Beyond Extraction

Material investigations for a post-carbon future

ARCH 6209 Material Investigation
Dalhousie School of Architecture
Fall 2023 Thursday, 9:30–12:30, HB2
James Forren (james.forren@dal.ca)
Office hours: Tuesday, 1:00–2:00

July 30, 2024

"Land restoration scheme, Goshems Farm, Tilbury Essex". Imagery (c) 2022 Google, Imagery (c) 2022 Getmapping pic, Infoterra Ltd, image from Material Reform by Material Cultures (MACK, 2022).

Calendar Description

This course uses a controlled workshop environment to examine characteristics of a material (e.g., metal, ceramic, glass) and methods for forming and finishing. Using principles of material science, it considers the harvesting or processing of raw material, the testing of structural capacity and environmental behaviour, and applications in design.

Additional Course Description. Conventional building practices cause significant environmental harm. They are frequently extractive and one-directional. Concrete, virgin steel, glass, extruded

polystyrene and non-certified timber use raw materials, or **feedstocks** (such as limestone, sand, iron ore, petrochemicals, and non-sustainable wood), whose **extraction** (mining, harvesting, or otherwise removing from their natural reservoir) and **conversion** to building materials damages the environment, release tons of **embodied carbon** and harms surrounding communities. The walls, columns, floor slabs, and windows created leave behind significant waste streams at their end of use, overlooking opportunities for buildings to take part in renewable and regenerative cycles which can otherwise repair our environment.

HG Matthews Brickworks, Bellingdon, Buckinghamshire. Jess Gough, image from Material Reform by Material Cultures (MACK, 2022).

In this course students will learn to look at the built environment

HG Matthews Brickworks, Bellingdon, Buckinghamshire. Jess Gough, image from Material Reform by Material Cultures (MACK, 2022).

as a regenerative loop, exploring novel material reservoirs to disrupt conventional supply chains and means and methods of construction; thereby reducing and potentially reversing environmental harms for social, economic, and architectural

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).

benefit. Students will learn how advancements in energy, agriculture, aquaculture, and other industries can couple with advances (and traditions) in building technology to achieve net-negative climate goals.

In the course, students will learn about the use of bio-based and industry byproduct material feedstocks as alternatives to traditional construction materials such as steel, concrete, expanded polystyrene, and engineered timber. Students will have the opportunity to investigate a feedstock (such as cement, biochar, flax, or mycellium) in order to uncover new and emerging

feedstock-conversion-utilization toolkits for building materials. Student investigations will support design investigations in ARCH 5013 Design-Build Studio as part of a landscape, structural, enclosure, or finish assembly. 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 research framework for material inquiry in masters-level coursework and thesis.
2. Enact research methodologies for materials in masters-level coursework and thesis, including:
   - understanding of taxonomy of construction means and methods
   - ability to conduct literature review from relevant sources and databases
   - understanding and ability in the principles of composite construction materials
   - awareness of requirements of regulating bodies and authorities having jurisdiction
3. Deploy disruptive strategies and tactics for material practice, including:
   - prioritizing local economies and feedstocks
   - calculating embodied carbon
   - addressing bio-based and byproduct material issues and strategies

4. Engage with experts, industry professionals, and general public through architectural dissemination 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 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 instructor.

"Cleveland Steel & Tubes Ltd reclamation yard, Thirsk, Yorkshire". Imagery (c) 2022 Google, Imagery (c) 2022 Infoterra Ltd & Bluesky, Maxar Technologies, Map Data (c) 2022, image from Material Reform by Material Cultures (MACK, 2022).

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**

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.

ASSESSMENT
Components and Evaluation

	Assignment	Weight	Type	Authorship	Evaluated by
6029-1	Research Dossier Draft	35%	Letter	individual	instructor
6029-2	Research Dossier Final	35%	Letter	individual	instructor
6029-3	Practicums	15%	Pass/Fail	individual	instructor
6029-4	Exhibit	15%	Pass/Fail	individual or group	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

