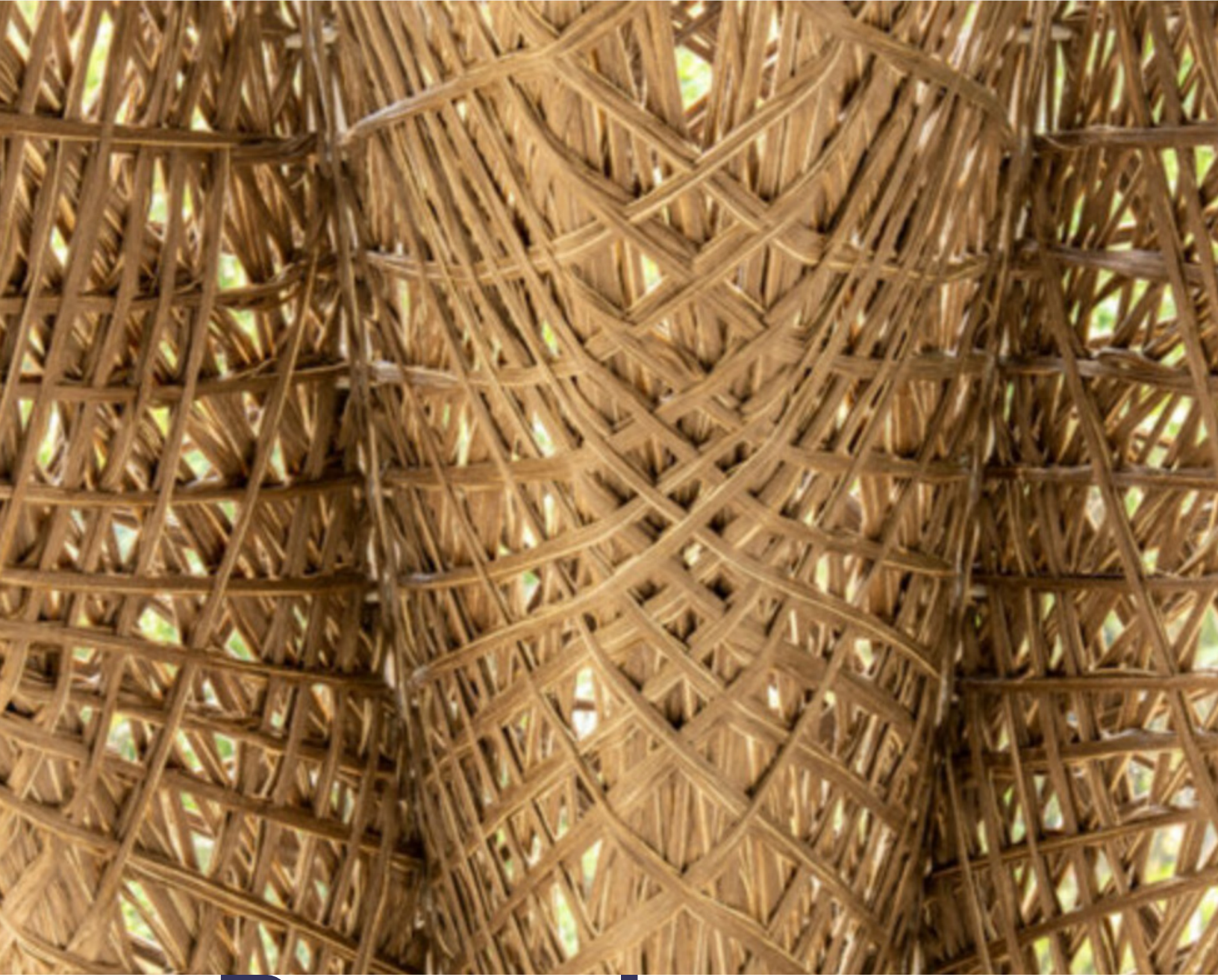


Beyond Extraction

Material investigations for a post-carbon future

ARCH 5013 Design-Build Studio
Dalhousie School of Architecture
Fall 2024 Monday, Thursday, 2:00–5:30, 1202
James Forren (james.forren@dal.ca)
Office hours: Tuesday, 1:00–2:00

July 30, 2024

Fologram, bricklaying with augmented reality.

Calendar Description

This field-based studio develops architectural abilities in the realization of building innovation. It emphasizes tools and processes that professionals need for detailed design development. It focuses on prototypes for building systems such as structures, processes, and materials.

Additional Course Description.

In this studio students will develop design propositions from a deep consideration of material properties and technological potentialities.

They will also learn principles and methods of sustainable design (balancing assessments of embodied carbon and global warming potential with requirements for structural, environmental, and social performance) and digital design and construction.

This course will expand the research-based ARCH 6209 Material Investigations course, ‘Beyond Extraction’, and draw on ongoing research in the Material, Body, Environment Laboratory to address design-build agendas with bio-based materials and computationally informed construction processes. Students will develop material-based design research capacities integrating research in:

Material Cultures (https://materialcultures.org/planting-buildings/)

- bio-based materials and
- building production technologies of CNC manufacture

The course is organized Two Stages:

1. Material Research
   - In-class practicums for production and testing of material specimens
   - Student selection of material and technology (additive manufacture, mold casting) for producing and testing material specimens
2. Design Proposal
   - In-class practicums on design methodologies (morphogenetic design, material-driven design, parametric design)
   - Design and production of a full-scale assembly, mock-up, or prototype

Research in ARCH 6209 Material Investigations will support a proposal for a landscape, structural, enclosure, or finish assembly through models,

Living Building Material (LBM) specimen (top); Additive manufactured biopolymer binder-aggregate composite specimens. Esther Fu, Gabriel Malo, Rodrigo Guerreiro, image from " Strategies for reducing your project's embodied carbon" (Build Green Atlantic, 2023).

physical specimens, drawings, and/or diagrams at a scale, scope and modality (model, drawings, prototypes) of their choice. This is intended to prepare students for graduate-level materials research in Thesis. The outcomes of the research will be formatted for publication and / or exhibit.

This is a new construction paradigm for architects to consider, where we can tune material attributes in relation to desired environmental and performance outcomes. Guests from architecture and other industries will supplement lectures and readings.

Learning Objectives

1. Prepare a design research framework for masters-level coursework and thesis.
2. Enact design methodologies for materials in masters-level coursework and thesis, including:
    - ability in tactics and strategies for conventional and novel means and methods of construction
    - awareness of work with engineers, manufacturers, and other professionals
    - awareness of work with researchers in other disciplines
    - understand requirements of regulating bodies and authorities having jurisdiction
3. Deploy disruptive strategies and tactics for material driven design, including:
    - prioritizing local economies and feedstocks
    - addressing bio-based and byproduct material issues and strategies

Rationale for the Course.
This course is intended to prepare students for material-based research in masters-level coursework and thesis.

