

CARLETON UNIVERSITY
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

ACSE 3209
BUILDING SCIENCE
FALL 2026

Instructor: Burak Gunay, PhD, PEng
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Office hours: Mondays, 1:00–2:00 p.m., CB 5206, or by appointment (by email)
Teaching assistants: TBD

1) Course Schedule

The class meets on Mondays and Wednesdays from 2:35 to 3:55 p.m. in [REDACTED]. Unless otherwise announced in class, all tutorials, problem-analysis sessions, and laboratory activities will be held in [REDACTED].

2) Course Description

Building-envelope design and analysis; applied heat transfer and moisture transport; solar radiation; hygrothermal modelling; control of rain, air, vapour, and heat; materials for wall, window, curtain-wall, roof, and foundation systems; building-envelope retrofit case studies; building codes; and envelope construction.

3) Prerequisites

MAAE 2400 and third-year status in the B.Eng. Architectural Conservation and Sustainability Engineering program, or third-year status in the B.Eng. Civil Engineering program.

4) Learning Outcomes

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

- explain the fundamentals of heat, air, and moisture transfer in buildings;
- apply principles of building-envelope design in a cold climate;
- select and apply strategies to control heat, air, and moisture transfer in buildings;
- interpret fundamental concepts in relevant building codes and standards;
- describe the basic functions of hygrothermal simulation tools;
- perform hygrothermal analyses of envelope assemblies;
- describe methods for analysing and testing air infiltration;
- describe methods for analysing and testing thermal transmittance;
- select and apply strategies to mitigate moisture damage in buildings;
- interpret psychrometric processes in buildings; and
- apply strategies that use thermal mass effectively.

5) Graduate Attributes

The Canadian Engineering Accreditation Board (CEAB) requires graduates of undergraduate engineering programs to possess 12 attributes. Courses in all four years of our programs evaluate students' progress toward acquiring these attributes. Aggregate data—typically collected from all sections of a course during an academic year—are used for accreditation and to guide program improvements. Some assessments used to measure graduate attributes (GAs) may also contribute to final grades; however, an individual student's GA measurements are not used to determine year-to-year progression or eligibility to graduate. The following table lists the GAs measured in this course and the corresponding assessment tools.

GA indicator	Assessment tool
GA 2.1 – Problem definition	Selected midterm questions
GA 2.2 – Approach to the problem	Selected assignment questions
GA 2.3 – Use of assumptions	Selected assignment questions
GA 2.4 – Interpretation of the solution and validity of results	Selected final questions

For information about GAs and continual curriculum improvement, visit the [Engineers Canada accreditation webpage](#).

6) Accreditation Units

Mathematics	Natural science	Complementary studies	Engineering science	Engineering design
–	–	–	75%	25%

7) Textbooks, Learning Materials, and Costs

All required software is available free of charge through the Civil & Environmental Engineering desktop on [cuDesktop](#).

Students are not required to purchase textbooks or other learning materials for this course.

8) Topics and Tentative Plan

All dates are tentative and subject to change. If an announcement conflicts with this document, the announcement will govern.

Week of September 7

Background

- Definition and importance of building science
- A brief history of building science

No tutorials will be held.

Week of September 14

Weather and climate

- Temperature, precipitation, wind, and solar radiation

Tutorial a: Problem analysis: weather and climate

Tutorial b: Solar-geometry demonstration using a heliodon

Week of September 21

Opaque assemblies

- Thermal-transmittance calculation methods for above-grade assemblies
 - Insulation materials
 - Solar radiation on opaque assemblies
 - Thermal properties of below-grade assemblies
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Week of September 28

Fenestration

- Components of a window
- Window technologies
- Shading systems

Tutorial a: LBNL THERM and WINDOW

Tutorial b: Infrared thermography, heat-flux measurement, and analysis of wall sections

Week of October 5

Thermal mass

- Thermal storage in building fabric
- Applications of thermal mass in building design

Week of October 12

Heating and cooling generation

- Traditional heating equipment
- Heat pumps
- Cooling equipment
- Centralized and decentralized configurations

Tutorial a: Refrigeration-cycle demonstration using the HVAC trainer

Tutorial b: Problem analysis: heat transfer and storage

Week of October 19

Properties of air

- Psychrometric analysis
 - Mixing, heating, cooling, dehumidifying, and humidifying air
-

Week of October 26

Reading week. No in-person lectures or tutorials will be held.

