

# CIV\_ENV 388-2

## Building Science: Applications for Sustainable Buildings – part II

### Winter Quarter 2023

This course enriches and applies the concepts learned in Building Science part 1. The course comprises both theoretical and practical sessions. The theoretical sessions introduce the four indoor environmental factors affecting occupants' comfort inside buildings - thermal, visual, acoustic, and indoor air quality – and biophilic concepts. The practical sessions focus on the design of a virtual project consisting of a sustainable student housing, integrating concepts about occupants' comfort, well-being, and health with energy-efficiency principles. The goal of this project is to optimize design features such as orientation, building materials, openings, and shadings to guarantee the highest thermal and visual comfort to the occupants with the least energy consumption. Quantitative calculations related to energy consumption and visual and thermal parameters are conducted with the help of computer software presented in the practical sessions.

At the end of the course, students will be able to:

- Describe the indoor environmental parameters for occupant comfort
- Master sustainable solutions for energy-efficient and comfortable design
- Optimize a design based on trade-offs between energy and comfort aspects
- Use computer software for the calculation of human-centric and energy metrics
- Work in a group to iterate design
- Actively participate in design critiques
- Present a final project to a potential client motivating design choices

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<b>Instructor</b>	Dr. Giorgia Chinazzo Office: Tech A320 Office hours: By appointment (email to coordinate) Email: giorgia.chinazzo@northwestern.edu
<b>Class times</b>	2-3:20 Tuesday and Thursday
<b>Location</b>	Technological Institute M128

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**Suggested textbook** DeKay, Mark, and G. Z. Brown. *Sun, wind, and light: architectural design strategies*. John Wiley & Sons, 2013. (Available at Northwestern library)

**Pre-requisites** It is compulsory to attend the first Building Science course offered in the Fall quarter.  
However, special requests could be accommodated. Please contact the instructor.

<b>Course Assessment</b>	<p>Group project – <b>70%</b>  <i>Poster, report + interim, mid-term and final presentations of a sustainable design for a student housing (grade divided in smaller parts as detailed below)</i></p> <p>Mid-term exam – <b>15%</b>  <i>Multiple choices and open questions on the content presented in the first half of the course</i></p> <p>Final exam – <b>15%</b>  <i>Multiple choices and open questions on the content presented in the second half of the course</i></p>
<b>Deliverables</b>	Project Report, Poster, and Presentation

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## Evaluations and expectations

### Attendance & Participation

Students are expected to actively participate in all classes by asking questions, raising concerns, and facilitating discussions, especially during project critiques. Students are allowed one "freebie" absence that will not deduct points from the attendance grade. However, students cannot skip the classes in which they are supposed to present their project to the class.

### Mid-term and final exams

They comprise multiple choices and open questions on the content presented in the first and second half of the course (for the mid-term and final exam, respectively). Questions are associated with points according to their complexity, for a total of 100 points per exam.

The exams will last 60 minutes.

### Group project

Students are requested to work in a group to develop a sustainable design for a student housing. The project will be introduced in the first week of the course and explained in a separate document.

Three (graded) presentations of the project development (called interim presentations) are scheduled during the course, in which groups must present their project advancements to the instructor and the class. A final presentation to the class (graded) is scheduled in the last week of the course. Students are expected to actively participate in other groups' presentations (interim and final) with questions and comments. The participation to other groups' presentations will contribute to the final grade. Failure to present project advancements **in the presentations** will result in a No-pass final grade.

Deliverables (to be uploaded on Canvas):

- Final report
- Final poster (project presentation to a client)
- Final presentation

## Grade breakdown

Evaluation type	Assignment type	Points	Percentage of the final grade
Mid-term exam	Quizzes	100 points	15%
Final exam	Quizzes	100 points	15%
First interim presentation	Presentation	100 points	7%
Second interim presentation	Presentation	100 points	7%
Third interim presentation	Presentation	100 points	7%
Group Project (final presentation)	Poster	10 points	40%
	Presentation	10 points	
	Report	50 points	
	Overall project	30 points	
Individual questions to group projects	Questions	100 points (25p/presentation)	9%

All deliverables are due the day of the final presentation and must be uploaded on Canvas by 9 am (except the presentation that can be uploaded later in the day). **Late submissions are not accepted** and will receive a **grade of zero**.

