Dalhousie University - School of Architecture

ARCH 5224.03: Climate Systems

Course Outline - Summer 2024

Classes: Tuesdays, 9.30am-12.30pm
Room 1202 and online labs
Instructor: Brian Lilley
Office and office hours: Room B201E, for an appointment contact brian.lilley@dal.ca

Brightspace site: dal.brightspace.com
Teams site: *M1 Tech s24 - Lilley – RMD.* Zoom meetings will be arranged by invitation

ACADEMIC INFORMATION

Calendar Description

This course studies large-scale climate phenomena (solar energy, air pressure, and water systems) and how they can be modified to achieve a well-balanced microclimate in an architectural project. With an emphasis on passive design principles, this involves manual and/or digital experiments in site design, building form, material selection, and assemblies.

Additional Course Description

The course is structured over four 2-week periods that examine in turn solar power, air pressure, local hydrological cycles, and then combine into an investigation of the well-balanced microclimate. Each Unit will consider various scales of the phenomena, from larger climate to local site condition. The question of 'how do we respond to these phenomena?' will be addressed by examining strategies of harvesting, shielding, and porosity in Architecture. Further, we will be examining materials and assemblies in terms of attributes that directly respond to those strategies. Reacting to the question of inhabitation, 'How can material assembles successfully respond, before active mechanical systems become necessary?' we will also be examining mixed mode strategies of integration. Each unit will pose a simple microclimate design problem, working toward an analysis of a current studio design, as a group project of the student's choice.

In exploring and researching these topics, we will be starting with readings across scales, and looking at both case studies and architectural translations. To understand the phenomena in general terms, there will be a number of experiments (Harvesting, Shielding, Porosity) based on readily available materials and utensils at home. The four labs should not cost more than $10.00 each. There will also be the opportunity to consider scripting as it applies to the problem – both pseudo-scripting and grasshopper / Ladybug, for example.

Learning Objectives

- Develop and show an ability to research and experiment with environmental factors that underly passive design principles
- Understand and show an ability to translate passive design research into a robust material design proposal
- Develop an understanding of key material strategies and assembly detail that can inform comprehensive design

Jinhua Ceramic Pavilion, Wang Shu

Rationale for the Course
This course coincides with the first Design Studio in the graduate program, occurring in the summer term. As such it offers students an opportunity to work on a particular topic of design related to sustainable building: using Microclimate simulation to develop translations for responsive material assemblies. This process is useful as a form of design research contributing to sustainable, comprehensive design.

Assignment Descriptions
The main assignment is a process logbook that accumulates the term's work consecutively over the term's four units. As a guide for content, Exercises and Readings will be given for each Unit on a weekly or bi-weekly basis. The process log is a format document (to match your portfolio size) that captures the term's activities. All included material should be clearly and concisely labeled so that the document is self-explanatory, and useful for future reference. A further Assignment description will be given with the Introduction to each unit.

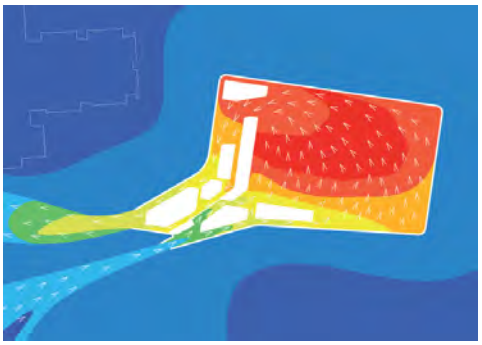
Solar Power - Unit 1 Description
Solar Energy is the light and energy driver across scales, along thermodynamic principles. Harvesting Solar Energy passively relies on orientation and duration, and usually means Thermal Mass storage and cavity walls. Mixed Mode includes solar convection, solar aquatics, and PV or Solar hot-water panels. Harvesting Light involves patterns of solid and void, transparent material, receptor material, and principles of reflectance and absorption.

