Dalhousie University - School of Architecture

ARCH 5223.03: Net-Positive Architecture

Course Outline – Summer 2024

Instructors: Jennifer Corson (primary) (jennifer@solterre.com), Keith Robertson (keith@solterre.com), David Gallaugher (david@solterre.com)
Room and time: TBA
Office hours: TBA
Brightspace: dal.brightspace.com

ACADEMIC INFORMATION

Calendar Description

This course focuses on ecological and socially beneficial net-positive architecture, from the first stage of an integrated analysis to final design details. It also examines international strategies for low-energy building; passive systems in ventilation, heating, and cooling; renewable energy systems; and the integration of engineering systems into architectural design.

Additional Course Description

This course introduces the core principles of creating architecture that is “net-positive,” a growing body of work that attempts to lessen the impact of buildings on the planet. These principles are related to the entire process of design.

Learning Objectives

- gain knowledge of green-building systems, strategies, and assemblies with case studies of Net-Zero and Net-Positive architecture
- learn decision-making matrix for greening building assemblies, materials and systems
- test the impact of material and system choices within a design project (M1 Design)
- learn and critically evaluate green building evaluation tools and building certification programs
- gain knowledge of the impact of material and system choices within a design project (M1 Design)
- gain the ability to use green design strategies as drivers for design concepts
- learn early design modelling tools for daylighting, energy, and material impacts (life-cycle assessment)

Integration with Other Courses

This course may be co-requisite with a design studio course.

Class Format

Classes will consist of lectures, site tours and student-led presentations. All classes will be in-person; attendance is expected. Lecture slides will be posted on Brightspace.

Weekly Hours

For this 3-credit-hour course, an average of 9 hours per week is expected for all course-related activities, including classes. If most students are spending substantially more time, please notify the instructors.

Topics

a) Net-Positive - Context
From early forms of carbon-based energy production to current renewable energy options, the historical use of energy will be presented and discussed.

b) Net-Positive – Conceptual Design
Following emerging green design principles, students will understand how early design decisions will influence building performance and obtain the skillset to implement systems to achieve net-positive buildings.

c) Net-Positive – Detailed Design
Daylighting strategies and the impact that they have on the building will be studied. Techniques to deliver high-performance buildings with consideration for water efficiency, material efficiency and energy consumption will be covered.

d) Net-Positive – Construction
Materials selection, building assembly and the environmental impact of this choice will be reviewed with emphasis on local climate, durability, appropriate technologies and life cycle consideration. Methods to analyse the effectiveness of reuse, recycling, salvage, deconstruction vs. demolition will be discussed. All students will undertake a simple whole-building life-cycle assessment exercise using software such as Athena Impact Estimator.

e) Net-Positive – Verification
A review of current assessment programs, including LEED, Green Globes, Living Building Challenge and Passive House, will be covered. These programs are an industry standard to achieving third-party verification and qualification for design projects and will be critically assessed with respect to the Net-Positive Architecture topics covered in this course.

Tours
This course and its co-requisite course will include several tours. The first tour will include an assessment of topography, solar exposure, climate conditions, and local economy in Blue Rocks, Nova Scotia. The second tour may include a boat trip to Eastern Points Island, near Blue Rocks. The third tour will include new construction and renovation projects that have a Net Zero and/or near zero impact on our built environments.

Travel Requirement
For off-campus travel, each student must download the Faculty's travel form from https://tinyurl.com/dal-travel-form, fill it in, and submit it to the School office before leaving.

Schedule

Week	Date	Topics and Events	Assignment Introductions and Due Dates
1	May 9	**Net-Positive Architecture, Net-Positive Context** Tour: Design site / tour	
2	May 16	**Net-Positive – Design** Lecture: Net-Zero, energy sources	Assignment 1 intro: Energy Modeling
3	May 23	**Net-Positive – Natural Light** Impact: Daylighting techniques, water efficiency	Due: Assignment 1 Assignment 2 intro: Daylighting