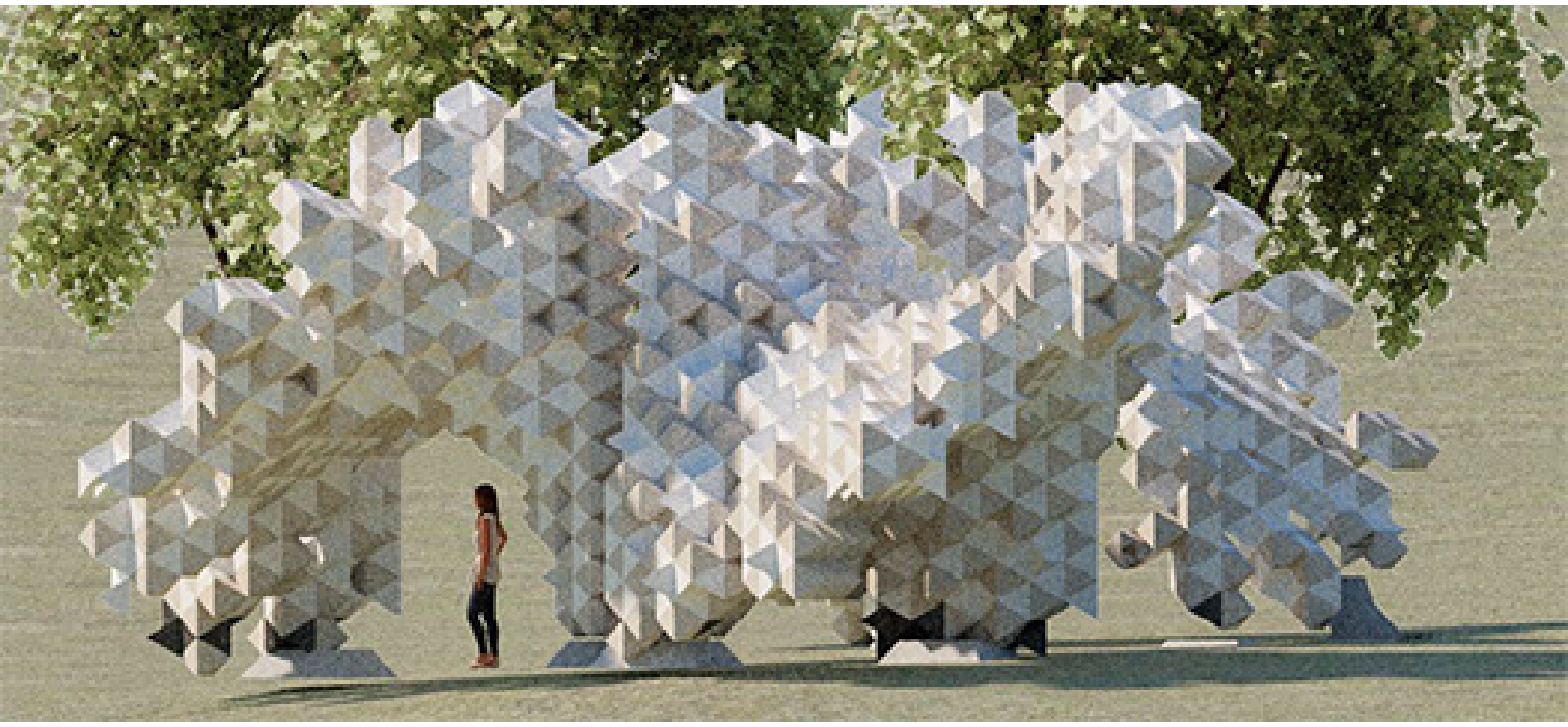
Class Format.
lectures, workshops, seminars, tutorials, reviews, site visits

Weekly Hours.
For this 6-credit-hour course, an average of 18 hours per week is expected for all course-related activities, including classes. If most students are spending substantially more time, please notify the instructor.

Material Cultures (https://materialcultures.org/planting-buildings/)

ARCH 5013 & ARCH 6209 Schedule

	Wk	Date	ARCH 5013 (M)	ARCH 6209 (Th)	ARCH 5013 (Th)	Due
A. MATERIAL RESEARCH	1	**Sept 9 to 13**	Materials: Flax, Biochar, 3DP Concrete, Mycellium (w Precedent Review) **5013-1 Assigned** **5013-2 Assigned**	1 Material Driven Design: Intrinsic (Precedent Selection & Team Selection) **Practicum 1** **6029-1 Assigned** **6029-3 Assigned**	A Material Driven Design: Extrinsic	
	2	**Sept 16 to 20**	Team Project Meetings	2 Global Warming Potential (GWP) & Life Cycle Analysis (LCA) **Practicum 2**	B Bio-Material Construction Taxonomy **Reading Discussion 1**	**5013-1.1**
	3	**Sept 23 to 27**	Researchers Introduction	3 Material Specimen Production **Practicum 3**	C **Precedent Study Due** Prototyping 1 Design Brief **5013-3 Assigned** **5013-4 Assigned**	**5013-2**
B. DESIGN PROPOSAL: PROTOTYPE 1	4	**Sept 30 to Oct 4**	**No Class**	Parametric Tools: Morphology **Practicum 4** **Research Dossier Draft Due**	D Virtual & Physical Prototyping: Overview	**6029-1**
	5	**Oct 7 to 11**	Virtual & Physical Prototyping: Methods	Parametric Tools: Simulation **Practicum 5**	Project Discussion	
	6	**Oct 14 to 18**	**No Class**	4 Parametric Tools: Fabrication **Practicum 6**	E Project Discussion **Reading Discussion 2**	**5013-1.2**
	7	**Oct 21 to 25**	Exhibition Introduction	Project Workshop	F Project Discussion	
	8	**Oct 28 to Nov 1**	**Mid-Review** **Prototype 1 Due**	Project Discussion	Design Brief Prototype 2 **5013-3 Assigned**	**5013-3**
C. DESIGN PROPOSAL: PROTOTYPE 2	9	**Nov 4 to 8**	Researcher Meetings	5 Project Workshop **6029-4 Assigned**	G Project Discussion **Reading Discussion 3**	**5013-1.3**
	10	**Nov 11 to 15**	*Reading Week (No Class)*			
	11	**Nov 18 to 22**	Exhibit Preparation	Project Workshop	Project Discussion	
	12	**Nov 25 to 29**	SLEQ & Project Workshop	Project Workshop **Research Dossier Final Due**	Project Discussion	**6029-2**
	13	**Dec 2 to 6**	Project Workshop	Project Workshop **Exhibit Due**	Project Discussion	**6029-4**
	14	**Dec 9 to 13**	**No Class**	**Final Review W, Th, or F** **Exhibit Installation** **Prototype 2 Due** **Drawings Due**		**5013-4, 5**



Rita Wang, Equilateral four-sided pyramid packing structure of degradable (brown) and structural (white) composite blocks. Image from “Soft Rock Studio” (Building Technology Educator’s Society 2021, 2021)

Required References [Draft]
Required readings will be uploaded to Brightspace. The following references are available through the library.