## Grading Scheme

Students will receive A, B or C, No-Pass grades, following this scheme:

A = 93%–100% (Pass)

A- = 90%–92% (Pass)

B+ = 87%–89% (Pass)

B = 83%–86% (Pass)

B- = 80%–82% (Pass)

C+ = 77%–79% (Pass)

C = 73%–76% (Pass)

C- = 70%–72% (Pass)

F < 69% (No-Pass)

## Course Syllabus - Winter 2023

### CIV\_ENV 388-2: Building Science: Applications for Sustainable Buildings

Week	Date	Lecture	Topic(s)	Assignment(s)	Assignment due
1	01/04	Course Introduction	Presentation of the course (sessions and exams) Energy and comfort dichotomy  In-class exercise: start of case studies analysis	<b>Group project:</b> Group definition  <b>Readings:</b> readings 1 and 2	
	01/06	<u>Practical session:</u> project presentation	Presentation of case studies  Project presentation	<b>Group project:</b> Site, passive strategies, and example analysis; Shape, structure, materials definition; Sustainability diagrams (e.g, passive strategies, sunpaths); Hand calculations;  Start to write the report	Final definition of group members
2	01/11	<i>Theoretical session:</i> current literature and articles	Discussion about readings		Readings 1 and 2
	01/13	<i>Theoretical session:</i> Thermal comfort	Psychrometrics, heat balance, PMV model, local discomfort, adaptive thermal comfort model, advanced comfort models and indoor factors interactions		
3	01/18	<i>Theoretical session:</i> Visual comfort – part 1	End of Thermal comfort (local discomfort)  Physics of light, physiology of vision, measuring light with photometric quantities		
	01/20	<i>Theoretical session:</i> Visual comfort – part 2	Light sources, Visual comfort		

4	01/25	<i>Theoretical session:</i> Visual comfort – part 3	Daylight metrics, designing with daylight		
	01/27	<b><u>Evaluation: First interim presentation</u></b>	<i>First interim presentation by students (8 min each + 7 min discussion) + <b><u>active participation by other students (O&amp;A)</u></b></i>	<b>Group project:</b> work on feedback (change/implement design)  Watch Rhino+Grasshopper recordings	Project presentation: site, passive strategies, examples, project shape, orientation, openings, and materials; Sustainability diagrams (e.g, passive strategies, sunpaths); Hand calculations
5	02/01	<u>Practical session:</u> tool workshop	Rhino + Grasshopper (pre-recorded videos)  Intro on computer simulations and results visualization  ClimateStudio workshop – part 1 (visual simulation)	<b>Group project:</b> implementation of project in Rhino and Grasshopper	
	02/03	<u>Practical session:</u> tool workshop	ClimateStudio workshop – part 2 (thermal simulation and Grasshopper plugin)	<b>Group project:</b> Definition of design options to be tested (what and why?)  Update the report	
6	02/08	<b><u>Evaluation: Mid-term exam</u></b>	<i>Multiple choices and open questions on visual and thermal comfort</i>		
	02/10	<i>Theoretical session:</i> Building standards and certifications – part 1	Codes, LEED certification and other energy-centric certifications		
7	02/15	<b><u>Evaluation: Second interim presentation</u></b>	<i>Second interim presentation by students (8min each + 7 min discussion) + <b><u>active participation by other students (O&amp;A)</u></b></i>	<b>Group project:</b> Calculation of human-centric metrics (visual and thermal) and energy consumption results of design options  Update the report	Presentation of entire project and design options to be tested (what and why?). No simulation results!  (Nothing to upload on Canvas, but you can present your project with a presentation and/or a poster)

	02/17	<i>Theoretical session:</i> Building standards and certifications – part 2  Visual comfort	Human-centric certifications: Living Building Challenge  <i>Exam correction</i>		
8	02/22	<i>Theoretical session:</i> Building standards and certifications – part 3  Visual comfort	Human-centric certifications: WELL  Non-image forming effects of light ALFA tool		
	02/24	<i>Theoretical session:</i> Acoustic comfort	Basic theory of sound, human perception of sound, sound rating  Building acoustics (acoustic properties of materials, sound absorbers, room acoustics, sound transmission, and insulation)  Summary of healthy buildings – group work in class		
9	03/01	<b><u>Evaluation: Third interim presentation</u></b>	<b><u>Third interim presentation by students (8min each + 7 min discussion) + active participation by other students (Q&amp;A)</u></b>	<b>Group project:</b> additional design iterations to improve energy and comfort – work on the best trade-off.  Include design options about the interiors (furniture and finishes).  Integration of qualitative concepts about acoustic, air quality, biophilic design and healthy buildings in general	Presentation of human-centric metrics and energy consumption results of design options. Conclusions about best design option and/or new design options to test.