Assignment 1: Design an interior microclimate that has even daylight, is warm and dry, for a small library (assembly occupation) with variable air changes depending on (flexible) functions. The assignment will include a brief reading synopsis, a hypothesis, experimental results, and a conclusion with action points for architectural translation.

Carrer del Bisbe, Barcelona, Spain

Air Pressure - Unit 2 Description
Principles of Air Pressure drive global weather systems, and also affect individual buildings. Harvesting air flow for energy is done with windmills, and for effective natural ventilation orientation and opening proportions are key elements. Passive strategies include Buoyancy and Stack effect; Mixed Mode includes plenums, heat recovery, and earth tubes; filtering of Air relies on capillary tunnels and absorptive material, with porosities aligned to dust particle sizes.

Assignment 2: Design an exterior microclimate in Nova Scotia that can be used for sports or outdoor activity throughout the year. The assignment will include a brief reading synopsis, a hypothesis, experimental results, and a conclusion with action points for architectural translation.


Philippe Rahm, Windtrap. Slovenia, 2008

Moisture Hydrology - Unit 3 Description
Hydrologic Systems provide a dynamic balance between large bodies of open water and filtered fresh groundwater. Harvesting involves rainwater retention through surface drainage, or through material permeability (filtering) and groundwater reservoirs. Active systems include solar aquatics, hot-water panels, ocean-loop cooling, geothermal systems and water turbines.

Assignment 3: Design an interior / exterior threshold with a microclimate that is bright / well-ventilated / and moderately humid for a kitchen garden and indoor / outdoor dining. The assignment will include a brief reading synopsis, a hypothesis, experimental results, and a conclusion with action points for architectural translation.


Non-Random Light by Moooi


The Oval, Naoshima Island, Japan, Tadao Ando

Microclimate Design - Unit 4 Description
To achieve balance, the materials and flows that compose a building need to achieve a synergistic metabolism, working together to achieve a microclimate that invites human occupation. Of necessity, a mapping of material attributes for different flows: of solar, air and moisture can then in combination regulate an environment's temperature, light quality, air change capacity, and moisture content.

Assignment 4: Describe one of the major spaces in your M1 Design Project in terms of Material Attributes and phenomena flow, and the resulting microclimate. The assignment will include a brief reading synopsis, a hypothesis, experimental results, and a conclusion with action points for architectural translation.

Portfolio Reflection - Unit 5 Description
Assignment 5: The Portfolio Reflection will be a written reflection of the term and identifies research directions based on the individual portfolio of work.

Weekly Hours
For this three credit-hour course, an average of 9 hours per week is expected for all course-related activities, including classes. If a majority of the students are working substantially more time, please notify the instructor. Each week will generally consist of a seminar and a lab experiment (this may vary with holidays etc).

Schedule
Weekly classes are scheduled on Tuesday Mornings from 9.30-12.30 in Room 1202.

	Week -Summer term 2024	*Principles*	*Strategies – Case Studies*	*Assemblies*
07 May	Week 1 Unit 1 Intro: Solar Power			
	Readings	Solar + Systems	Degradation balance: Fahey	Arch case study
		Thermodynamics Light Spectrum	Feedback Script	Cavity Wall, Perforation Shading, light shelves
14 May	Week 2 Unit 1: Solar Power			
	Experiment:	Harvesting	Shielding	Porosity / Filter
21 May, 9am	Assignment 1 due	reading synopsis, experimental result	Conclusion, action points	Unit 1 Review
21 May	Week 3 Unit 1 review and Unit 2 Intro: Air Pressure			
	Readings	Air Pressure Systems	Ant Hills - Wall Gradient	Arch case study
		Stack, Buoyancy, Natural Cooling, Convection	Feedback script	Solar Chimney, Louvres, Earth Tubes
28 May	Week 4 Unit 2: Air Pressure			
	Experiment:	Harvesting	Shielding	Porosity / Filter

