



Faculty of Engineering
Department of Civil Engineering
COURSE OUTLINE

CIVE 453 – Building and district energy simulation

Term – Summer 2020 (202005)

Instructor	Office Hours
Dr. Ralph Evins	Zoom during lecture times
E-mail: revins@uvic.ca	

List all prerequisites and co-requisites: [CIVE 450](#) is a co-requisite unless exemption is granted.

DATES

	Days:	Time:
Lectures and computer lab work will be interspersed in all sessions (see below)	Wednesdays	Time: 9:30 - 12:20

TA Name	E-mail
Kevin Cant	kcant@uvic.ca
David Rulff	drulff@uvic.ca

Required Text	Optional Texts
None	Building Performance Simulation for Design and Operation, Jan L.M. Hensen & Roberto Lamberts (Editor), 2011. Building Performance Analysis, Pieter de Wilde, 2018. Building Energy Modeling with OpenStudio , Brackney et al, 2018. (Free online).

COURSE OBJECTIVES

This course teaches the principles of building energy simulation and guides students in the use of such tools for the design of low-energy buildings. This is achieved through a term-long project in which groups of students develop a building design using simulation tools to assist them. This mimics the approach found in engineering practice, where simulation is an essential part of the design process.

Specific simulation tasks include:

- Climate analysis
- Geometric and building envelope design
- Daylight and solar gains, including glazing and shading
- Thermal comfort and building control
- Heating, ventilation and air-conditioning systems
- Air flow and natural ventilation
- Renewable energy and storage technologies
- District-level energy systems
- Parametric analysis and computational design optimisation.

As well as simulation skills, students will gain a better understanding of energy flows in buildings and districts, and of the integrated nature of the building design process. They will also practice working constructively together, budgeting their time appropriately and presenting their findings clearly.

LEARNING OUTCOMES: At the end of this course, students will be able to:

Use simulation tools to predict building energy performance.

Explain the core principles of building energy simulation.

Analyze the outputs of an energy simulation to determine their meaning, and evaluate their accuracy.

Compare building design alternatives using standard and parametric methods.

Identify specific building performance failings using simulation, and design interventions to address them.

Propose and implement a simulation strategy to assess a specific design aspect.

Discuss the limitations of the assumptions that underpin typical simulation tools.

Devise additional modelling steps that may be required to improve upon basic techniques.

Weight & Dates of Assessments:	Weight	Date
Course project - report	40%	Friday 2 August 2019
Course project - presentation	20%	Wednesday 31 July 2019
Weekly assignments	40%	See below

LABORATORIES (Description & Method of Delivery)

All sessions will be conducted in the computer lab. They will consist of short lectures on the principles underlying energy simulation, instruction and demonstration of their implementation using the software, and practical work to be completed by all students. Short weekly computational assignments will be set on Wednesdays for submission by 5pm the following Monday in weeks 1 to 10 (see Course Schedule).

Weekly assignments are to be completed individually. Electronic submission details TBC.

PROJECT: (Description & Method of Delivery)

A term-long project will apply the skills learnt during the course to the design of a low-energy building. The brief specifies the building geometry, basic design and modelling assumptions, but students must determine the glazing and shading, daylighting controls and HVAC design. The objective is to minimise energy use whilst maintaining comfortable indoor conditions. The project mimics the typical role of a building energy simulation specialist in an engineering consultancy.

Projects will be judged on their documented use of building simulation tools to justify design decisions. Most weekly assignments will relate to the final project work. The penultimate two weeks of term will be devoted to project work, with advice available during class times. Project submission will be in the form of a 20 page report (plus appendices) and associated model files. A report structure will be provided. Additionally, there will be a project presentation of 15 minutes plus 5 minutes of questions.

The project will be completed in groups. Students will be assigned to a group. Each group will submit one report and give one presentation. The contributions of each team member must be clearly stated, and may be used to assign different grades to members of a team.

NOTE: Failure to complete all weekly assignments will result in a grade of N being awarded for the course.

The final grade obtained from the above marking scheme for the purpose of GPA calculation will be based on the percentage-to-grade point conversion table as listed in the current Undergraduate Calendar.

COURSE LECTURE NOTES

Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

There will be no supplemental examination for this course.

GENERAL INFORMATION

Note to Students:

Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Secretary to set up an appointment.

Attendance

Students are expected to attend all classes in which they are enrolled. An academic unit may require a student to withdraw from a course if the student is registered in another course that occurs at the same time....