4	May 30	**Net-Positive – Materials** Material selection and impact; salvage and reuse; dismantling, local materials	Due: Assignment 2. Assignment 3 intro: Whole Building Life Cycle Assessment
5	June 6	**Net-Positive – Detailed Design** Site tour, boat/kayak	Due: Assignment 3. Assignment 4 intro: Technical Report
6	June 13	**Net-Positive – Low Carbon Envelope and Detailing** Lecture 1	Assignment 5 intro: Whole Building Section
7	June 20	**Net-Positive – Low Carbon Envelope and Detailing** Lecture 2	
8	June 27	Studio reviews (co-requisite course) Presentation of Assignment 4	Due: Assignment 4.
9	July 4	**Net-Positive – Integration** Presentation of Assignment 5 Studio reviews (co-requisite course)	Due: Assignment 5.
10	July 11	Studio reviews (co-requisite course) SLEQ	
11	TBA	Final design presentation	

Assignments

All assignments are done individually.

Assignment 1: Energy Modelling
The first design moves are often the most impactful for a building's energy use. This exercise will use "Matchbox" software to analyze energy performance of a simple model of their own design. The assignment will assess the impact of massing, envelope performance, and energy systems on overall energy use. Grading will be based on how effectively the student assesses design iterations to achieve a desired energy target.

Assignment 2: Daylight Simulation
The environmental benefits of harnessing natural light include reduced energy consumption, lower carbon emissions, and improved occupant well-being. Through this assignment, students gain hands-on experience using "Lightstanza" software. Students will create and analyze daylight of a simple model of their own design. The assignment will be graded on the creativity of the design, and the effectiveness of the daylighting strategies along with awareness and control of potential glare.

Assignment 3: Whole Building Life Cycle Assessment
As energy performance gets closer to net-zero operational energy, the materials in the building become the most significant impact of the building's life-cycle. Students will use "Athena Impact Estimator" to analyze two alternatives for the foundation, structure, and envelope of a simple design. Grades will be based on the thoughtfulness of the options assessed, and the overall impact of the selected design.

Assignment 4: Green Systems Technical Report

As a continuation from course lectures, students will research and prepare a technical report on a specific green building material, assembly or system relevant to their design studio project. The report will be presented to the class.

Possible topics in include:

- Water (collection, treatment, re-use, stormwater)
- Waste (collection, conveyance, treatment, re-use/disposal)
- Energy (Heating/cooling, Renewable energy systems, Passive systems)
- Daylighting (quantify, glare control, glazing performance.)
- Life-cycle material analysis
    - New construction
    - Salvaged/reused/buildings and components
- Innovative products or processes

The media and format of the report should be chosen to clearly convey the information analysed. This may be a different system than the one presented in Assignment 3: Whole Building Section/Model.

Students are to present to the class in a 5–10-minute presentation, along with appropriate models, drawings, simulation, and/or calculations.

Assignment 5: Whole Building Section/Model

Students will individually develop a whole building section or model that focuses on a system from their final design studio project in the co-requisite design course. This work will integrate "net-positive" system strategies into floor, wall, roof assemblies and the overall site. Possible systems could include:

- Envelope and structure
- Water (collection, heating, treatment, reuse, storm water, storm surge)
- Waste (solid, human)
- Heating/cooling
- Ventilation
- Renewable energy systems
- Passive systems

The media and scale of the Whole Building Section/Model should be chosen to clearly convey the system information. This may be a different system than the one researched in Assignment 4: Green Systems Technical Report. This section/model will also be shown at the final studio review in the co-requisite design course, but will not be considered in the evaluation for that course.

Class Attendance and Participation

All classes are in-person. Students are expected to attend all classes and contribute to discussions. For a necessary absence or missed due date, a Student Declaration of Absence should be e-mailed to one of the instructors.

Format and Submission of Assignments

Submissions will require sketched and technical details, computer simulation outputs, technical report writing and a presentation summary.

All assignments will be submitted through Brightspace. They will be due at the beginning of the class on the assigned date, although work should stop at 12:00 midnight before each assignment deadline. There are no acceptable excuses for not presenting work due to digital media issues.