04 June, 9am	Assignment 2 due	reading synopsis, experimental result	Conclusion, action points	Unit 2 Review
04 June	Week 5 Unit 2 Review and Unit 3 Intro: Moisture Hydrology			
04 June continued	Readings	Hydrology	On Weathering, Surfaces and Skins	Arch case study
		Drainage Planes, Condensation, Humidity	Feedback script	Hydronics, Geothermal, Ocean loop, Solar Aquatic
11 June	Week 6 Unit 3: Moisture Hydrology			
	Experiment:	Harvesting	Shielding	Porosity / Filter
18 June, 9am	Assignment 3 due	reading synopsis, experimental result	Conclusion, action points	Unit 3 Review
18 June	Week 7 Unit 3 Review and Unit 4 Intro: Microclimate Design			
	Readings	Building Metabolism	Phase Change (Delta T) Phenomena mapping	Arch case study
		Low Carbon	Feedback script	Wall assemblies
25 June	Week 8 Unit 4: Microclimate Design			
	Experiment:	Harvesting	Shielding	Porosity / Filter
02 July	Week 9 Unit 4: Microclimate Design			
09 July, 9am	Assignment 4 due	reading synopsis, experimental result	Conclusion, action points	Unit 4 Review
09 July	Week 10* Unit 4 Review and Unit 5 Intro: Portfolio Reflection			
12 July, 11.59pm	Assignment 5 due	assignments review, research direction	Conclusion, action points	

*Student ratings of instruction will be scheduled during the last class in Week 10, prior to review week.

Class Format
Teams studio site for shared information and daily co-ordination; Studio and home experiments, and reviews. Brightspace for official announcements, assignment submissions, and grading.

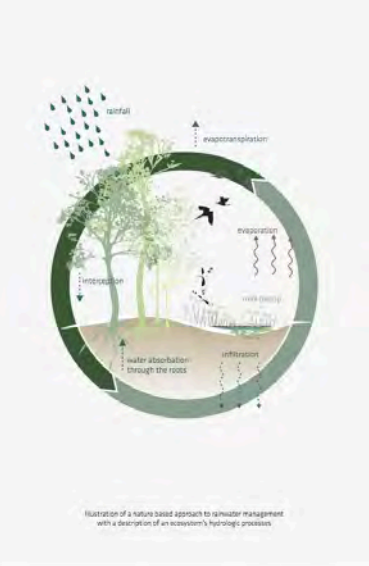
Integration with Other Courses
No co-requisite courses.

Required Reading
(list will be expanded with assignment hand-outs)

DeKay, Mark, and G. Z. Brown. 2014. *Sun, Wind, and Light: Architectural Design Strategies.* John Wiley & Sons.

Ford, Brian, Rosa Schiano-Phan, and Juan A. Vallejo. 2019. *The Architecture of Natural Cooling.* Routledge.

Liedl, Petra, Gerhard Hausladen, and Michael Saldanha. 2012. *Building to Suit the Climate: A Handbook.* Walter de Gruyter



City of Copenhagen Report on Cloudburst proofing – Natural Drainage strategies

Further References
System and Structure
Bachman, Leonard R. 2004. *Integrated Buildings: The Systems Basis of Architecture.* John Wiley & Sons.

McCullough, Malcolm. 2004*. Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing.* Boston: The MIT Press.

Detail
Garcia, Mark. 2014. *Future Details of Architecture.* John Wiley & Sons.

Corner, Donald B., Jan C. Fillinger, and Alison G. Kwok. 2017. *Passive House Details: Solutions for High-Performance Design*. Routledge.