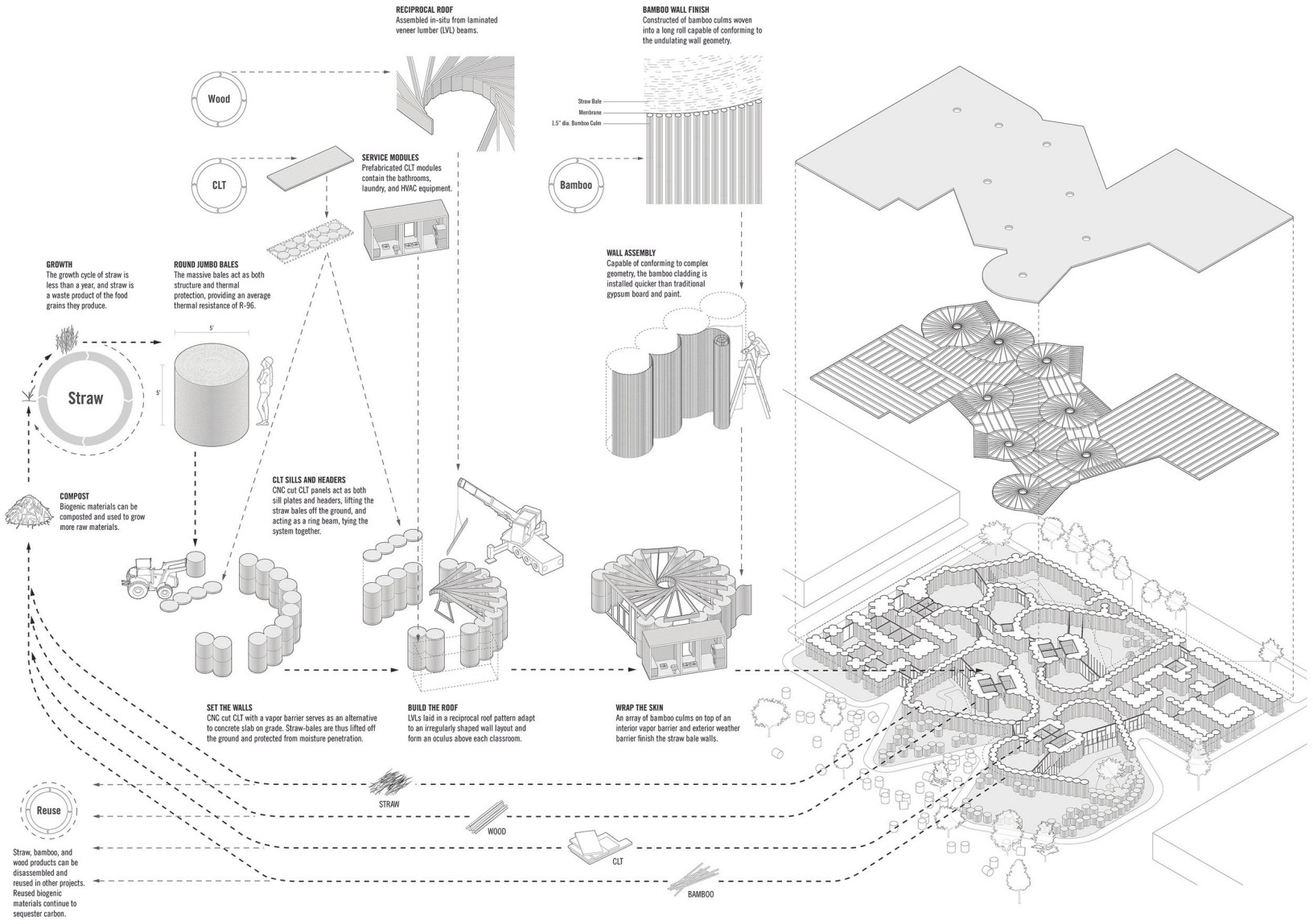
Letter	Percent	Definition	Description
A+	90–100%	Excellent	Considerable evidence of original thinking; outstanding capacity to analyze and synthesize; outstanding grasp of subject matter; evidence of extensive knowledge base.
A	85–89%		
A–	80–84%		
B+	77–79%	Good	Evidence of grasp of subject matter, 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%		

Letter	Percent	Definition	Description
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.



Radial Straw Bale School. Image from Two Straw Bale School Designs: Paul Lewis, Marc Tsurumaki, David J. Lewis, Kyle Reich, Adrian Mitchell, Zhuofan JOJO Ma, and Gabriela A. Villabos Zambrano. (https://ltlarchitects.com/radial-straw-bale-school).