An instructor may refuse a student admission to a lecture, laboratory, online course discussion or learning activity, tutorial or other learning activity set out in the course outline because of lateness, misconduct, inattention or failure to meet the responsibilities of the course set out in the course outline. Students who neglect their academic work may be assigned a final grade of N or debarred from final examinations.

Students who do not attend classes must not assume that they have been dropped from a course by an academic unit or an instructor. Courses that are not formally dropped will be given a failing grade, students may be required to withdraw and will be required to pay the tuition fee for the course." UVic Calendar, (2017-2018) <http://web.uvic.ca/calendar2018-01/undergrad/info/regulations/attendance.html>

ACCOMMODATION OF RELIGIOUS OBSERVANCE

The University recognizes its obligation to make reasonable accommodation for students whose observance of holy days might conflict with the academic requirements of a course or program.

Students are permitted to absent themselves from classes, seminars or workshops for the purposes of religious or spiritual observance.

In the case of compulsory classes or course events, students will normally be required to provide reasonable notice to their instructors of their intended absence from the class or event for reasons of religious or spiritual observance. In consultation with the student, the instructor will determine an appropriate means of accommodation. The instructor may choose to reschedule classes or provide individual assistance.

Where a student's participation in a class event is subject to grading, every reasonable effort will be made to allow the student to make up for the missed class through alternative assignments or in subsequent classes. Students who require a rescheduled examination must give reasonable notice to their instructors. If a final exam cannot be rescheduled within the regular exam period, students may request an academic concession.

To avoid scheduling conflicts, instructors are encouraged to consider the timing of holy days when scheduling class events. For further information, including a list of days of religious observances, please contact the Equity and Human Rights Office or visit their website: web.uvic.ca/eqhr.

Discrimination and Harassment Policy (GV0205)

<http://web.uvic.ca/calendar2018-01/general/policies.html>

Faculty of Engineering, University of Victoria

Standards for Professional Behaviour

"It is the responsibility of all members of the Faculty of Engineering, students, staff and faculty, to adhere to and promote standards of professional behaviour that support an effective learning environment that prepares graduates for careers as professionals...."

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour which contains important information regarding conduct in courses, labs, and in the general use of facilities. <http://www.uvic.ca/engineering/current/undergrad/index.php#section0-23>

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the Undergraduate Calendar for the UVic policy on academic integrity.

Policy on Academic Integrity

<http://web.uvic.ca/calendar2018-01/undergrad/info/regulations/academic-integrity.html>

Equality

This course aims to provide equal opportunities and access for all students to enjoy the benefits and privileges of the class and its curriculum and to meet the syllabus requirements. Reasonable and appropriate accommodation will be made available to students with documented disabilities (physical, mental, learning) in order to give them the opportunity to successfully meet the essential requirements of the course. The accommodation will not alter academic standards or learning outcomes, although the student may be allowed to demonstrate knowledge and skills in a different way. It is not necessary for you to reveal your disability and/or confidential medical information to the course instructor. If you believe that you may require accommodation, the course instructor can provide you with information about confidential resources on campus that can assist you in arranging for appropriate accommodation. Alternatively, you may want to contact the Resource Centre for Students with a Disability located in the Campus Services Building.

The University of Victoria is committed to promoting, providing, and protecting a positive, and supportive and safe learning and working environment for all its members."

Course Schedule

Week	Topics
1	<u>Introduction.</u> Why do we use building energy simulation? A refresher on energy flows in buildings. Project briefing.
2	<u>Simulating energy flows.</u> An introduction to the OpenStudio software. Simulating energy flows in a simple building.
3	<u>Geometry.</u> Introduction to the OpenStudio SketchUp plugin. Start on project geometry.
4	<u>Inside and outside boundary conditions.</u> Internal and external loads. Thermal comfort. Analysis of the climate (strategy selection).
5	<u>Building envelopes.</u> Constructions (insulation, thermal mass). Glazing (geometry, transmittance). Shading devices (internal/external, passive/active).
6	<u>Parametric modelling and optimization.</u> Use of the OpenStudio parametric module. Advanced parametrics and optimization.
7	<u>Lighting.</u> Lighting design and control. Daylighting. Use of the OpenStudio Radiance link.
8	<u>Ventilation.</u> Mechanical ventilation. Natural ventilation. Openings and air flow networks.
9	<u>HVAC systems.</u> Delivery and air-side systems. Plant and water-side systems. Control.
10	<u>Energy systems.</u> Advanced HVAC modelling. Urban and district modelling.
11	<u>Project work.</u>
12	<u>Project work.</u>
13	<u>Presentations. Report due.</u>