Week of November 2

Midterm examination (in class on Monday)

Infiltration (Wednesday)

- Drivers of infiltration
- Infiltration testing

Tutorial a: Psychrometric processes—mixing, heating, and cooling—demonstrated using the HVAC trainer

Week of November 9

Infiltration (continued)

- Airflow networks
- Control of infiltration in buildings

Ventilation

- Modes of ventilation

Week of November 16

Ventilation (continued)

- Mechanical-ventilation configurations
- Control of ventilation systems
- Assessment of mechanical-ventilation systems

Tutorial a: Problem analysis: infiltration and ventilation

Tutorial b: Balometer and micromanometer demonstration

Week of November 23

Moisture-transport mechanisms

- Vapour diffusion
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Week of November 30

Moisture-transport mechanisms (continued)

- Vapour convection
- Capillary transport
- Precipitation

Tutorial a: WUFI software demonstration

Tutorial b: Wet-cup/dry-cup method demonstration

Week of December 7

Moisture-induced degradation mechanisms

- Mould, efflorescence, corrosion, and freeze–thaw damage

Design strategies to mitigate moisture-induced degradation

Final examination: Held in person; location to be announced.

9) Evaluation and Marking Scheme

Assessment	Weight
Assignment 1	8%
Assignment 2	8%
Assignment 3	8%
Laboratory participation	10%
Midterm examination	16%
Final examination	50%
Total	100%

Participation bonus: A 5% bonus will be awarded for participating in more than 80% of the in-class polls.

a) **Final Examination**

- i) Final examinations are for evaluation purposes and will not be returned to students.
- ii) Students who are unable to write the final examination because of a serious illness, emergency, or another circumstance beyond their control may apply for accommodation by contacting the Registrar's Office. Consult [Section 4.3 of the University Calendar](#).

b) **Term Work Late-Submission Policy**

Assignments submitted after the due date without the instructor's permission will incur a 25% penalty immediately and an additional 25% penalty for each subsequent 24-hour period after the deadline.

c) **Deferred Term Work and Self-Declaration**

Students who cite medical or other extenuating circumstances beyond their control as the reason for missed term work, including the midterm examination, must immediately inform the instructor and arrange an alternative. In all cases, **this must occur no later than three (3) days after the term work was due**. The alternative arrangement must be made before the last day of classes in the term, as published in the academic schedule. Consult [Section 4.4 of the University Calendar](#).

10) Academic Dates

Students should be aware of the academic dates, including the last day for academic withdrawal, posted on the [Registrar's Office website](#).

11) Academic Integrity and Plagiarism

- a) Consult the [Faculty of Engineering and Design academic-integrity webpage](#) for information about the Academic Integrity Policy and related procedures. Violations of the policy may result in penalties such as a reduced grade, a grade of F in the course, suspension, or expulsion.
- b) One of the main objectives of the Academic Integrity Policy is to ensure that *the work you submit is your own*. When studying or preparing with other students, you must write your own solutions and avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting them as one's own without proper citation or reference to the original source.

Examples of policy violations include, but are not limited to:

- submitting work prepared, in whole or in part, by someone else;
- using another person's data or research findings without appropriate acknowledgement;
- submitting a computer program developed, in whole or in part, by someone else, with or without modifications, as one's own; and
- failing to acknowledge sources through proper citation or failing to use quotation marks when reproducing another person's words.

12) Copyright

The materials created for this course—including the course outline, slides, posted notes, videos, laboratory materials, projects, assignments, quizzes, examinations, and solutions—are intended for personal use only. They may not be reproduced, redistributed, or transmitted in any form or by any means, whether electronic, mechanical, photocopied, recorded, or otherwise, without written permission from the author or authors, during or after the semester.

13) Learning and Working Environment

The University and all members of its community share responsibility for ensuring that the University's educational, work, and living environments are free from discrimination and harassment. If you have concerns about harassment or discrimination relating to age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](mailto:equity@carleton.ca) at equity@carleton.ca.

We will strive to create an environment of mutual respect through equity, diversity, and inclusion in this course. The space in which we work will be safe for everyone. Please be considerate of everyone's personal beliefs, choices, and opinions.

14) Academic Accommodations

You may require special arrangements to meet your academic obligations during the term. The processes for requesting accommodation are described below.

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with learning disabilities, psychiatric or mental-health disabilities, attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD), chronic medical conditions, and impairments in mobility, hearing, or vision. If you have a disability requiring academic accommodation in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca.