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?
6029-1	Oct 3	Yes	3%	n/a	n/a
6029-2	Nov 28	Yes	3%	no	n/a
6029-3	Sep 12, 19, 26, Oct 3, Oct 6, Oct 17	No	n/a	no	n/a
6029-4	Dec 5	Yes	3%	no	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

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

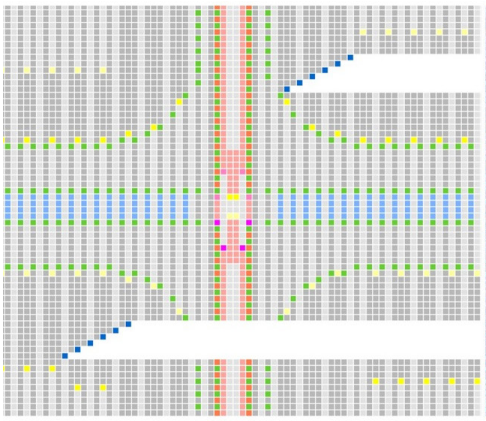
While students are expected to have working knowledge of Rhino and Grasshopper in alignment with their previous BEDS coursework, the course instructor is a researcher in computation and design and will offer practica on relevant platforms, as well as fabrication technologies. Students are expected to utilize and engage critically with digital technologies in their coursework. Floating lab licenses for Rhinocerous will be made available to all enrolled students.

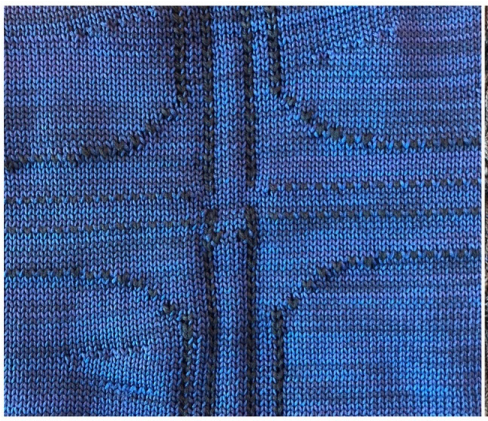
Below are a list of some Grasshopper for Rhino plug-ins that may be of use.

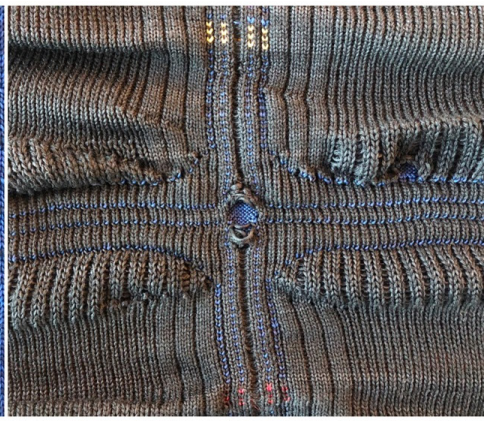
Fologram, Rhinovault, Karamba, Galapagos, Octopus

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


Knitting pattern


Front textile face


Back textile face

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

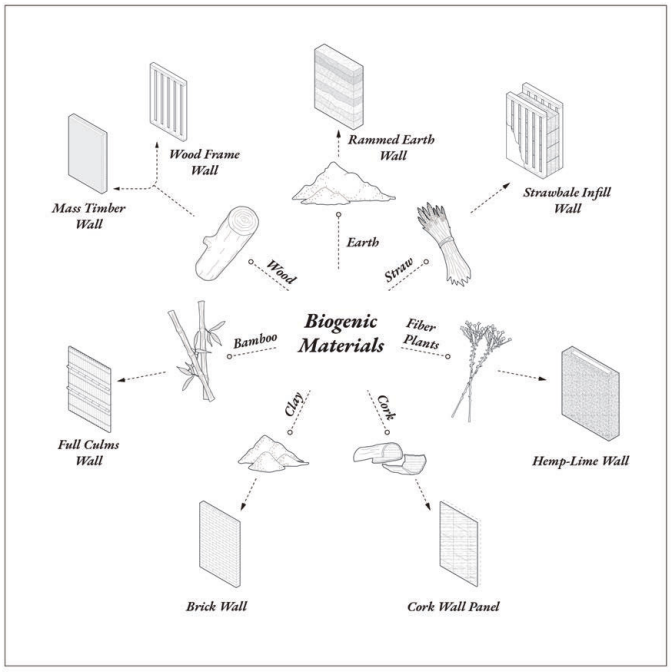
Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, 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 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



Graphic showing common biogenic materials and their typical uses. (Examples shown in graphic are informed by Lewis 2022). Larissa Korol, image from Biofibrous Potentialities (Dalhousie 2023).