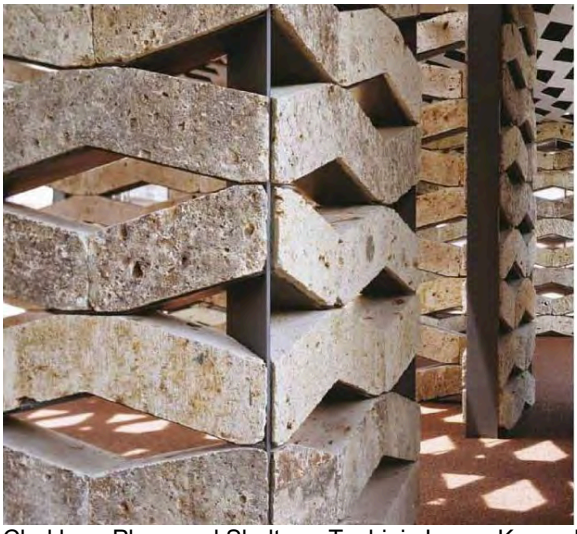
General
Yeang, Ken. 2019. *Saving the Planet by Design: Reinventing Our World Through Ecomimesis.* Routledge.

Meyer, Christopher Michael, Shawna Michelle Meyer, and Daniel Hemmendinger. 2018. *Pamphlet Architecture 36: Buoyant Clarity.* Chronicle Books.

Moe, Kiel. 2010. *Thermally Active Surfaces in Architecture*. Princeton Architectural Press.

Moe, Kiel. 2013. *Convergence: an Architectural Agenda for Energy*. New York: Princeton Architectural Press.

Schafer, R. Murray. 1977. *Our Sonic Environment and The Soundscape*. New York: Knopf.



Chokkura Plaza and Shelter – Tochigi, Japan Kengo Kuma & Associates

ASSESSMENT

Components and Evaluation, Criteria for Assessment

A short description below of components and their weights that will count toward the final grade. For each component, details will be provided in a separate assignment outline, which are attached at the end of this document. All assignments are graded in Brightspace according to the following rubric.

Assignment 1: *21 May* Solar Power	20%	individual	evaluated by instructor
Assignment 2: *04 June* Air Pressure	20%	individual	evaluated by instructor
Assignment 3: *18 June* Moisture Hydrology	20%	individual	evaluated by instructor
Assignment 4: *09 July* Microclimate Design	30%	group	evaluated by instructor
Assignment 5: *12 July* Portfolio Reflection	10%	individual	evaluated by instructor

Assignment Rubric

Research	achieves excellence 5 points	meets expectations 3.75 points	insufficient evidence 1 point	Criterion Score
Criterion 1 criticality of research work and insightfulness of hypothesis	The criticality of research work and insightfulness of hypothesis are distinctive, and all important aspects of the topic have been addressed.	The criticality of research work and insightfulness of hypothesis meet expectations. Clarity and insight may be uneven, but the most important aspects of the topic have been sufficiently addressed.	The criticality of research work and insightfulness of hypothesis does not meet expectations. A lack of clarity and insight, and many important aspects of the topic have not been addressed.	/ 5
Criterion 2 clear, sequential development of investigations and testing of the study issues	A clear, sequential development of investigations and testing of the study issues that achieves excellence	The development of investigations and testing of the study issues meet expectations	The development of investigations and testing of the study issues are insufficient and do not meet expectations	/ 5

Design	achieves excellence 10 points	meets expectations 7.5 points	insufficient evidence 1 point	Criterion Score
Criterion 3 design work demonstrating a developing understanding of the study issues	design work demonstrates an understanding of the study issues that achieves excellence	design work demonstrates a developing understanding of the study issues that meets expectations	design work demonstrates an undeveloped understanding of the study issues that does not meet expectations	/ 10

Total	/ 20

Overall Score

achieves excellence 20 points minimum	meets expectations 15 points minimum	insufficient evidence 3 points minimum

Attendance or Participation Requirements

Except by prior permission or SDA, attendance in each class is mandatory. There will be a brief meeting at the beginning of each class session for student feedback. Participation in all reviews is mandatory.

Mid-term Standing

Oral feedback will be delivered with assignment reviews; the students expected to take notes and submit to the instructor. Written feedback will be delivered if a student is borderline or failing at that point.