Block, Philippe, Cristián Calvo Barentin, Francesco Ranaudo, and Noelle Paulson. “Imposing challenges, disruptive changes: rethinking the floor slab.” *The materials book: inspired by the 6th lafargeholcim foundation* 67 (2019).

Brand, Stewart. *How buildings learn: What happens after they’re built*. Penguin, 1995.

Dahmen, Joseph. “Soft futures: mushrooms and regenerative design.” *Journal of Architectural Education* 71, no. 1 (2017): 57-64.

De Wolf, Catherine Catherine Elvire Lieve. “Material quantities in building structures and their environmental impact.” PhD diss., Massachusetts Institute of Technology, 2014.

De Wolf, Catherine Catherine Elvire Lieve. “Low carbon pathways for structural design: embodied life cycle impacts of building structures.” PhD diss., Massachusetts Institute of Technology, 2017.

Fernandez, John. *Material architecture*. Routledge, 2012.

Forren, James. “Soft Rock Studio: Exploring a “Soft Systems” Approach to “Artificial Rock”.” *Building Technology Educator’s Society 2021*, no. 1 (2021): 14.

Forren, James. “Material as Common Good: Feedstock Valorization in Building Materials Using Biochar as a Case Study.” *The Plan Journal: The Good Material*, no. 2 (2021).

Ingold, Tim. *Making: Anthropology, archaeology, art and architecture*. Routledge, 2013.

King, Bruce. *The new carbon architecture: building to cool the climate*. New Society Publishers, 2017.

King, Bruce, and Chris Magwood. *Build Beyond Zero: New Ideas for Carbon-smart Architecture*. Island Press, 2022.

Lewis, Paul, Marc Tsurumaki, David J. Lewis. *Manual of Biogenic House Sections: Materials and Carbon*. ORO Editions, 2022.

Magwood, Chris. *Making better buildings: a comparative guide to sustainable construction for homeowners and contractors*. New society publishers, 2014.

Magwood, Chris. “Opportunities for Carbon Dioxide Capture and Storage in Building Materials.” Trent University, 2019.

Material Culture and Amica Dall. *Material Reform: Building for a Post-Carbon Future*. Mack, 2023.

Mockford, Kevin, Laure Nolte, Preston Stronach, and James Forren. “Sky Pillar: Characterization and prototyping of biochar-cement composites”. In Post-Carbon: CAADRIA 2022. *International Conference for The Association for Computer-Aided Architectural Design Research in Asia (CAADRIA)*, 2022. https://caadria2022.org/projects/sky-pillar-characterization-and-prototyping-of-biochar-cement-composites/

Oxman, Neri. *Neri Oxman: Material Ecology*. The Museum of Modern Art, 2020.

Simonen, Kathrina, Barbara X. Rodriguez, and Catherine De Wolf. “Benchmarking the embodied

carbon of buildings." *Technology| Architecture+ Design* 1, no. 2 (2017): 208-218.

Tsing, Anna Lowenhaupt. *Friction: An ethnography of global connection*. Princeton University Press, 2011.

Optional References [Draft]

Barentin, Cristián Calvo, Ioannis-Athanasios Zornatzis, Gnanli Landrou, Thibault Demoulin, Guillaume Habert, and Philippe Block. "When low strength materials meet funicular structures: a sustainable clay floor structure solution for emerging contexts." In *IOP Conference Series: Earth and Environmental Science*, vol. 588, no. 4, p. 042024. IOP Publishing, 2020.

Bennett, Jane. V*ibrant matter: A political ecology of things.* Duke University Press, 2010.

Ching, Francis DK. *Building construction illustrated*. John Wiley & Sons, 2020

Dahmen, Joseph, Juchan Kim, and Claudiane M. Ouellet-Plamondon. "Life cycle assessment of emergent masonry blocks." *Journal of cleaner production* 171 (2018): 1622-1637.

Kayaçetin, Nuri Cihan, and Ali Murat Tanyer. *Embodied carbon in buildings: Measurement, management, and mitigation*. 2018.

Myers, Lynn, "Robotically wound flax fiber builds a 'bioinspired' pavilion in freiburg, germany". Designboom. https://www.designboom.com/architecture/robotically-wound-flax-fiber-livmats-pavilion-freiburg-07-19-2021/. Accessed June 30, 2023.

Fu, Esther. "Building with Biomaterials." Dalhousie University, 2023.

Gonchar, Joanne. "Neri Oxman's 'Material Ecology' Exhibition at MoMA Illuminates and Inspires". Architectural Record. April 6, 2020. https://www.architecturalrecord.com/articles/14545-neri-oxmans-material-ecology-exhibition-at-moma-illuminates-and-inspires

Kimmerer, Robin. *Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants*. Milkweed editions, 2013.

Korol, Larissa. "Biofiberous Potentialities: Cultivating, Experimenting and Scaling Biological Fibre Materials in Architecture." Dalhousie University, 2023.

Kwinter, Sanford. "Soft systems." *Culture Lab* 1 (1993): 208-227.

Nolte, Laure. "On Light and Matter: Structural Optics of Biomaterials." Dalhousie University, 2023.

"Vault construction process photos". Esther Fu, image from Building with Biomaterials (Dalhousie 2023)

ASSESSMENT
Components and Evaluation

	Assignment	Weight	Type	Authorship	Evaluated by
5013-1	Reading Discussion	15%	Letter	individual	instructor
5013-2	Precedent Analysis	15%	Letter	individual	instructor
5013-3	Prototype 1	25%	Letter	individual or group	instructor
5013-4	Prototype 2	25%	Letter	individual or group	instructor
5013-5	Drawings	20%	Letter	individual	instructor

Components that are Required but not Assessed
Students must have updated WHMIS certification. Depending on nature of individual material investigation, respirator fit-testing may be required.