- 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

REUSE

MATERIALS - BIOTIC LOOP

Biotic materials are environmentally preferable based on their ability to sequester carbon during the lifespan of the building and their regenerative capacity. As natural products they are intrinsically biodegradable and can feed back into growth cycles as nutrients for soil. However, chemical additives, use of adhesives or metal fasteners, and binding to other materials impede humification.

REUSE

Biotic materials may not be strong enough to withstand damage during the disassembly process. Other barriers to reuse are a lack of standardization of the components and the time and cost necessary to dismantle the materials.

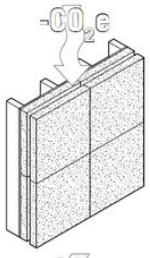
RECYCLING

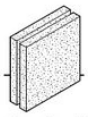
Recycling involves th material in order to product of equal qua like hemp-lime and for use in new versio identical products d and adhesives.

BIOTIC

CORK

Includes expanded cork insulation and cork façade panels. The process of expanding cork uses heat to bind cork granules together rather than using an adhesive, which makes it compostable and recyclable.



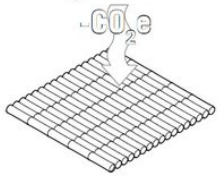


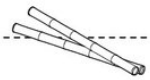
Modular cork panels and insulation can be disassembled for reuse or processed into granules. Mechanically detachable systems facilitate reuse while adhesive binding makes recovery more difficult.

Cork granules can be re in new cork-based build materials.

BAMBOO

Whole bamboo culms and bamboo wattle are minimally processed, making them more readily reuseable and biodegradable, while products such as bamboo plywood and flooring may contain adhesives.

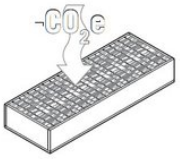




Whole bamboo members can be recovered for reuse, especially if assembled with non-damaging methods or the use of added materials.

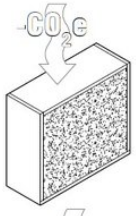
STRAW

Straw is an agricultural waste product typically formed into bales or framed into prefabricated panels. Its direct reuse is limited by the natural degradation of the material, but bales can safely decompose at end of life if free of added chemicals or finishes and panels can be designed to be disassembled for composting.



HEMP

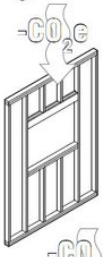
Hemp itself is compostable. However, hemp-lime uses lime as a binder and should be reused if possible. Hemp in this form may also be incinerated for energy.

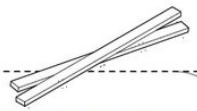


Hemp-lime can be broke reused in new hemp-lim Insulation panels can b if they are disassemble damage.

LUMBER

Dimensional lumber can be repurposed, downcycled into other wood-based products, or composted at the end of its lifespan if it has not been treated with chemicals and preservatives.

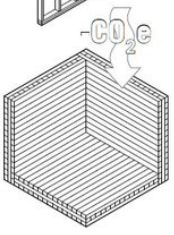


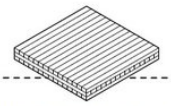


Dimensional lumber can be carefully disassembled and reused in other projects.

MASS TIMBER

Mass timber can be reused, downcycled, or composted. However, monolithic mass timber assemblies such as dowel-laminated timber are easier to recycle and compost than products that use adhesives or mechanical fasteners.

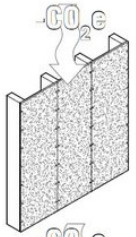




Mass timber panels can be reused, but one obstacle is the lack of standardization, as custom panels are cut for a particular project.

WOOD COMPOSITE

Wood composite materials such as MDF and particle board are made from downcycled wood fibers. However, they contain adhesives that make them unable to be composted or recycled.



Wood composite materials use wood fibers from recycled wood.

PLYWOOD

Plywood is formed by glue laminating thin wood veneers with perpendicular grain orientations into a sheet good

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

Assignment 6029-1. Research Dossier Draft
Select a feedstock (such as flax or mycellium), conversion process (such as pyrolysis), conversion product (such as biochar or graphene), or utilization method (such as 3D Printed concrete) that holds promise for disrupting current extraction processes. From the lists of Required Content and Additional Content below, develop a profile of this feedstock, conversion, product, or utilization and its potential for construction. This 'content' can include text, drawings, photos, as well as physical specimens. The dossier should identify relationships between content areas (ie. might utilization in other fields inform potential utilization in architecture).