Required References

Bere, Justin. 2014. *An Introduction to Passive House*. London: RIBA.
Berger, Alan. 2009. *Systemic Design Can Change the World*. Amsterdam: Sun Architecture.
Gorgolewski, Mark. 2018. *Resource Salvation: The Architecture of Reuse*. Hoboken, NJ: Wiley.
Liljequist, Brad. 2016. *The Power of Zero*. Portland: Ecotone.
McDonough, William, and Michael Braungart. 2013. *The Upcycle*. New York: Farrar, Straus and Giroux.
Straube, John. 2012. *High Performance Enclosures*. Somerville, MA: Building Science Press.

Instructors also will assign readings, tutorials, and articles from online resources.
https://app.lightstanza.com/
https://matchboxenergy.com/
https://www.athenasmi.org/our-software-data/impact-estimator/
https://www.architecture2030.org/
https://www.2030palette.org/
https://www.buildingscience.com
https://www.buildinggreen.com
https://www.rmi.org/our-work/buildings/scaling-zero-net-carbon/rmi-innovation-center/
https://www.powerhouse.no/en/prosjekter/powerhouse-drobak-montesorri/
https://www.living-future.org/lbc/
https://foursevenfive.ca/

Required Materials and Travel Expenses

- Access to computer and internet for simulation and modelling.
- Access to 3D building modelling software such as Revit or Sketchup

Two classes will be off-site at building locations that demonstrate net-positive architecture and technologies. Cost to travel to these locations (within 1 hour of the School of Architecture) is the responsibility of the student.

- Travel expense: Transportation to the Blue Rocks and Lunenburg vicinity
- Kayak rental: Pleasant Paddling, Blue Rocks. Estimate $160.

ASSESSMENT

Assignments will be evaluated by the instructors. Letter grades for individual assignments will be converted to their mid-point percentage, multiplied by their percentage weight, added, then converted to a final letter grade for the course.

Assignment 1: Energy Modelling (10%)

This grade component is based on:

- assessment of early design moves on the energy performance of a building
- ability to convey an understanding of this assessment

Assignment 2: Daylight Simulation (10%)

This grade component is based on:

- development of creative daylight solutions
- ability to assess the achievement of accepted daylight design parameters

Assignment 3: Whole Building Life Cycle Assessment (10%)
This grade component is based on:

- ability to analyze the environmental impact of a building's envelope, structure, and foundation systems
- ability to compare analyses of environmental impact

Assignment 4: Green Systems Technical Report (30%)
This grade component is based on:

- effectiveness/assessment of environmental benefit (30%)
- clarity of research (20%)
- application/integration to design project (20%)
- innovation (20%)
- oral presentation (10%)

Assignment 5: Whole Building Section/Model (30%)
This grade component is based on:

- drawing quality (30%)
    - notation
    - clarity
    - line weight
- building envelope detailing (40%)
    - thermal barrier
    - moisture barrier
    - air barrier
    - vapour barrier
    - structural integration
    - material selection
- integrating systems/technology (30%)

Class Participation (10%)
This grade component is based on individual contributions to group discussions of topics and student assignments during classes and field trips throughout the term. The evaluation criteria are:

- depth of understanding of topics
- thoughtful, timely, and constructive responses
- clear oral expression.

Graduate Grade Standards for the Course

Letter	Grade point	Percent	Definition
A+	4.3	90–100%	
A	4.0	85–89%	
A–	3.7	80–84%	
B+	3.3	77–79%	
B	3.0	73–76%	
B–	2.7	70–72%	
F	0.0	0–69%	
INC	0.0		Incomplete
W	neutral; no credit obtained		Withdrew after deadline
ILL	neutral; no credit obtained		Compassionate reasons, illness

Other, exceptional grades are noted in the graduate calendar.

Grading Format
Grades for individual assignments will be returned either directly to the student during class time or sent by email. Final grades will be issued as per Dalhousie protocol.

Calculation of Final Grades
Letter grades for individual assignments will be converted to their mid-point percentage, multiplied by their weight, added, then converted to a final letter grade.

COURSE-SPECIFIC POLICIES

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	May 23	yes	3%	June 15	receives 0% and no comments
Assignment 2	May 30	yes	3%	June 15	receives 0% and no comments
Assignment 3	June 6	yes	3%	June 15	receives 0% and no comments
Assignment 4	June 27	yes	3%	July 11	receives 0% and no comments
Assignment 5	July 4	no			receives 0% and no comments

* 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.