Field trips to local farms, manufacturers, or other related sites are required.

Guidelines for Citing Sources
Chicago Manual of Style: Author-Date Style. For details, see:

Chicago quick guide: http://tinyurl.com/chicago-quick-guide

Chicago Manual full guide: http://tinyurl.com/chicago-full

Format for Assignments
See assignment description.

Submission of Assignments
See assignment description.

Criteria and Standards for Assessment
See assignment description.

University Standards for Individual Assignments

Letter	Percent	Definition	Description
A+	90–100%	Excellent	Considerable evidence of original thinking; outstanding capacity to analyze and synthesize; outstanding grasp of subject matter; evidence of extensive knowledge base.
A	85–89%		
A–	80–84%		

Letter	Percent	Definition	Description
B+	77–79%	Good	Evidence of grasp of subject matter, some evidence of critical capacity and analytical ability; reasonable understanding of relevant issues; evidence of familiarity with the literature.
B	73–76%		
B–	70–72%		
C+	65–69%	Satisfactory	Evidence of some understanding of the subject matter; ability to develop solutions to simple problems.
C	60–64%		
C–	55–59%		
D	50–54%	Marginal pass	Evidence of minimal familiarity with the subject matter; minimal analytical and critical skill.
F	0–49%	Fail	Little evidence of understanding of the subject matter; weakness in analytical and critical skills; limited or irrelevant use of the literature.
INC		Incomplete	(counts as zero in GPA calculation)
W		Withdrew after deadline	(neutral in GPA calculation)
ILL		Compassionate reasons, illness	(neutral in GPA calculation)

In a graduate course, a final grade below B– will be recorded as an F.

Calculation of Final Grades
Percentage grades will be multiplied by their weight, added, then converted to a final letter grade.

Grading Format
Assignment evaluations will be issued to students as grades, written comments, and/or oral comments.

Material Cultures (https://materialcultures.org/planting-buildings/)

COURSE-SPECIFIC POLICIES
Due Dates and Late Submissions

	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?
5013-1	Sept 19, Oct 17, Nov 7	No	n/a	n/a	n/a
5013-2	Oct 12	Yes	3%	no	n/a
5013-3	Nov 9	Yes	3%	no	n/a
5013-4	Nov 30	Yes	3%	no	n/a
5013-5	Dec 7	No	n/a	n/a	n/a

* 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.

Academic Integrity
Instructor may use plagiarism software to check written assignments.

Lecture Notes or Recordings
Students may record lectures.

Field trip sites
Possible field trip sites include:

Tap root (https://taprootfarms.ca/)

Deanery (https://thedeaneryproject.com/)

Elmsdale lumber (https://www.elmsdalelumber.ca/)

RDA Atlantic (https://www.rdaatlantic.com/)

Strescon limited (https://oscoconstructiongroup.com/strescon/)

Halifax Water

Sky Pillar installation at the Deanery Project. James Forren, image from "Sky Pillar" (CAADRIA, 2022)

Facilities
Facilities at Dalhousie which may be accessed for course:

Light Prototyping Lab (https://virtualtour.dal.ca/dal/engineering-/chorus-aviator-light-prototyping-lab)

Design Lab (https://virtualtour.dal.ca/dal/engineering-/2005-design-lab)

Heavy Prototyping Lab & Central Shops (https://virtualtour.dal.ca/dal/engineering-/central-shops)

Light structures testing lab

Heavy structures testing lab

SEM (https://www.dal.ca/dept/ctri/research-areas/fmc/technique.html)

Researcher labs
Affiliated research labs and centres who may speak with us about their work.

CWRS (https://centreforwaterresourcesstudies.dal.ca/)

Mapel (Oceanography) (https://www.dal.ca/faculty/science/oceanography/people/faculty/hugh-macintyre.html)

Structural Assessment and Retrofit (SAR) Research Group (https://www.dal.ca/sites/sar/about.html)

Canada Research Chair in Sustainable Infrastructure (https://www.dal.ca/faculty/engineering/research/research-chairs/crc-sustainable-infrastructure/about.html)

UNB Off site construction Centre (https://www.unb.ca/ocrc/)

Verschuren Centre (https://www.verschurencentre.ca/)

Flaxmobile (https://nscad.ca/nscad-professor-jennifer-greens-flaxmobile-project-receives-support-from-research-nova-scotia/)

Software Applications
While students are expected to have working knowledge of Rhino and Grasshopper in alignment with their previous BEDS coursework, the course instructor is a researcher in computation and design and

will offer practica on relevant platforms, as well as fabrication technologies. Students are expected to utilize and engage critically with digital technologies in their coursework. Floating lab licenses for Rhinocerous will be made available to all enrolled students.

Below are a list of some Grasshopper for Rhino plug-ins that may be of use.

Fologram, Rhinovault, Karamba, Galapagos, Octopus

LCA in Rhino

https://nomadarchitects.lv/lca-in-rhino

https://www.oneclicklca.com/parametric-and-generative-carbon-optimisation/

https://res.cloudinary.com/patternbuildings/image/upload/v1615456641/tutorials/paper_on_GH_tools_c0m9ge.pdf

Four meter span prototype. Block Research Group, Image from “When low strength materials meet funicular structures” (IOP Publishing, 2020)

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 POLICIES AND RESOURCES

This course is governed by the academic rules and regulations set forth in the University Calendar and the Senate. For university regulations, go to https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=82&chapterid=4741&loaduseredits=False.

A. University Statements

Academic Integrity
http://www.dal.ca/dept/university_secretariat/academic-integrity.html
At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). 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. Read more: https://www.dal.ca/content/dam/dalhousie/pdf/dept/university_secretariat/Syllabus_Statement_(Aug%202015).pdf

Accessibility
The Student Accessibility Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of: a disability, religious obligation, or any barrier related to any other characteristic protected under Human

Rights legislation (NS, NB, PEI, NFLD). Read more: https://www.dal.ca/campus_life/academic-support/accessibility.html