Consider how you curate images, as well as how you process content. Would it help to create a chart of information you collect? Redraw a chart or graph to highlight information? Make a diagram or drawing of a specimen or process?

Required Content

1. Basic data:
   - Common and scientific name
   - Common use
   - Where found
   - Other helpful, important or interesting information
2. Typical method(s) of processing.
3. Embodied carbon calculations for feedstock before conversion.
4. Possible utilizations (i.e. landscape element, wall assembly, structural span, structural point-load)
5. Literature references

Additional Content (3 of the following)

1. Photos of physical specimens you make
2. Examples of physical testing potentials as a building material supported by reference literature
   - Means and methods of manufacture (Mix-design, production, moulding, etc)
   - Mechanical, thermal, optical, or other testing
   - Possible material corollaries (ie plaster for concrete)
   - Corollary in contemporary construction (ie 'swap-out' scenarios)
   - Demonstrator projects
3. Description of significant intrinsic material properties supported by reference literature
   - Thermal, and/or
   - Mechanical, and/or
   - Optical, or other
4. Description of significant extrinsic material properties supported by reference literature
   - Economic, and/or
   - Socio-cultural, and/or
   - Governmental, and/or
   - Political, or other
5. Utilization in other fields (ie. manufacture, medicine, agriculture, energy, etc.) supported by reference literature
6. Environmental impacts supported by reference literature
7. Resource locations, supply chains, methods of harvesting

Organize your findings in the provided InDesign template.

Conclude your dossier with a Statement of Intent for Design. What would you like to explore in design? For example, in your review of the ‘state-of-the-art’, what gaps have you discovered? For instance, can this be adapted to Atlantic Canadian context? Are there extensions to the studies you can offer, considering other domains or issues? Are there applications that remain to be explored?

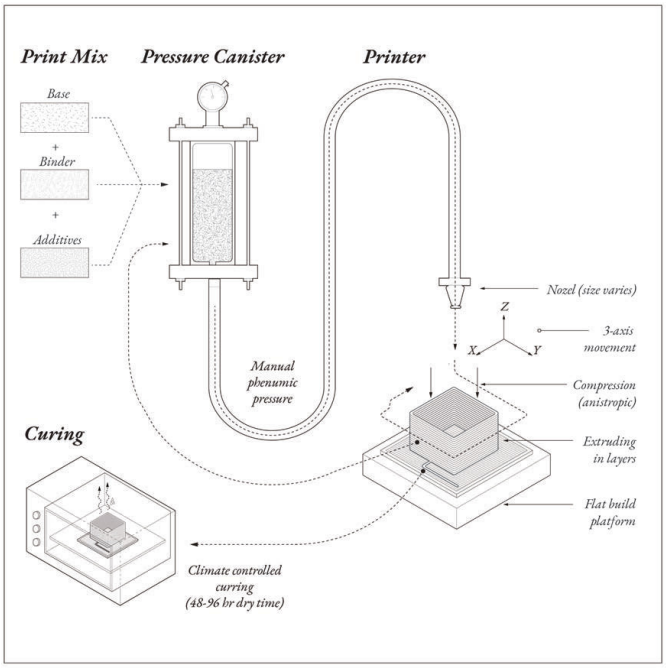
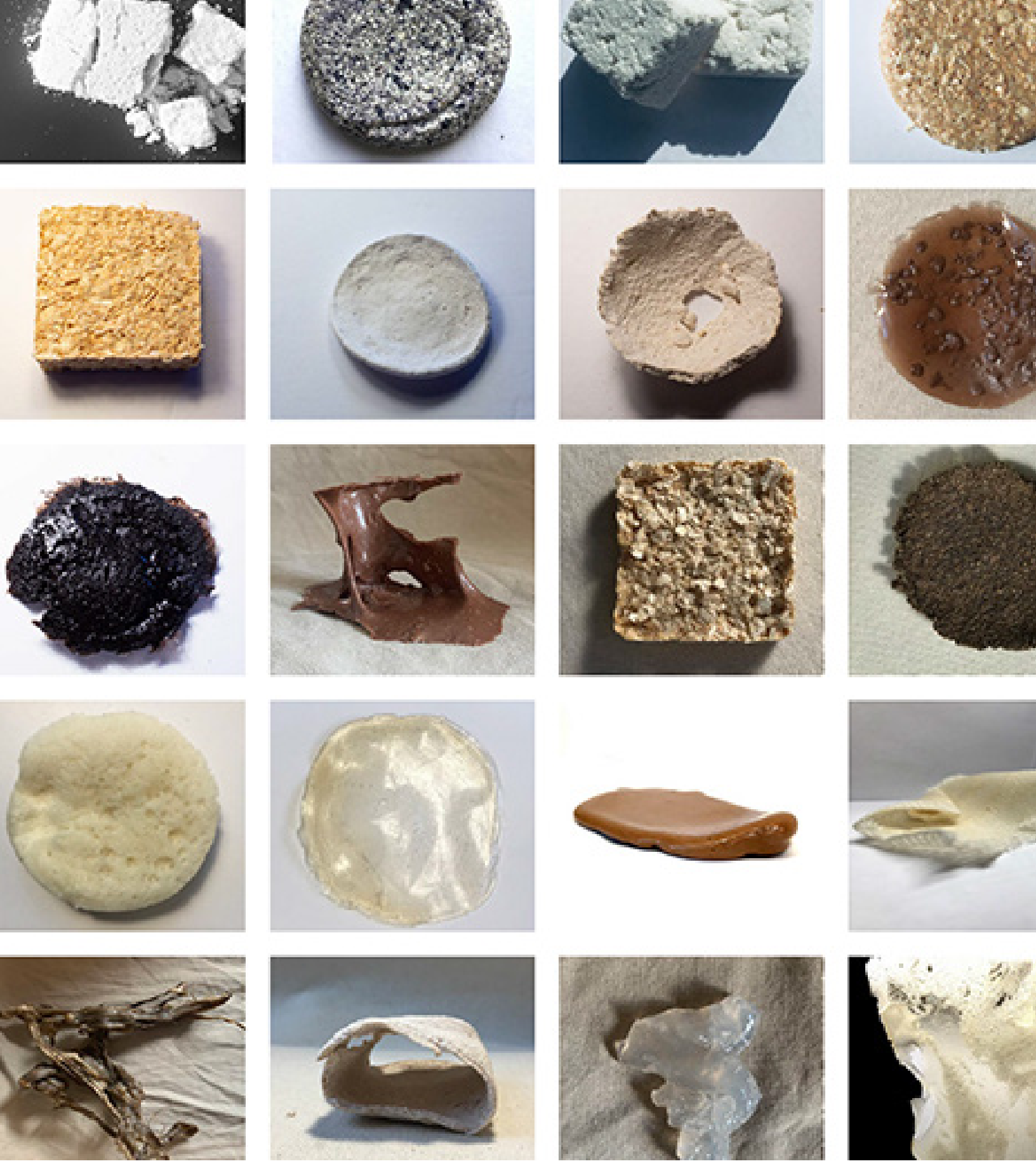


