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emergency contact information: If there is an emergency, I will communicate with the class through the Outlook LCA Winter 2023 Group email list.

Equity, Diversity and Inclusion

The Faculty of Architecture and Planning is committed to recognizing and addressing racism, sexism, and other forms of oppression within academia and the professions of architecture and planning. We, the faculty, are working to address issues of historic normalization of oppressive politics, segregation, and community disempowerment, which continues within our disciplines today.

university policies

This course is governed by the academic rules and regulations set forth in the University Calendar and the Senate. <https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog>
See the School's "Academic Regulations" page (tinyurl.com/dal-arch-regulations) for links to university policies and resources:

- Academic Integrity
- Accessibility
- Student Code of Conduct
- Diversity and Inclusion – Culture of Respect
- Territorial Acknowledgement: Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.¹
- Work Safety
- Fair Dealing policy
- Important Dates in the Academic Year (including add/drop dates)
http://www.dal.ca/academics/important_dates.html
- Dalhousie Grading Practices Policy
https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

learning and support resources

- General Academic Support – Advising
https://www.dal.ca/campus_life/academic-support/advising.html
- Dalhousie Libraries <http://libraries.dal.ca>
- Copyright Office <https://libraries.dal.ca/services/copyright-office.html>

SLEQs

Student Learning Experience Questionnaires (SLEQs) will occur week 12 – week 13. There is no class these weeks. Please complete them on your own.

¹ For more information about the purpose of territorial acknowledgements, or information about alternative territorial acknowledgements if your class is offered outside of Nova Scotia, please visit <https://native-land.ca/>.

ARCH 5210.03 Life Cycle Analysis

Calendar Description

This course studies the range of environmental impacts associated with building materials and assemblies, from their raw state to the end of their useful life. It considers operating energy, embodied energy and carbon sequestration, with particular attention to the structure and building envelope of wood framed heritage buildings.

Additional Description

The course hangs on the course assignments which when viewed as a collection asks you to use Life Cycle Analysis (LCA) thinking and in particular carbon mitigation strategies to decarbonize the design of a building system (e.g., mechanical, structural, envelope, interior finish) specific to your thesis or a heritage building identified at the beginning of term.

There are four assignments. The first assignment asks you to select a system and also generate a position about how you will deal with the time value of carbon and in particular, the course ideal of negative carbon. The second assignment asks you to complete a set of carbon calculations including embodied carbon and upstream or up-front carbon specific to the system you selected in assignment # 1. The third assignment asks to identify a total life cycle negative carbon strategy for the system. The fourth assignment asks you to create a presentation that includes the appropriate tables, diagrams, drawings and specification of your Ideas Identified in assignments #1 -#3. Ideally, this work could be included in your final thesis presentation.

Learning Objectives

You will gain an understanding of how to use LCA thinking and decarbonization strategies to identify an overall carbon strategy as well as the selection of materials for a building system. The hope is that this course informs your thesis work.

Course Prerequisites

There are no prerequisites for this course.

Schedule

The course will be delivered online. The course starts on Wednesday, January 10 and ends Wednesday, February 15. We meet twice a week, Tuesday afternoon @2:30 - 5:30 and Wednesday morning 9:30am - 12:30pm via the class TEAMS site. You will receive TEAMS invites for both class times before the beginning of term,

Office hours are by prior arrangement.

With the exception of week 2, we will meet twice a week. Tuesdays, with the exception of week 1, will be devoted to what I have called project. During this time, you will present your assignment and we will discuss your work in the context of your thesis or selected heritage building. Consider this time a combination of review and desk crit. Each Wednesday starting in week 1 and ending in week 5 the class will include a lecture about carbon with an emphasis on how to decarbonize a building. Week 6 will be devoted to reviewing and presenting your final presentations. The lecture will include presentations & notes which you can download. The lectures will be recorded.