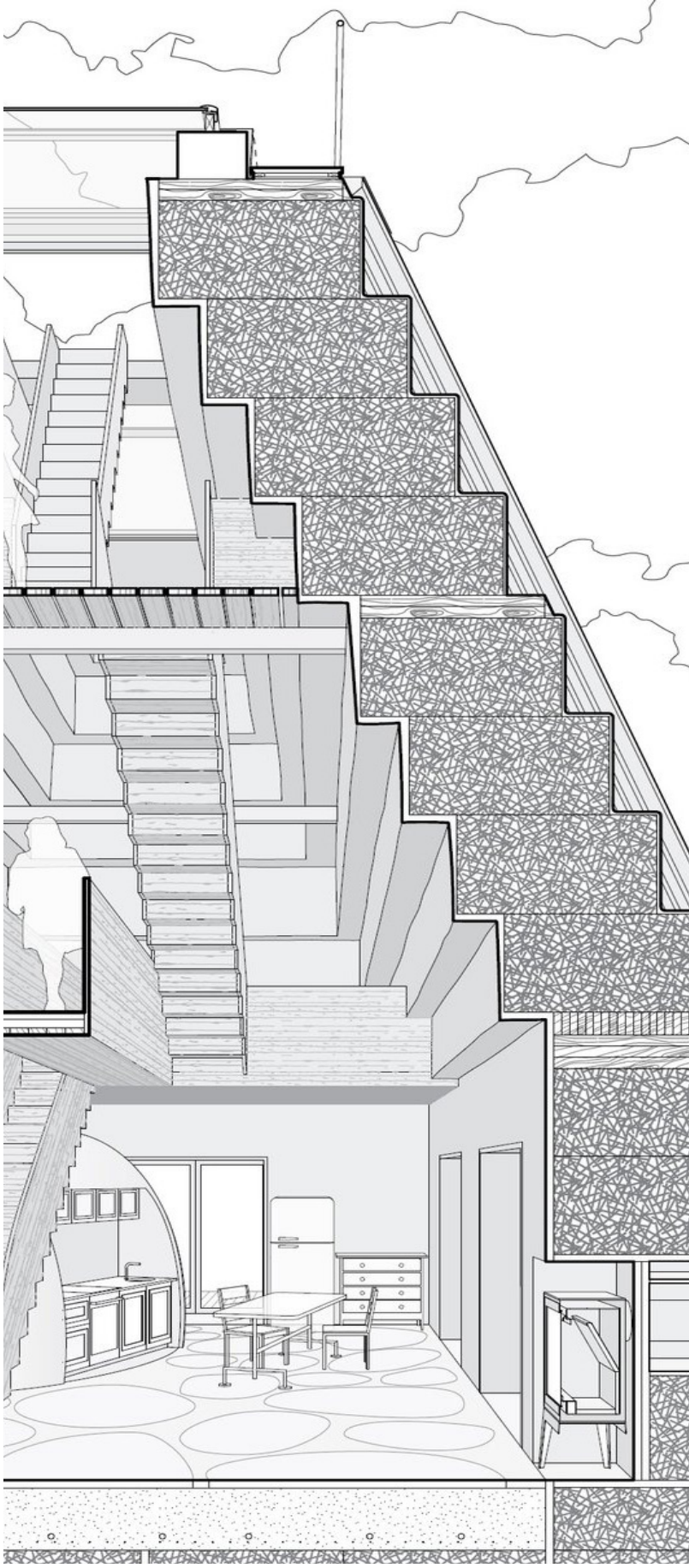
Student Code of Conduct
Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and 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. Read more:

https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/student-life-policies/code-of-student-conduct.html

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). Read more: http://www.dal.ca/cultureofrespect.html

Recognition of Mi'kmaq Territory

Dalhousie University would like to



Lewis, Paul, Marc Tsurumaki, David J. Lewis, image from Manual of Biogenic House Sections (ORO Editions, 2022)

acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit the office in the McCain Building (room 3037) or contact the programs at elders@dal.ca or 902-494-6803 (leave a message).

B. University Policies and Programs

- Important Dates in the Academic Year (including add/drop dates): http://www.dal.ca/academics/important_dates.html
- University Grading Practices: Statement of Principles and Procedures: https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html
- Scent-Free Program: http://www.dal.ca/dept/safety/programs-services/occupationalsafety/scent-free.html
- Student Declaration of Absence: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/academic-policies/student-absence.html

C. Learning and Support Resources

- General Academic Support – Advising: https://www.dal.ca/campus_life/academic-support/advising.html
- Fair Dealing Guidelines: https://libraries.dal.ca/services/copyright-office/guidelines/fair-dealingguidelines.html
- Dalhousie University Library: http://libraries.dal.ca
- Indigenous Students: https://www.dal.ca/campus_life/communities/indigenous.html
- Black Students: https://www.dal.ca/campus_life/communities/black-student-advising.html
- International Students: https://www.dal.ca/campus_life/international-centre.html
- Student Health Services: https://www.dal.ca/campus_life/health-and-wellness.html
- Counselling: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html
- Copyright Office: https://libraries.dal.ca/services/copyright-office.html

- E-Learning website: http://www.dal.ca/dept/elearning.html
- Dalhousie Student Advocacy Services: http://dsu.ca/dsas
- Dalhousie Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html
- Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html
- Faculty or Departmental Advising Support: Studying for Success Program: http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

D. Safety

- Biosafety: http://www.dal.ca/dept/safety/programs-services/biosafety.html
- Research Laboratory Safety Policy Manual: http://www.dal.ca/dept/safety/documents-policiesprocedures.html
- Faculty of Architecture and Planning: Work Safety: https://www.dal.ca/faculty/architecture-planning/current-students/inside-building/work-safety.html

Bio-vault 2 installation, Bio-Vault 2 Free Lab, Dalhousie University, 2024.

ASSIGNMENTS

Assignment 5013-1. Reading Discussion

Through the term there will be three reading seminars: four to five readings each, five pages or less.

Each seminar will have four to five seminar leaders who will be responsible for co-facilitating the discussion. As a discussion leader, come to the session with at least three Thoughts, Questions, or Epiphanies (TQEs) from your readings. The class will take 15 minutes at the start to discuss the reading in small groups. You'll then write two TQEs from each group (including your group) on the board and select a few for us to workshop into more developed questions for further discussion.

Seminar Readings

Seminar 1. Feedstock

Stewart Brand, *How Buildings Learn*, "Shearing Layers" (excerpt)

John Fernandez, *Material Architecture*, Introduction (excerpt)

Material Cultures, *Material Reform*, Introduction (excerpt)

Bruce King, *New Carbon Architecture*, Introduction (excerpt)

Catherine De Wolf, "Low carbon pathways for structural design" (excerpt)

Seminar 2. Conversion

Anna Tsing. *Friction* (excerpt)

Sanford Kwinter, "Soft Systems" (excerpt)

Joe Dahmen, "Soft Futures" (excerpt)

Tim Ingold, *Making*, "Materials" (excerpt)

James Forren, "Soft Rock Studio" (transition design?)