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

Submission of Assignments
For each assignment, a PDF of the work is to be submitted to the corresponding Brightspace folder.

Group Assignments
The fourth assignment will be a group assignment, based on the Design Studio project and the Design Studio groups. All members of the group will receive the same grade.

Grading Format
The Course Instructor will review the final portfolio, after the assignments are reviewed. Final comments on the coursework will be given by request. Assignment grades will be issued privately to students through Brightspace, not posted.

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.

Calculation of Final Grades
Numerical grades for the assignments (through Brightspace), will be 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 21	yes	1.5%	July 13	receives 0% and no comments
Assignment 2	June 4	yes	1.5%	July 13	receives 0% and no comments
Assignment 3	June 18	yes	1.5%	July 13	receives 0% and no comments
Assignment 4	July 9	yes	1.5%	July 13	receives 0% and no comments
Assignment 5	July 12	yes	1.5%	July 13	receives 0% and no comments

* For example, if an assignment is evaluated at 75% before applying a 1.5%-per-weekday deduction, it would receive 73.5% for being 1–24 hours late; 71% for 25–48 hours late; etc. Note: less than 69% is a failing grade in the graduate school.

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.

M Pavilion, Melbourne - Sean Godsell Architects

Academic Integrity
Students are expected to submit original work. If the work raises a concern, the instructor may use plagiarism software to check an assignment.

Lecture Notes or Recordings
The instructor will provide lecture notes. Students may record lectures with permission.

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

Brian Lilley
12 Feb 2024

ARCH 5224: Climate Systems

Summer 2024 Dalhousie University, School of Architecture. Instructor: Brian Lilley brian.lilley@dal.ca

Assignment 1: Solar Power

Description

Solar Energy is the light and energy driver of our world, across scales, described by thermodynamic principles. Harvesting Solar Energy passively relies on a building's available solar hours, orientation relative to the Sun, compact proportion (a low surface area to volume ratio), selective shading (overhangs) and thermal mass storage. When these features are tailored to the local climate and environment, they can produce well-lit spaces that stay in a comfortable temperature range. Mixed Mode includes solar convection, solar aquatics, and PV or hot water panels. Harvesting Light involves patterns of solid and void, transparent material, receptor surface material, and principles of reflectance and absorption.

Readings + Seminar

Readings as per in Teams channels E1 and E2; for further interest:

Brown, Robert D. 2010. *Design With Microclimate: The Secret to Comfortable Outdoor Space*. Island Press.

"Daylighting | WBDG - Whole Building Design Guide." n.d. https://www.wbdg.org/resources/daylighting

Jones, David R.H. and Michael F. Ashby. 2019. *Engineering Materials 1: An Introduction to Properties, Applications and Design*. Butterworth-Heinemann.

Minke, Gernot. 2012. *Building With Earth: Design and Technology of a Sustainable Architecture*. Walter de Gruyter.

Moe, Kiel. 2010. *Thermally Active Surfaces in Architecture*. Princeton Architectural Press.

"Passive Solar Heating | WBDG - Whole Building Design Guide." n.d. https://www.wbdg.org/resources/passive-solar-heating

White, Mary Anne. 2018. *Physical Properties of Materials, Third Edition*. CRC Press.

Wikipedia. 2024. *"Daylighting (Architecture)."* Wikipedia. January 20, 2024. https://en.wikipedia.org/wiki/Daylighting_(architecture)

Wikipedia. 2023. *"Passive Solar Building Design."* Wikipedia. December 30, 2023. https://en.wikipedia.org/wiki/Passive_solar_building_design. https://www.wbdg.org/resources/daylighting

Experiments

Collecting Data: For large scale climate / weather conditions, take screenshots with 'Windy'.
For local climate / weather conditions overlays, the following smartphone apps (or similar) at your location: 'Sunseeker', 'Windseeker'.

Observation: Take a local walk and identify a Microclimate ideal for Solar harvesting and / or light transmission. Photograph and analyze its beneficial characteristics.