Class Schedule

Tuesday @ 2:30pm-5:30pm

Wednesday @ 9:30am - 12:30pm

week 1: January 10 (T) project: start-up & LCA thinking
January 11 (W) the time value of carbon & system selection

week 2: January 17 (T) no class

January 18 (W) no class

week 3: January 24 (T) **assignment #1 due**
project: LCA thinking system objectives & carbon analysis review

January 25 (W) decarbonizing buildings 1: carbon calculations

week 4: January 31 (T) **assignment #2 due**
project: carbon calculation review

February 1 (W) decarbonizing buildings 2: strategies

week 5: February 7 (T) **assignment #3 due**
project: negative carbon strategies review

February 8 (W) decarbonizing buildings 3: tables, plans, 1:10 detail and specifications

week 6: February 14 (T) penultimate
project: tables, plans, 1:10 detail & specifications review

February 15 (W) **assignment #4 due**
final presentation

Course References

The course references include several subject areas. There are no required course textbooks, readings, electronic resources equipment or software. Rather, please consider these references as background readings and/or as an entry point into a particular issue you may encounter when completing the assignments or a career resource. The references will be posted on the class Brightspace site whose http address you will receive before the beginning of term.

Expected Time Spent on the Course

Because this course is condensed into the first six weeks of the term, expect to spend an average of 18 hours per week for all course-related activities during these six weeks.

Course Assignment - to be done individually

The assignment has 4 parts. Please read each part before starting work on the assignment. You will note that each assignment builds on the previous one(s).

#1: identify the building system you want to decarbonize (15%)

Identify the building, the building system and the building system's materials that you want to decarbonize. The end point of the assignment set is a 1:10 detail so be aware of this ask and ensure to include all materials that will be included in the 1:10 detail. The building can be one from your thesis or a heritage building identified in the first week of class.

Once identified, pick out to a first order the building's expected operating life span and how many years are required before the projected savings in operating energy and associated reduction in atmospheric carbon emissions compare to the up-front carbon emitted into the atmosphere as a result of the building's construction. Relate this information to the time value of carbon and how your decarbonization strategy works with the "tipping point" - the Intergovernmental Panel on Climate Change's (IPCC) goals of strengthening the "global response to the threat of climate change, sustainable development and efforts to eradicate poverty" due to the impacts of global warming of 1.5°C above preindustrial levels and related global greenhouse gas emission pathways. This question assumes embodied or making carbon is a priority and the point of the question is for you to tell me what you will be doing about upstream carbon with regards to the design and specification of your selected system? I am looking for a "high level" answer to this question. In particular, your understanding of how upstream carbon can impact your system design thinking. Consider the above a scoping exercise and a launch point into assignments #2-#4.

The deliverable for this assignment is a pdf which you will post to the class Brightspace site.

#2: carbon calculations (25%)

This assignment quantifies some of the working assumptions you made in assignment #1.

List all the materials used to make your selected system. Determine each material's upstream or up-front embodied energy, the time the material is storing or keeping carbon from the atmosphere (expected operating life) and your end-of-life material strategy - do you have a strategy to keep carbon stored in the material from the atmosphere once it has reached its end-of-life in the building, or not? Identify any biogenic carbon capture opportunities in the material list as well as the role the system plays in the building's operating carbon budget.

The deliverable for this assignment is a pdf which you will post to the class Brightspace site.

#3: decarbonizing the system: negative carbon (25%)

Based on the findings from assignments #1 & #2, determine where you could achieve the greatest reduction in atmospheric carbon and how you would go about to doing this in terms of your system design. There are several paths you can take in your negative carbon strategy.

You can treat the problem as a "carbon - less" exercise, a carbon status exercise or a carbon removal and storage exercise or some combination of the three. Determine the permeance or "leakiness" of your proposed solution and how this will impact the larger goal of capping global temperature to 1.5°C by 2050.

Two other questions to consider:

1) Please address the question of whether buildings are disposable? Is your design disposable? This question links back to assignment #2. How do you plan to deal with changing planning permission and densification of your site?

2) In any decarbonization strategy, there is the question of demand or need for the building to exist. Recognizing you could be working on your thesis project, please explain your reasons why your building should exist.