Seminar 3. Utilization

Lewis Tsurumaki Lewis, *Manual of Biogenic Sections* (excerpt)

Philipe Block, "Imposing challenges, disruptive changes" (excerpt)

Chris Magwood, *Making Better Buidlings* (excerpt)

Neri Oxman, *Neri Oxman: Material Ecology* (excerpt)

TBA

Rubric

This rubric is a general guide to help frame evaluation for discussion leaders. This is not a check-box evaluation, but rather a general guide capturing dimensions of an overall impression, and intended to help clarify for you what is expected in discussion.

A+. "A" level standards, plus exceptional discussion leadership. Contributions provide exceptional insights, or exceptional supports/advancement of others insights into readings to define discussion takeaways. Demonstrates exceptional familiarity with the material.

A. "A minus" level standards, plus provides advanced leadership, supporting classmates's comments, finding threads to connect discussion points, and advancing gaps in the conversation. Demonstrates excellent familiarity with the material.

A-. Provides excellent leadership, and excellent effort to advance discussion. Additionally, provides space for classmate's reflection. Attentively listens to instructor and fellow students. Answers questions. Asks questions. Provides evidence from the text. Forms plausible, coherent explanations. Concedes to better points and arguments. Makes reasonable attempts to persuade other participants. Demonstrates excellent preparation with the material.

B+. Provides leadership, and good effort to advance discussion. Listens to instructor and fellow students. Answers questions. Asks questions. Forms plausible, coherent explanations. Concedes to better points and arguments. Makes reasonable attempts to persuade other participants. Demonstrates good familiarity with the material.

B. Good effort to lead. Listens to instructor and fellow students. Answers questions. Asks questions. Forms plausible, coherent explanations. Concedes to better points and arguments. Demonstrates some preparation with the material.

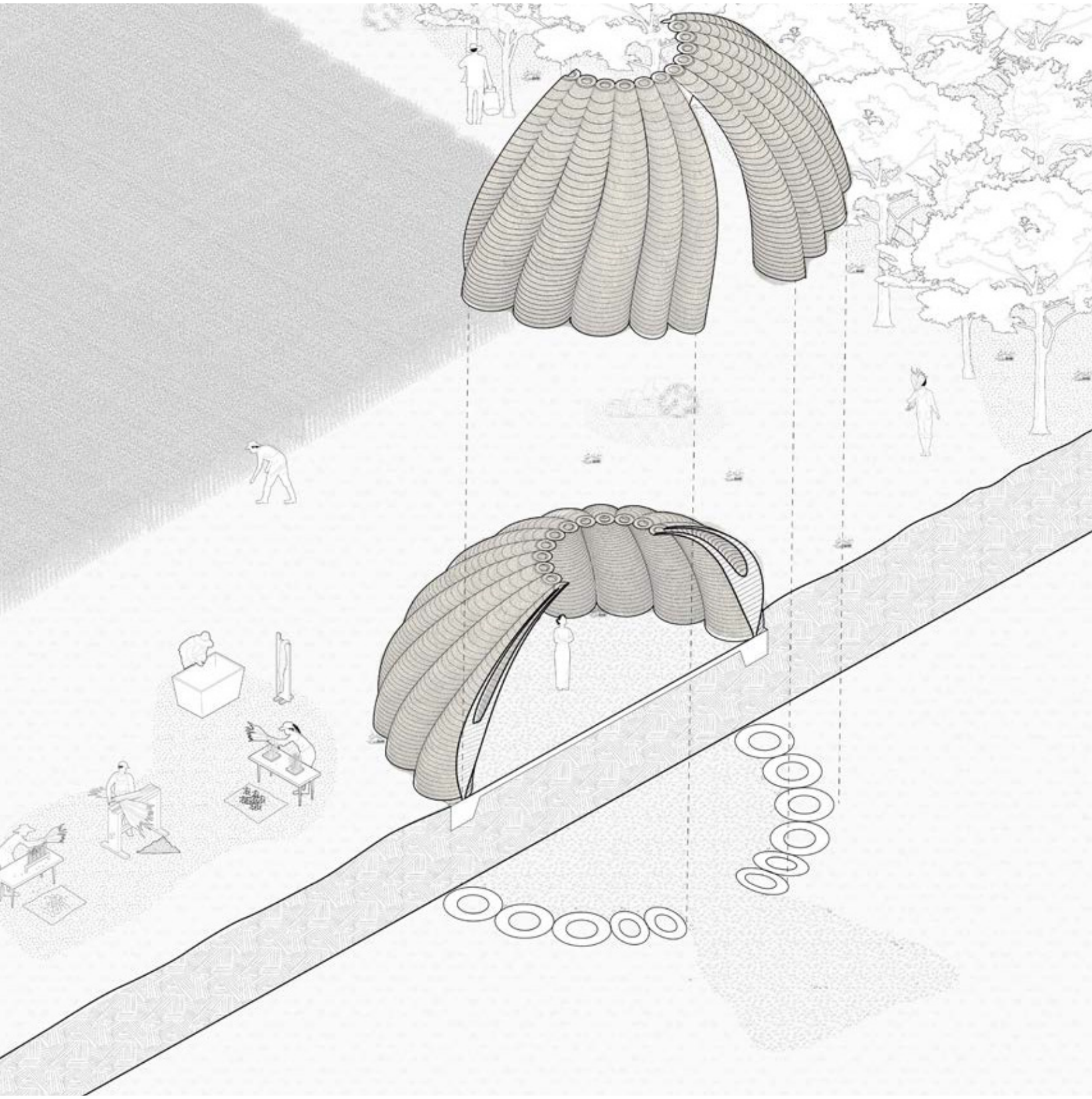
B-. Contributes to discussion. Listens. Answers questions. Asks questions. Demonstrates little preparation with the material.

F.

"The Living Room". Hub for Biotechnology in the Built Environment. From More with Less: Reimagining Architecture for a Changing World 2023 (Farrell Centre, Newcastle-upon-Tyne) (http://bbe.ac.uk/a-poetic-marvel/).

Assignment 5013-2. Precedent Study

Conduct a holistic assessment of a project integrating material-driven design methods, digital design and/or construction processes, and alternative feedstock utilization. Report on feedstock properties, means and methods of design construction, life-cycle considerations, and quantitative methods. Also report on drawing methods and techniques. Capture this in a PDF template (provided) and share with the class in a 5 minute presentation.



Axonometric of architectural demonstrator of 3D printed flax fibre. Larissa Korol, image from Biofibrous Potentialities (Dalhousie 2023).