Request academic accommodations through the [Ventus Student Portal](#) for each course at the beginning of every term. For in-term tests or midterm examinations, request accommodations at least two (2) weeks before the first test or midterm. The deadlines for requesting final-examination accommodations are published in the [University academic calendars](#) for undergraduate and graduate students.

Accommodation for Student Activities: Carleton University recognizes the substantial benefits to both students and the University that result from participation in activities beyond the classroom. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Contact your instructor with any requests for academic accommodation during the first two weeks of class or as soon as possible after the need for accommodation becomes known. For details, see the [Senate Policy on Accommodation for Student Activities](#).

Pregnancy Obligation: Contact your instructor with any requests for academic accommodation during the first two weeks of class or as soon as possible after the need for accommodation becomes known. For details, review the [Student Guide to Academic Accommodation](#).

Religious Obligation: Contact your instructor with any requests for academic accommodation during the first two weeks of class or as soon as possible after the need for accommodation becomes known. For details, review the [Student Guide to Academic Accommodation](#).

Survivors of Sexual Violence: Carleton University is committed to maintaining a positive learning, working, and living environment in which sexual violence is not tolerated and survivors are supported through academic accommodations under Carleton's Sexual Violence Policy. For information about available services and support, visit [Sexual Violence Prevention and Survivor Support](#).

15) Engineering Academic Advising

The [Engineering Academic Support Service](#) assists undergraduate engineering students with course selection, registration, and learning support from first year through graduation. [Contact information for undergraduate academic advisors](#) is available online.

16) Student Mental Health and Wellness

As a university student, you may experience mental-health challenges that can significantly affect your academic success and overall well-being. Carleton's [Wellness Services Navigator](#) helps students connect with mental-health and wellness resources.

If you would like departmental assistance connecting with resources, contact the faculty member for your program. Alternatively, contact the department at CEEUGChair@cunet.carleton.ca.

ACSE: Prof. Burak Gunay; burak.gunay@carleton.ca; office 5206, Canal Building

CIVE: Prof. Heng Khoo; heng.khoo@carleton.ca; office 3364, Mackenzie Building

ENVE: Prof. Shoeleh Shams; shoeleh.shams@carleton.ca; office 4242, Mackenzie Building

On-campus and off-campus resources include:

1. **Carleton's Wellness Desk:** Located in room 204A of MacOdrum Library, the Wellness Desk is a space where students can learn about resources, connect with the Wellness Coordinator, and decompress during stressful times of the year. No appointment is required during operating hours.
2. **Carleton's Health and Counselling Services:** To book an appointment, contact the main clinic at 613-520-6674. If your need is urgent, inform the Patient Care Coordinator, or go to the main clinic in person at 2500 Carleton Technology and Training Centre and indicate that you are in crisis and need to speak with someone immediately. Further information is available from [Carleton Health and Counselling Services](#).
3. **Residence Counselling and Wellness Service:** Counselling services specifically for students living in residence.
4. **Therapy Dogs:** Carleton's therapy dogs and their owners, who are University staff and faculty, provide comfort and support to help students thrive.

5. **Emergencies and Crisis** and **Emergency Numbers**.
6. **Good2Talk** (1-866-925-5454): A free, confidential helpline offering professional counselling, information, and referrals related to mental health, addictions, and well-being for post-secondary students in Ontario, 24 hours a day, 365 days a year.
7. **Empower Me**: Undergraduate students have access to free e-counselling services in the community 24 hours a day, 365 days a year.
8. **The Walk-In Counselling Clinic** (off-campus community resource): The clinic has locations throughout Ottawa and the greater Champlain region that are open seven days a week. Individuals are assisted without an appointment on a first-come, first-served basis during clinic hours. Services are available in many languages and are free and confidential.
9. **Distress Centre of Ottawa and Region**: Available 24 hours a day, 365 days a year. Distress Line: 613-238-3311; Crisis Line: 613-722-6914 or 1-866-996-0991; text: 343-306-5550.
10. **Distress and Crisis Ontario**: Chat is available from 2:00 p.m. to 2:00 a.m. ET.
11. **BounceBack Ontario** (toll-free: 1-866-345-0224): A free skill-building program managed by the Canadian Mental Health Association. It is designed to help adults and youth aged 15 and older manage low mood, mild to moderate depression and anxiety, stress, or worry. The program is delivered by telephone with a coach and through online videos, providing tools to support mental wellness.