Citations

All references and source material must be cited properly, using Chicago Manual of Style: Author-Date Style. For details, see:

Chicago quick guide: https://tinyurl.com/quick-author-date
Chicago Manual full guide: https://tinyurl.com/full-author-date

Plagiarism software will not be used to check assignments.

Recordings

Students who wish to record a presentation or discussion must obtain approval from everyone present.

FACULTY POLICY

Equity, Diversity and Inclusion

The Faculty of Architecture and Planning is committed to recognizing and addressing racism, sexism, xenophobia 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 STATEMENTS

Territorial Acknowledgement

The Dalhousie University Senate acknowledges that we are in Mi’kma’ki, the ancestral and unceded territory of the Mi’kmaq People and pays respect to the Indigenous knowledges held by the Mi’kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people. The Dalhousie University Senate also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Internationalization
At Dalhousie, “thinking and acting globally” enhances the quality and impact of education, supporting learning that is “interdisciplinary, cross-cultural, global in reach, and oriented toward solving problems that extend across national borders.”

Academic Integrity
At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect. As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Accessibility
The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion please contact the Student Accessibility Centre (for all courses offered by Dalhousie with the exception of Truro). Your classrooms may contain accessible furniture and equipment. It is important that these items remain in place, undisturbed, so that students who require their use will be able to fully participate.

Conduct in the Classroom – Culture of Respect
Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect
Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2).

Code of Student Conduct
Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don’t follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can’t be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Fair Dealing Policy
The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie.

UNIVERSITY POLICIES, GUIDELINES, AND RESOURCES FOR SUPPORT

Dalhousie courses are governed by the academic rules and regulations set forth in the Academic Calendar and the Senate.

- https://academiccalendar.dal.ca/catalog/viewcatalog.aspx
- https://www.dal.ca/dept/university_secretariat/university_senate.html

University Policies and Programs

- Important Dates in the Academic Year (including add/drop dates)
  - https://www.dal.ca/academics/important_dates.html
- Classroom Recording Protocol
  - https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-protocol.html
- Dalhousie Grading Practices Policy
  - https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html
- Grade Appeal Process
  - https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html
- Sexualized Violence Policy
  - https://www.dal.ca/dept/university_secretariat/policies/human-rights---equity/sexualized-violence-policy.html
- Scent-Free Program
  - https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html

Learning and Support Resources

- Academic Support - Advising https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html
  - https://www.dal.ca/campus_life/academic-support/advising.html
- Student Health & Wellness Centre
  - https://www.dal.ca/campus_life/health-and-wellness.html
- On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond)
  - https://www.dal.ca/campus_life/academic-support/On-track.html
- Indigenous Student Centre and Indigenous Connection
  - https://www.dal.ca/campus_life/communities/indigenous.html
  - https://www.dal.ca/about-dal/indigenous-connection.html
- Elders-in-Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit the office in the Indigenous Student Centre or contact the program at elders@dal.ca or 902-494-6803.
- Black Student Advising Centre
  - https://www.dal.ca/campus_life/communities/black-student-advising.html
- International Centre
  - https://www.dal.ca/campus_life/international-centre.html
- South House Sexual and Gender Resource Centre
  - https://southhousehalifax.org/about-us
- LGBTQ2SIA+ Collaborative
  - https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-collaborative.html

- Dalhousie Libraries
    - https://libraries.dal.ca/
- Copyright Office
    - https://libraries.dal.ca/services/copyright-office.html
- Dalhousie Student Advocacy Service (DSAS)
    - https://www.dsu.ca/dsas
- Dalhousie Ombudsperson
    - https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html
- Human Rights & Equity Services
    - https://www.dal.ca/dept/vpei.html
- Writing Centre
    - https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html
- Study Skills/Tutoring
    - https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Safety

- Faculty of Architecture and Planning: Work Safety
    - https://www.dal.ca/faculty/architecture-planning/current-students/inside-building/work-safety.html

20 March 2024