Diagram of Liquid Deposition Modeling. Larissa Korol, image from Biofibrous Potentialities (Dalhousie 2023).

Are there ways computational technologies can support management, manufacture, installation or other? How do you wish to further investigate this feedstock for architectural application? What is a possible testing scenario for your anticipated application?

Outcomes

Submit dossier as PDF uploaded to Brightspace. Retain any physical specimens or samples for future exhibit.



James Forren, image from “Soft Rock Studio” (Building Technology Educator’s Society 2021, 2021)

Assignment 6029-2. Research Dossier Final

Revise your Dossier Draft based on comments provided. Also, after exploring your feedstock, process, product, or utilization in a specific architectural application, expand on your current findings in Design. This can include drawings and models from Design. Reflect on these in relation to your prior research. Is your current work addressing a gap from your prior research? Are there methods you are exploring you would like to connect to the research?

Compression tested cylinders of one hundred percent biochar content samples.These cylinders tested up to 14 MpA. James Forren, image from "Sky Pillar" (CAADRIA, 2022)

You should also edit down the dossier to under 5000 words and no less than 1500 words.

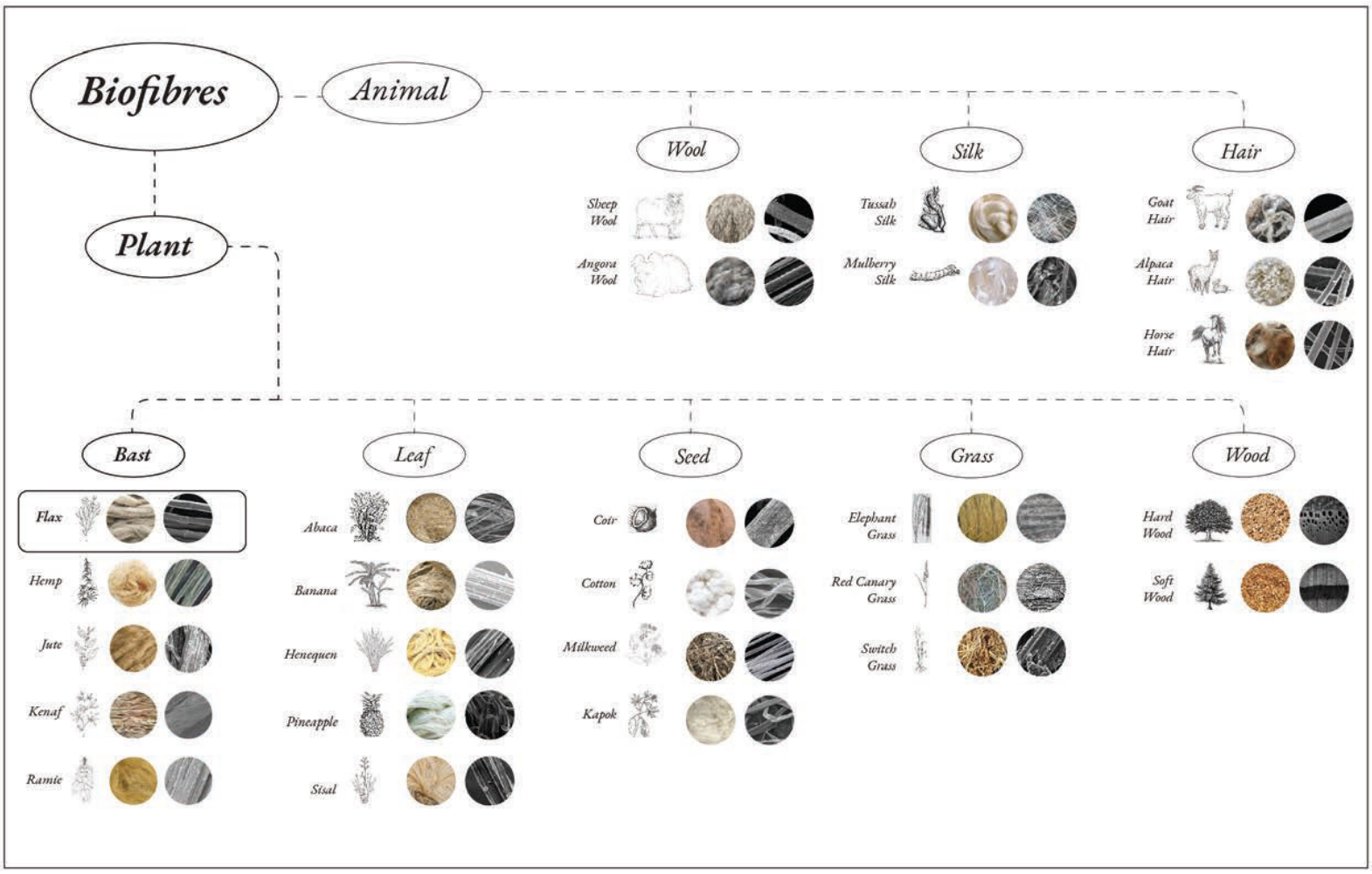
The function of dissemination is to share your work with outside audiences who