Sketch and take notes and photographs to record the following experimental work:

A. Harvesting: Place a solid mass (e.g. brick) in a window with a southerly orientation. On a sunny day measure the surface temperature of the brick and an adjacent wall, over a number of hours. If possible (ie materials are available) create a Trombe wall condition with glass, and a Solarwall condition with metal. Measure the decrement rate. Collate together with screenshot weather information.

B. Shielding: Use card materials (cereal boxes) to form a proportionally scaled opening with a flexible blind. Test with a light source. Sketch how this might be operational.

C. Porosity / Filter: Use a colander or a sieve or equivalent between the sun and your mass object. Is there a notable effect on surface temperature? Take photos of the perforated shadow patterns, and experiment with the size of dots using a hole punch or similar with cardboard material. Use foil material (or similar) to bounce light further into the room.

Assignment 1: Design an interior microclimate that has even daylight, is warm and dry, for a small library room (10x10x10 sqm maximum size, assembly occupation) assuming variable air changes depending on (flexible) functions. Sketch, model or computer model the room. Include information only to describe the solar flow of light and heat energy, material types and interaction (buoyancy, not ventilation). The assignment will include a brief reading synopsis, a hypothesis regarding passive thermal balancing and passive daylighting in creating a microclimate, experimental results, and a conclusion with action points for future architectural translation / application.

Grading
This assignment is worth 20% of the total grade. It is an individual assignment, evaluated by the instructor. The due date: 21 May, 9am. In-class review on same date. Format: Pdf portfolio pages uploaded to Brightspace Dropbox and Unit Conceptboard.

Grading Criteria
- criticality of written work and insightfulness of annotations to design work (5 pts). -
- clear, sequential development of investigations and testing of the study issues (5 pts).
- design work demonstrating an understanding of the study issues (10 pts)

ARCH 5224: Climate Systems

Summer 2024 Dalhousie University, School of Architecture. Instructor: Brian Lilley brian.lilley@dal.ca

Assignment 2: Air Pressure

Description

Principles of Air Pressure drive global weather systems and affect individual buildings. Harvesting air flow for energy is done with windmills, and effective ventilation orientation and opening proportions are key elements. Passive strategies include Buoyancy and Stack effect; Mixed Mode includes plenums, heat recovery, and earth tubes; filtering of Air relies on capillary tunnels and absorptive material, with porosities aligned to dust particle sizes.

Readings + Seminar

Cochran, Leighton. 2012. *Wind Issues in the Design of Buildings*. ASCE Publications.

Hunt, Nick. 2017. *Where the Wild Winds Are: Walking Europe's Winds From the Pennines to Provence*. Hachette UK.

Kato, Shinsuke, and Kyosuke Hiyama. 2012. *Ventilating Cities: Air-flow Criteria for Healthy and Comfortable Urban Living*. Springer Science & Business Media.

Lally, Sean. 2014. *The Air From Other Planets: A Brief History of Architecture to Come*. Lars Muller Publishers.

Lechner, Norbert. 2014. *Heating, Cooling, Lighting: Sustainable Design Methods for Architects*. John Wiley & Sons.

Mumovic, Dejan, and Mat Santamouris. 2013. *A Handbook of Sustainable Building Design and Engineering: An Integrated Approach to Energy, Health and Operational Performance*. Earthscan.

Passe, Ulrike, and Francine Battaglia. 2015. *Designing Spaces for Natural Ventilation: An Architect's Guide*. Routledge.

Short, C. Alan. 2017. *The Recovery of Natural Environments in Architecture: Air, Comfort and Climate*. Taylor & Francis.

