
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<td>Problem Analysis</td>
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<td>Team Work</td>
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<td>Ethics and Equity</td>
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<td>Investigation</td>
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<td>Design</td>
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**Evaluation:**

The final course mark will be determined as follows:

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<td>Group projects:</td>
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<td>Final assessment:</td>
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<td>Total:</td>
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**Note:** 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.

1. **Quizzes and Examinations:**

A three-hour written final assessment will be held during the regular examination period. This may be an in-person exam or an online assessment delivered through the course OWL site, as circumstances dictate. There is no requirement to pass the final assessment in order to pass the course.

2. **Weekly Assignments:**

Assignments will be given on a weekly basis. Assignments are to be submitted prior to the due date using Gradescope accessed through the course OWL site. Late assignments will be assessed a penalty of 10% per day, to a maximum of 4 days, after which they will receive a mark of zero. Extensions are to be negotiated with the course instructor, not the teaching assistants.

3. **Group Projects:**

Two group projects will be given as part of the course. The first of these will involve examining aspects of the pressure distribution on the sides and top of a low-rise building based on wind tunnel tests, while the second will examine aspects of the design pressures acting on a low-rise building and how these vary by wind direction. Group reports for both projects are to be submitted prior to the due date using Gradescope accessed through the course OWL site. Late reports will be assessed a penalty of 10% per day, to a maximum of 4 days, after which they will receive a mark of zero. Extensions are to be negotiated with the course instructor, not the teaching assistants.

4. **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.
For more information on scholastic offenses, please see:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

**Attendance:**
Any student who, in the opinion of the instructor, has not engaged sufficiently in 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.

**Accommodation:**
Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: Academic Accommodation for Students with Disabilities

**Academic Consideration for Student Absence:**
Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the term, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student’s final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student’s final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are *not* met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

For Western University policy on Consideration for Student Absence, see Policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs and for the Student Medical Certificate (SMC), see:
Religious Accommodation:
Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar.

Use of Recordings:
All of the remote learning sessions for this course will be recorded. The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals under special circumstances. Please contact the instructor if you have any concerns related to session recordings. Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

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: https://www.uwo.ca/univsec/pdf/board/code.pdf

Course delivery with respect to the COVID-19 pandemic:
Although the intent is for this course to be delivered in-person, the changing COVID-19 landscape may necessitate some or all of the course to be delivered 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 assessments affected will be conducted online as determined by the course instructor.

When deemed necessary, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western’s Remote Proctoring website at: https://remoteproctoring.uwo.ca

Notice:
Students are responsible for regularly checking their email, course website (https://owl.uwo.ca/portal) and notices posted outside the Civil and Environmental Engineering Department Office

Consultation:
Students are encouraged to discuss problems with their teaching assistant and/or the Instructor in tutorial sessions. Office hours will be arranged for the students to meet with the Instructor and teaching assistants. Other individual consultation can be arranged by appointment with the instructor.
**Course Breakdown:**

25% Natural Science; 75% Engineering Science.
AUs: Total 36; Natural Science 9; Engineering Science 27.

The attached document “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is part of this course outline.
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.

NEW: Requests for Academic Consideration using the Self-Reported Absence Form

If you experience an unexpected illness or injury or an extenuating circumstance (48 hours or less) that is sufficiently severe to temporarily render you unable to meet academic requirements (e.g., attending lectures or labs, writing tests or midterm exams, completing and submitting assignments, participating in presentations) you should self-declare using the online Self-Reported Absence portal. This option should be used in situations where you expect to resume academic responsibilities within 48 hours or less.

Each student will be allowed a maximum of two self-reported absences between September and April and one self-reported absence between May and August. Self-reporting may not be used for final exams or assessments (e.g. midterm exams, tests, reports, presentations, or essays) worth more than 30% of any given course.

For full instructions about the Self-Reporting System refer to the Academic Calendar link here.

A. GENERAL REGULATIONS & PROCEDURES (other than self-reported absences)

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.

2. If you are an upper year student and you are missing a test/assignment/lab or examination that is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If your course work is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097.

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 (other than self-reported absences)

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. 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, you should report to your department office to request relief. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief.

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

4. Discuss with the instructor if and when the test can be rescheduled. N.B. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.
C. **FINAL EXAMINATIONS (cannot be self-reported)**

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to 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 sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. 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 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 2021 Western Academic Calendar available at [www.westerncalendar.uwo.ca](http://www.westerncalendar.uwo.ca).

Self-Reporting Absences
Absences Due to Illness
Academic Accommodations for Students with Disabilities
Academic Accommodations for Religious or Holy Days
Course Withdrawals
Examinations
Scheduling of Term Assignments
Scholastic Offences
Student Medical Certificate
Engineering Academic Regulations

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 16, 2021
- Full courses and full-year half course (i.e. “E”, “Y” or no suffix): September 16, 2021
- Second term half course (i.e. “B” or “G”): January 11, 2022

Drop Deadlines:
- First term half course (i.e. “A” or “F”): November 12, 2021
- Full courses and full-year half courses (i.e. “E”, “Y” or no suffix): November 30, 2021
- Second term half or second term full course (i.e. “B” or “G”): March 7, 2022

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, Mechatronic 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

Revised 08/04/21