Assignment 5013-3. Prototype 1

Select an architectural application for your feedstock from ARCH 6029. This can be an existing or new application. Do you want to explore its potential as a component part of an envelope, structure, or landscape assembly? Develop a means and methods of developing, designing, and testing this application. What are the criteria you want to design for? What is the scale you want to test at? What is the test you want to run? What is the media you want to use? These decisions will form your 'study design'.

You can consider intrinsic characteristics (what does the material 'want' to be?). As well, you can consider extrinsic ones (what might an 'enigmatic' use of this material look like? Or, alternatively, a cost-effective use?).

You will be evaluated on the rigor and precision of your investigation. If you elect to do drawings or virtual prototypes, you will need to determine

a language and method of precision. If you elect to explore physical specimens, you will need to establish an iterative method of refinement. Through running repeated tests you will be able to either prove, refute, or evolve your hypothesis about its possible utilization.

Assignment Schedule

WEEK 3 TO 4. STUDY DESIGN.

A) Conduct a **literature review** of precedent design projects utiizing your feedstock or similar feedstocks. Based on this review, and your research from Assignment 2, develop a

basis of design: principles, requirements, and objectives (theory, criteria, goals) that you will seek to address through testing and prototyping. This might be an intrinsic property (*such as thermal conductivity or compressive strength*); or extrinsic property (*such as cultural significance or economic value)*. It might arise from the desire to replace an existing building component (*such as XPS insulation*); enhance a means and method of fabrication or construction (*such as 'growing concrete'*); or utilize a combination of intrinsic properties and means and methods of fabrication to come up with a novel building assembly or class (*such as additively manufactured wall systems from bio-cementitious slurries*). What are the important characteristics of your proposed design? Cost effectiveness? High strength-to-weight value? Aesthetic qualities or impact?

Literature review (precedents)

B) Develop a **test,** or **series of tests**, that will help you get closer to this goal. *This might mean trying to test mixes of ingredients so that they form mechanically stable blocks. Or making drawings of a speculative building assembly or system that integrates your feedstock. Or producing mock-ups of a component or assembly using a corollary material system.* You might need to propose more than one test.

Establish a **metric of precision** for these tests. *For example, tracking the quantities of ingredients used in material mixes; the scale and level of detail for drawings and models; the number of specimens and/or prototypes and iterations.* Consult examples of the types of tests you

are considering for how they are carried out. Consider how you will evaluate test outcomes.

C) Identify how you will conduct **carbon budgeting** for your application. *For instance, using tabulated values for feedstocks and other ingredients in a material mix and scale by volume.*

WEEK 4 TO 5. TESTING.

Carry out your study design. Conduct your **first tests**. Document the test set-up, test execution, and test results. Conduct an evaluation of your test results. Determine changes you will make for a second iteration of the test.

WEEK 5 TO 6. TESTING TO PROTOTYPING.

Conduct your **second round of tests**, documenting these as well. What conclusions can you draw from these tests? How will you now convert the outcomes of these tests to a prototype?

Based on your test results, and using a set of **prototype methods** begin **prototyping** your application. Exploring it through model, drawings, or one-to-one constructions.

We should be able to identify one or more of these building technology taxonomies in your prototype methods:

- Element
- Component
- Assembly, and/or
- System

Your prototyping may use a combination of these taxonomic categories.

Your prototyping may be physical, virtual, or a combination of both.

Examples of prototyping methods include wall sections, three-dimensional drawings, or other visualizations. A test from Week 7 and 8 may evolve to serve as one of your prototype descriptions.

One method might be a series of bricks assembled in a small mock-up. Another might be a material specimen with drawings of assemblies of bricks (or fibers, or linear elements, or 3d prints). Yet another might be (or be part of) a life cycle system diagram.

You do not need to complete your prototype this week, but you should come to class with a plan and the beginning of one of your modalities.

WEEK 6 TO 7. PROTOTYPING.

Conduct a **carbon budget** of one of your prototype descriptions. Ie. what is the $CO2_e kg/m^3$ of a brick or assembly?

Evaluate your prototype outcomes against your important design characteristics. Are there adjustments which could enhance this? Conduct any feasible revisions to any of your prototype descriptions.

Articulate your **methodology**: how you have connected your set of prototyping methods under an over-arching theoretical framework.

WEEK 7 TO 8. PROTOTYPING.

Synthesize your design approach with quantitative findings on embodied carbon. What are building performance enhancements? How are these being measured? How do these compare with carbon gains or offsets?

Outcomes

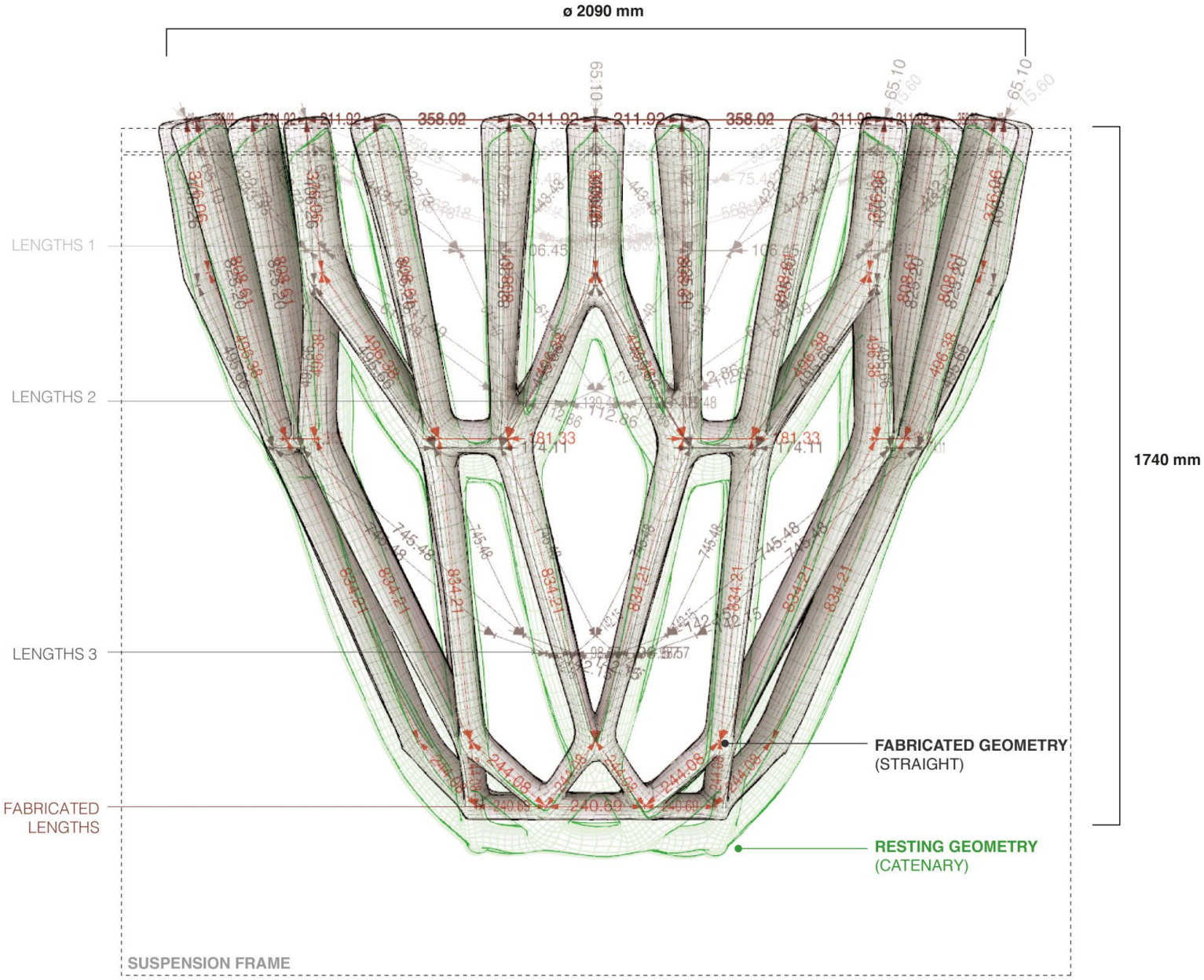
Submit process documentation as a **PDF** uploaded to Brightspace. Submit packaged InDesign document folder as **ZIP** to OneDrive link. Retain any physical specimens or samples and large format prints for future exhibit.