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Update the report

	03/03	<u>Practical session: Project revision</u>	<i>Working session</i> Q&A with instructor (individual groups)	<b>Group project:</b> finalize project: report, poster, and presentation
10	03/08	<u>Practical session: Project revision</u>	<i>Working session</i> Q&A with instructor (individual groups)	
	03/10	<b><u>Evaluation: Final presentation</u></b>	<b><u>Final presentation by students + active participation by other students (Q&amp;A)</u></b>	Upload poster, report, and presentation on Canvas ( <i>by 9 am</i> ).  Print poster to display during the final presentation
11	03/17 at 12:00 pm	<b><u>Evaluation: Final exam</u></b>	<i>Multiple choices and open questions on the content presented in the second half of the course</i>	

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#### **Academic Integrity**

Students in this course are required to comply with the policies found in the booklet, "Academic Integrity at Northwestern University: A Basic Guide". All papers submitted for credit in this course must be submitted electronically unless otherwise instructed by the professor. Your written work may be tested for plagiarized content. For details regarding academic integrity at Northwestern or to download the guide, visit: <https://www.northwestern.edu/provost/policies/academic-integrity/index.html>

#### **Accessibility**

Northwestern University is committed to providing the most accessible learning environment as possible for students with disabilities. Should you anticipate or experience disability-related barriers in the academic setting, please contact AccessibleNU to move forward with the university's established accommodation process (e: [accessiblenu@northwestern.edu](mailto:accessiblenu@northwestern.edu); p: 847-467-5530). If you already have established accommodations with AccessibleNU, please let me know as soon as possible, preferably within the first two weeks of the term, so we can work together to implement your disability accommodations. Disability information, including academic accommodations, is confidential under the Family Educational Rights and Privacy Act.

#### **COVID-19 Classroom Expectations**

Students, faculty, and staff must comply with University expectations regarding appropriate classroom behavior, including those outlined below and in the COVID-19 Code of Conduct. With respect to classroom procedures, this includes:

Policies regarding masking and social distancing evolve as the public health situation changes. Students are responsible for understanding and complying with current masking, testing, Symptom Tracking, and social distancing requirements.

In some classes, masking and/or social distancing may be required as a result of an Americans with Disabilities Act (ADA) accommodation for the instructor or a student in the class even when not generally required on campus. In such cases, the instructor will notify the class.



*No food is allowed inside classrooms. Drinks are permitted, but please keep your face covering on and use a straw.*

*Faculty may assign seats in some classes to help facilitate contact tracing in the event that a student tests positive for COVID-19. Students must sit in their assigned seats.*

*If a student fails to comply with the COVID-19 Code of Conduct or other University expectations related to COVID-19, the instructor may ask the student to leave the class. The instructor is asked to report the incident to the Office of Community Standards for additional follow-up.*

### **COVID-19 Testing Compliance**

*To protect the health of our community, Northwestern University requires unvaccinated students who are in on-campus programs to be tested for COVID-19 twice per week.*

*Students who fail to comply with current or future COVID-19 testing protocols will be referred to the Office of Community standards to face disciplinary action, including escalation up to restriction from campus and suspension.*

### **Diversity, Equity and Inclusion**

*This course strives to be an inclusive learning community, respecting those of differing backgrounds and beliefs. As a community, we aim to be respectful to all students in this class, regardless of race, ethnicity, socio-economic status, religion, gender identity or sexual orientation.*

### **Exceptions to Class Modality**

*Class sessions for this course will occur in person. Individual students will not be granted permission to attend remotely except as the result of an Americans with Disabilities Act (ADA) accommodation as determined by AccessibleNU.*

*Maintaining the health of the community remains our priority. If you are experiencing any symptoms of COVID do not attend class and update your Symptom Tracker application right away to connect with Northwestern's Case Management Team for guidance on next steps. Also contact the instructor as soon as possible to arrange to complete coursework.*

*Students who experience a personal emergency should contact the instructor as soon as possible to arrange to complete coursework.*

*Should public health recommendations prevent in person class from being held on a given day, the instructor or the university will notify students.*

### **Guidance on Class Recordings**

*This class or portions of this class will be recorded by the instructor for educational purposes. Your instructor will communicate how members of the class can access the recordings. Portions of the course that contain images, questions or commentary/discussion by students will be edited out of any recordings that are saved beyond the current term.*

### **Prohibition of Recording of Class Sessions by Students**

*Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of University policy and state law. Students requesting the use of assistive technology as an accommodation should contact AccessibleNU. Unauthorized use of classroom recordings – including distributing or posting them – is also prohibited. Under the University's Copyright Policy, faculty own the copyright to instructional materials – including those resources created specifically for the purposes of instruction, such as syllabi, lectures and lecture notes, and presentations. Students cannot copy, reproduce, display, or distribute these materials. Students who engage in unauthorized recording, unauthorized use of a recording, or unauthorized distribution of instructional materials will be referred to the appropriate University office for follow-up.*

### **Support for Wellness and Mental Health**

*Northwestern University is committed to supporting the wellness of our students. Student Affairs has multiple resources to support student wellness and mental health. If you are feeling distressed or overwhelmed, please reach out for help. Students can access confidential resources through the Counseling and Psychological Services (CAPS), Religious and Spiritual Life (RSL) and the Center for Awareness, Response and Education (CARE). Additional information on all of the resources mentioned above can be found here:*

*<https://www.northwestern.edu/counseling/>*

<https://www.northwestern.edu/religious-life/>

<https://www.northwestern.edu/care/>