Each question asks you to think beyond the immediate. The deliverable for this assignment is a pdf which you will post to the class Brightspace site.

#4: presenting your negative carbon strategy: tables, plans, details & specifications (35%)

Please collate all the information gathered in assignments #1-#3 and put together a presentation about how you plan to "carbon out" your selected building system. A part of this presentation will be a 1:10 detail of your selected system that highlights both what and how you have decarbonized materials, selected the building system's degree of integration regarding adaptability and disassembly, and dealt with the issue of the time value of carbon.

The deliverable for this assignment is a pdf which you will post to the class Brightspace site.

Course Evaluation

Your grade will be based on the results and associated credit weight of the four parts to the assignment. Each part, due at the beginning of class on the assigned due date, is to be done individually. AP will grade the work using the following scale <http://tinyurl.com/dalgrading>

letter grade	numerical (%) equivalent
A+	90 - 100
A	85 - 89
A-	80 - 84
B+	77 - 79
B	73 - 76
B-	70 - 72
F	< 70

Students will receive oral feedback after each assignment is graded. Please see **Due Dates and Late Submissions** below where late assignments are discussed.

Assignment Grading Rubric

A+ The work exceeds expectations. It shows *considerable command* of the required research, argumentation, drawings and writing. The work could be considered publishable in an academic journal.

A The work constitutes excellent graduate work. It shows *command* of the required research, argumentation, drawings and writing. In theory, it could be published, but would need significant revision.

A- The work constitutes very good graduate work. It shows an *understanding* of the required research, argumentation, drawings and writing. The work is not publishable because one or more aspects of the research, argumentation, drawings and/or writing are missing or not developed completely.

B+ The work is good graduate work. It shows a *conditional understanding* of the required research, argumentation, drawings and writing. The work has an identified weakness in one or more areas of research, argumentation, drawings and/or writing.

B The work is satisfactory graduate work. It shows a *satisfactory understanding* of the required research, argumentation, drawings and writing. The work has substantial weaknesses in one or more areas of research, argumentation, drawings and/or writing.

B- The work is passable graduate work. It shows a *minimal understanding* of the required research, argumentation, drawings and writing. The work has considerable weaknesses and/or errors in one or more areas of research, argumentation, drawings and/or writing.

F Work is absent or the work is not passable graduate work. It shows a substantial and significant weaknesses including errors in research, argumentation, drawings and writing.

Due Dates and Late Submissions

Deductions for late submissions encourage time management and maintain fairness among students.

	Due date	Is a late assignment accepted?	If so, what is the deduction per weekday? *	Is there a final deadline for a late submission?	What happens after that?
Assignment 1	January 24	yes	3%	January 31	receives 0% and no comments
Assignment 2	January 31	yes	3%	February 7	receives 0% and no comments
Assignment	February 7			February 14	
Assignment 3	February 15	no	n/a	no	receives 0%

* For example, if an assignment is evaluated at 75% before applying a 3%-per-weekday deduction, it would receive 72% for being 1–24 hours late; 69% for 25–48 hours late; etc.

Note:

The following University or School policies take precedence over course-specific policies:

- No late assignments are accepted after the last day of weekly classes (the Friday before review week).
- With a Student Declaration of Absence (maximum two per course), an assignment may be submitted up to three weekdays late without penalty. An SDA cannot be used for the final assignment.
- With a medical note submitted to the School office, a course assignment (including a final assignment) may be submitted more than three weekdays late without penalty. The number of weekdays depends on how long you were unable to work, as indicated in the medical note. If more than one course is affected, you should consult with the Undergraduate/Graduate Coordinator to set a new schedule of due dates.
- A student with an accessibility plan that allows for deadline extensions does not need to submit an SDA.

If you need to complete a Student Declaration of Absence form, <https://cdn.dal.ca/content/dam/dalhousie/pdf/campuslife/Health%20and%20wellness/FINAL%20Student%20Declaration%20of%20Absence%20Form.pdf> please submit it to me via email. AP will grade the work using Dalhousie University’s Graduate course grade scale according to how the work compared to the Grade Rubric.