Experiments

Collecting Data: Take screenshots with the following smartphone apps at your location: Windseeker or equivalent, Windy (Airgram window). Sketch and take notes and photographs to record the following experimental work:

Harvesting: Using a Draft detector (or candle or incense) measure the velocity / force of air ventilating your room at the window and at the door, correlate to Airgram screenshots, diagram, repeat over a number of hours in the day. Collate together with screenshot information.
Shielding: Use card materials (cereal boxes or what is at hand) to form a proportionally scaled opening with a flexible wind shutter, paying attention to wind deflection. Sketch how this might be operational.
Porosity / Filter: Fan and plastic bag – testing degrees of punctuation. Masking / breaking wind force – Hair Dryer. Use soft or porous material (or similar) to absorb or interfere with air movement.

Assignment 2: Design an exterior microclimate (partially covered) in Nova Scotia that can be used for sports throughout the year. The assignment will include a brief reading synopsis, a hypothesis, experimental results, and a conclusion with action points for architectural translation.

Grading

This assignment is worth 20% of the total grade. It is an individual assignment, evaluated by the instructor. The due date: 04 June 2024, 9am. In-class review on same date.

Format: Pdf portfolio pages uploaded to the Brightspace Dropbox, and review on Conceptboard.

Grading Criteria

- criticality of written work and insightfulness of annotations to design work (5 pts). -
- clear, sequential development of investigations and testing of the study issues (5 pts).
- design work demonstrating an understanding of the study issues (10 pts)

ARCH 5224: Climate Systems

Summer 2024 Dalhousie University, School of Architecture. Instructor: Brian Lilley brian.lilley@dal.ca

Assignment 3: Moisture Hydrology

Description

Hydrologic Systems provide a dynamic balance between large bodies of open water and filtered fresh groundwater. Harvesting involves rainwater retention through surface drainage, or through material permeability and groundwater reservoirs. Active systems include solar aquatics, hot-water panels, ocean-loop cooling, geothermal systems and water turbines.

Readings + Seminar

Haynes, Andrea. 2014. *A Floating Wetland Handbook*. SPUR Urban Centre.

Meyer, Christopher Michael, Shawna Michelle Meyer, and Daniel Hemmendinger. 2018. *Pamphlet Architecture 36: Buoyant Clarity.* Chronicle Books.

Mostafavi, Mohsen, and David Leatherbarrow. 1993. *On Weathering: The Life of Buildings in Time*. MIT Press.

Nute, Kevin. 2018. *Naturally Animated Architecture: Using the Movements of the Sun, Wind, and Rain to Bring Indoor Spaces and Sustainable Practices to Life*. World Scientific.

Pearson, Christie. 2020. *The Architecture of Bathing: Body, Landscape, Art*. National Geographic Books.

Keywords:
Hydrology
Drainage Planes, Condensation, Humidity
Hydronics, Geothermal, Ocean loop, Solar Aquatic

Experiments

Collecting Data: Take screenshots with the following smartphone apps at your location: Windy (Meteogram window). Sketch and take notes and photographs to record the following experimental work:

Harvesting: The Infinity Pool edge – Place one container inside of another, and a drain hole in the outer container. Place outside and observe the qualities as per a traditional Roman Impluvium. Record how much water you collect over a week (ml / cm2) and compare to your typical water usage for a week (L). How large of a collector surface would you need to balance? Or, how large of a personal Impluvium (or ?) do you need?
Shielding: Addressing surface build-up of Humidity, when wearing a mask and glasses. Using the principal of Surfactants, dip a pair of glasses (the glass) into soapy water and then let dry. Check the use of glasses again when wearing a mask, the fogging should be greatly reduced. What other options are available for surfactants?
Porosity / Filter: Using a typical brick, let it stand in a container of water, and measure how long it takes for capillary action to absorb the water. Note the environmental conditions. Repeat outdoors and record corresponding Meteogram readings.

Assignment 3: Design an interior / exterior threshold with a microclimate that is bright / well-ventilated / and moderately humid for a kitchen garden and indoor / outdoor dining. Include a Hydrology diagram that addresses water collection, storage, and recycling. The assignment will include a brief reading synopsis, a hypothesis, experimental results, and a conclusion with action points for architectural translation.