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

Outcomes

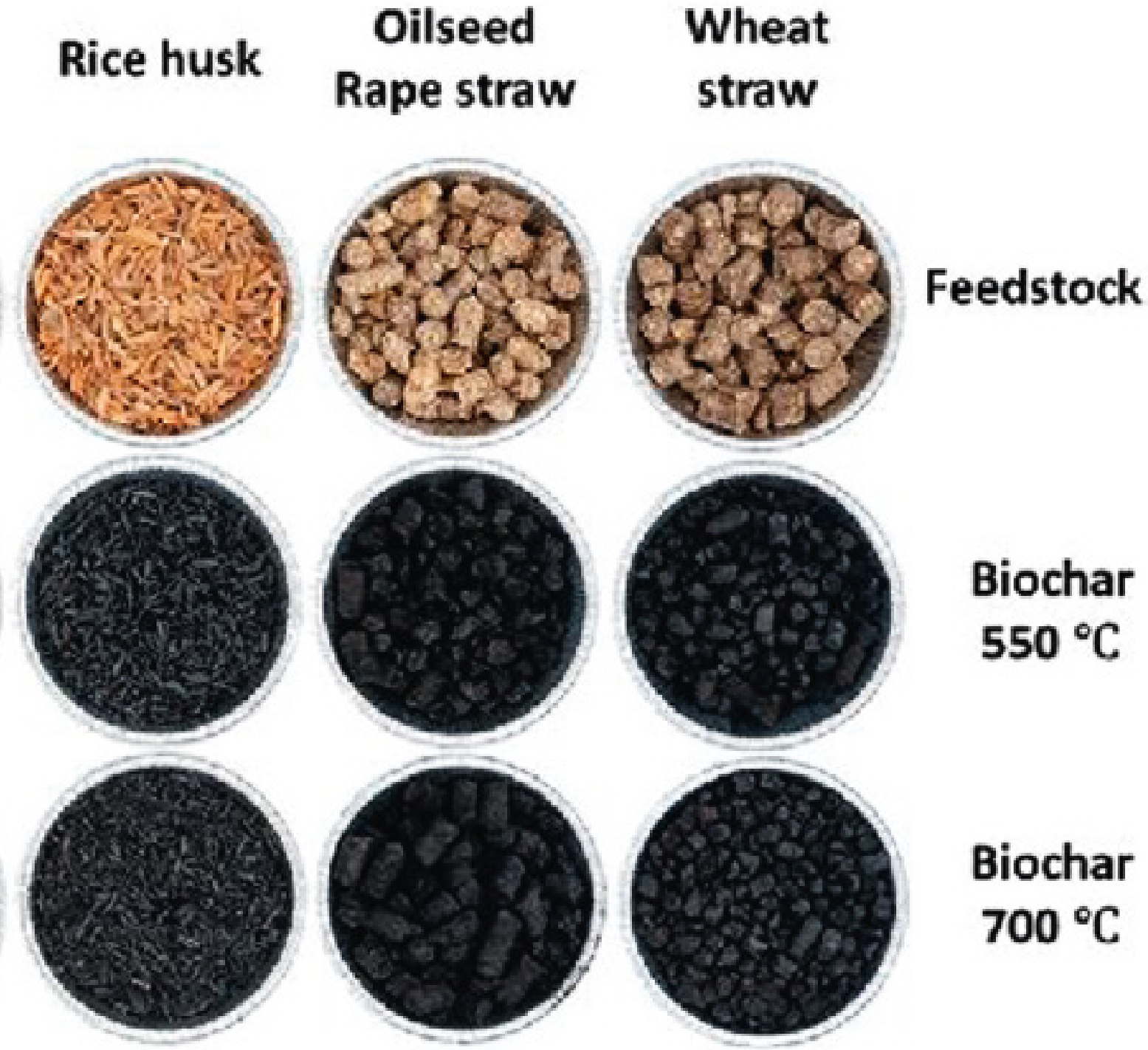
Submit process documentation as a **PDF** uploaded to Brightspace. Submit packaged InDesign document folder as **ZIP** to OneDrive link. Retain any physical specimens or samples and large format prints for future exhibit.



Biofibre diagram broken into plant and animal based sources. Larissa Korol, image from Biofibrous Potentialities (Dalhousie 2023).

Assignment 6029-3. Practicums

Assignment 6029-3 is graded pass/fail. This consists of a series of weekly Practicums to introduce you to new technical processes. These will be completed the day of class and completion will be recorded with a submission of your results to Brightspace.



Biochar feedstock and byproducts from 550 deg C (1,022 deg F) and 700 dec C (1292 deg F). Image reprinted with permission from "Standard Biochar Materials" by Ondřej Mašek, Wolfram Buss, Saran Sohi in Environmental Science & Technology published by American Chemical Society, Sep 1, 2018.

Assignment 6029-4. Exhibition

Assignment 6029-4 is graded pass/fail. This assignment and involves two parts.

1. Coordinating with your classmates and instructor so work can be printed and exhibited. This means responding to requests for information in a timely manner. This also includes printing your pages for pinning up.

2. Completing a task for the exhibit.

The tasks are:

- Create and print a large format map of the exhibit layout for guests (2 people).
- Create a handheld pamphlet for the exhibit (1 person).
- Create and print a title and questions banner (1 person).
- Select, order, and pick-up food (2 people).
- Set up and break down exhibit room (2 people).
- Pin up and pin down banner, map and layouts (4 people).
- Create labels, collect, set-up, and return physical specimens (2 people).