"BioKnit". 3D knitted fabric programmed and applied structurally at human scale using fungi, bacteria, and simple physics. Hub for Biotechnology in the Built Environment (2019) (http://bbe.ac.uk/bioknit-prototype/).

Assignment 5013-4. Prototype 2

Develop your initial tests into a full scale prototype. This is an evolution of the Schematic Design level of Prototype 1 (where many of the major issues and relationships are established) into a Design Development phase where these relationships and issues begin to be resolved through full scale explorations and propositions.

Kevin Mockford and Sebastian Sarrazin, Analysis mapping tile curvature of clay (green), mussel shell (cyan), pistachio (pink), and rice (brown) tiles to vaulted shell. Image from “Soft Rock Studio” (Building Technology Educator’s Society 2021, 2021)

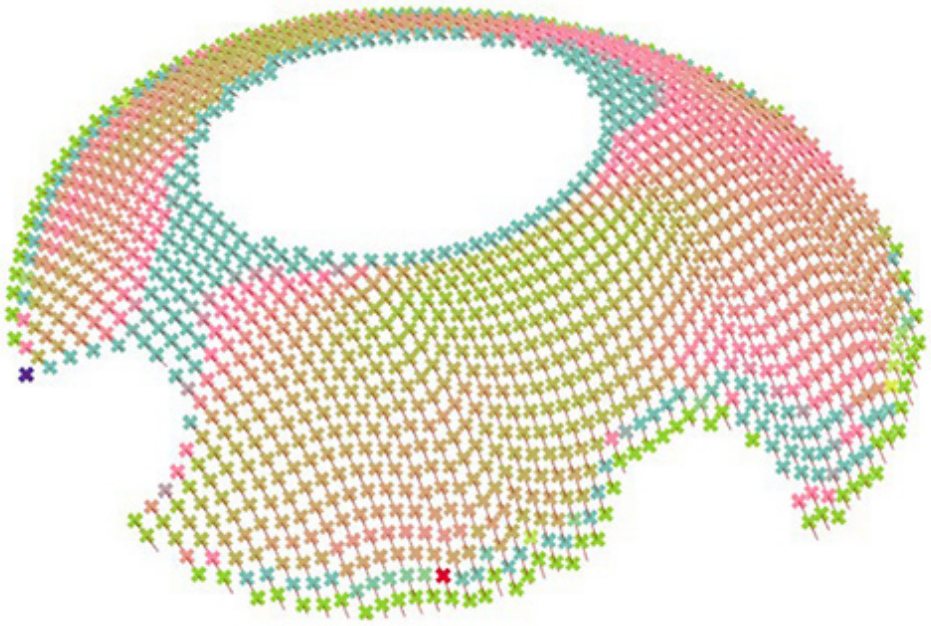


"BioKnit". Structural force and fabrication drawing. Hub for Biotechnology in the Built Environment (2019) (http://bbe.ac.uk/bioknit-prototype/).

Assignment 5013-5. Drawings

This assignment lasts through Prototype 1 and 2. Develop at least 2 pages of a drawing set for your prototype. Determine important views, relationships, unique drawings and details. Develop a project lexicon for the components and elements of your design. Consider how a reader moves through the drawings from page to page. How notes refer back and forth. The drawings will form the basis for weekly reviews and discussions of your project.

You may also curate your process documentation into photo-film strips, charts, graphs, tables, drawing layouts, or other visual organizations that help us understand your process. You can use the dossier template if helpful, but this is not required. Your outcomes will eventually need to be formatted for the template for the next assignment.



Kevin Mockford and Sebastian Sarrazin, Analysis mapping tile curvature of clay (green), mussel shell (cyan), pistachio (pink), and rice (brown) tiles to vaulted shell. Image from “Soft Rock Studio” (Building Technology Educator’s Society 2021, 2021)

Aguahoja, created with substances such as pectin and cellulose as alternatives to petro-based plastics. Photo courtesy The Mediated Matter Group (Architectural Record, 2020)

Assignment 4. Final Dossier

The outcomes of Assignment 2 make up the Background of a disseminated work. The outcomes of Assignment 3 make up the findings. The function of dissemination is to share your work with outside audiences who can benefit from what you have learned. This includes other architects and researchers, as well as the general public. As part of this you will also write a conclusion about your work. If you identified and responded to a gap in Assignment 2, how well has your investigation responded to or filled this gap? Was it successful? What would need to be done differently, or explored further? Is there a general framework you can distill from this that you can articulate and share with others?

Your work from the term will be compiled in a final Dossier. The spreads, along with any full size drawings, scale models, or physical specimens, will be displayed in the Exhibition Room reserved

for a day. We can invite guests from multiple places to come, see, and discuss the work.