Grading

This assignment is worth 20% of the total grade. It is an individual assignment, evaluated by the instructor. The due date: 18 June 2024, 9am. In-class review on same date.

Format: Pdf portfolio pages uploaded to the Brightspace Dropbox, and review on Conceptboard.

Grading Criteria

- criticality of written work and insightfulness of annotations to design work (5 pts). -
- clear, sequential development of investigations and testing of the study issues (5 pts).
- design work demonstrating an understanding of the study issues (10 pts)

ARCH 5224: Climate Systems

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Assignment 4: Microclimate Design

Description

To achieve balance, the materials and flows that compose a building need to achieve a synergistic metabolism, working together to achieve a microclimate that invites human occupation. Of necessity, a mapping of material attributes for different flows: of solar, air and moisture can then in combination regulate an environment's temperature, light quality, air change capacity, and moisture content.

This will be a group or individual project, and should be coordinated with any design studio groups in place. Please send feedback about group formation by the first Tuesday class in this unit.

Readings + Seminar

Review of Solar, Wind and Moisture / Hydrology
Metabolism + Microclimates

- Identify key readings to support your hypothesis. Which readings from the previous units are relevant? To be discussed in class.

Experiments

Collecting Data: Take screenshots with the following smartphone apps at your project location: Windy or similar for describing site conditions. Sketch and take notes and photographs to record the following strategies and experimental work:

- Harvesting: Identify harvesting potential from your site studies
- Shielding necessities: indicate major weather loads and where blocking and deflecting strategies are useful
- Porosity / Filter: Identify opportunities to modify the local environment as per your Microclimate goals. Note the environmental conditions and range of modification necessary.

Conduct a suitable experiment related to material attributes in the assemblies that you propose, to help achieve your hypothesis:

1. Identify Microclimate potentials and formulate a hypothesis (goals). Use weather data and site photos / mappings to support your aims. Diagram the key microclimatic variables to support your formation of microclimatic goals.
2. Formulate Architectural Interventions that respond to your aims regarding Harvesting, Shielding, and Porosity. Design a small 'kitchen' experiment that explores these ideas.
3. Translate / Integrate these ideas into your architectural scheme for the Design Studio.

Assignment 4: Describe one of the major spaces in your M1 Design Project in terms of Material Attributes and phenomena flow, and the resulting microclimate. Diagram the key microclimatic variables to support your formation of key Microclimatic goals. The assignment will include a brief reading synopsis, a hypothesis, referenced experimental results, related detail design work, a description of key materials characteristics, and a conclusion with action points for your architectural translation.

Grading

This assignment is worth 30% of the total grade. It is a group assignment, evaluated by the instructor. The due date 09 July 2024, 9am. In-class review on same date.

Format: Pdf portfolio pages uploaded to the Brightspace Dropbox, and review on Conceptboard.

Grading Criteria

- criticality of written work and insightfulness of annotations to design work (5 pts). -
- clear, sequential development of investigations and testing of the study issues (5 pts).
- design work demonstrating an understanding of the study issues (20 pts)

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Assignment 5: Portfolio Reflection

Description

Reflect on the working method proposed by this class: combining Readings and Hands-on experimentation to inform design work.

- Identify key readings to support your hypothesis about Microclimate design, from Assignment 4.
- Identify key experimental approaches that you can pursue.
- Select work from this term's assignments that best considers the strategies of Harvesting, Shielding, and Porosity / Filter.

Assignment 5: In two pages describe with both text and images potential future research directions, based on your work: Consider key readings, possible experiments, work describing key strategies and action points for your architectural translation.

Grading

This assignment is worth 10% of the total grade. It is an individual assignment, evaluated by the instructor. The due date 12 July, 11.59pm. Format: Pdf portfolio pages uploaded to Brightspace Dropbox.

Grading Criteria: - criticality of written work and insightfulness of research supporting future investigations. (10 pts).