

Building Enclosure Systems:

Bioclimatic and Ecological Approaches to Tall Building Enclosure Design

ARCH 505

Credit: 3 semester hours

Instructor: Jong-Jin Kim 734-763-3518 (o) daylight@umich.edu

Time: Monday 8:30 - 11:30 am

Format: Online

Office Hour: Wednesday 11:30-12:20PM (online)

DESCRIPTION

This course is to examine new environmentally sustainable methods of designing building enclosure systems. The revision of seven decade old practice of building enclosures as single-layer curtain walls is the ultimate goal of the course. Bioclimatic design and eco-diversity are the key course themes. New functions of building facades, windows and walls, will be introduced, and their performance criteria will be examined. Various methods of assembling multifunctional enclosure systems will be investigated to enhance the thermal and visual comfort in building perimeter zones and to improve the energy efficiency and resource self-sustainability of opaque and transparent building skins. In the process, recent advancements in high-performance glass technology, daylighting systems, and solar and wind energy production methods will be examined. As the final outcome of the course, each student will develop an innovative sustainable building enclosure system for a building type of his/her choice.

The main topics of the course include:

- 1) Thermal, visual and energy performance of windows and walls,
- 2) Enclosures for self-sustaining buildings,
- 3) Double Skin Enclosures,
- 4) Sun control, daylighting, natural ventilation and vegetated facade, and
- 5) Proposals for a multi-functional resource-producing enclosure system.

INSTRUCTIONAL METHODOLOGY

Online lectures will be given on a specific topic each week. Bi-weekly assignments and projects will be issued to develop innovative façade design schemes for tall buildings. Student-driven research on emerging building technologies and products that could be applied to new façade assemblies will be an important pedagogy of the course.

ATTENDANCE POLICY

All classes will be offered online, and all class meetings will be recorded. Attendance to all online classes are strongly encouraged. Students who reside outside the US Eastern time zone who cannot attend the class during the regular class hours are allowed to attend the classes

asynchronously using the recordings of class sessions. Interactive office hours will be set up for the students who cannot attend the classes during the regular hours.

SCHEDULE

Week	Topic
1	8/31 Course Introduction (Course Structure, Projects, Course Tools) Building Enclosure: Past, Present and Future
2	9/7 Labor Day (No Class)
3	9/14 Transparent Envelope: Glass Properties (U-values, Visible Transmittance, SHGF,), Solar Spectrum, Solar Heat Gain, Conductive Heat Loss, Glass Surface Temperature (Thermal Imaging) <i>Window 7.7.10 (https://windows.lbl.gov/tools/window/software-download)</i> <i>Assignment 1: Glass Property and Energy Conservation by High Performance Windows</i>
4	9/21 Glass Types and High Performance Glass
5	9/28 Enclosures for Self-Sustaining Buildings Roof Functions and Design <i>Project 1: Vision for Sustaining Building Enclosures</i>
6	10/5 Form-Driven Enclosure Design (Opaque Enclosures)
7	10/12 Energy and Resources Harnessing: Solar Thermal, PV, Site Solar Access Analysis <i>Project 2: Resource Production from Enclosures (Solar)</i>
8	10/19 Solar Application in Buildings and Daylighting, Passive Enclosure Design
9	10/26 Double Skin Envelope (Sealed) <i>Project 3: Double Skin Envelope</i>
10	11/2 Double Skin Envelope (Unsealed)
11	11/9 Science and Art of Sun Control, Sizing Shading Devices, Case-Study of Facades with Exterior Shading Devices <i>Project 4: Proposal for a Sustainable Building Enclosure (System Integration: Energy and Water Harvesting, Double Skin, Daylighting and Sun Control)</i> <i>Project 3 (Double Skin Facade) Due</i>

12	11/16	Double Skin Envelope (Case Study of the BSRB Double Skin)
13	11/23	Thanksgiving Break (No Class)
14	11/30	Perimeter Thermal Systems
15	12/7	Project 3 Review (Last Day of Class)

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in--class activities, and the way the course is usually taught may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Services for Students with Disabilities (SSD) office to help us determine appropriate academic accommodations. SSD (734-763-3000; <http://ssd.umich.edu>) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.

COLLEGE ACADEMIC POLICIES

Students are held to all of the academic policies of the college. For the college academic policies, refer the college website: <https://taubmancollege.umich.edu/policies>

Original writing and creative work are essential for academic integrity. The originality of student work will strongly be enforced. Note the college policies on plagiarism.

“Plagiarism is knowingly presenting another person's ideas, findings, images or written work as one's own by copying or reproducing without acknowledgement of the source. It is intellectual theft that violates basic academic standards. In order to uphold an equal evaluation for all work submitted, cases of plagiarism will be reviewed by the individual faculty member and/or the Program Chair. Punitive measures will range from failure of an assignment to expulsion from the University.”

ASSISTANCE IN WRITING

For assistance in writing, contact the ELI faculty in the building. The resources of the Sweetland Center for Writing are available for both undergraduate and graduate students. They offer classes, one--on--one assistance in a variety of modalities, and resource guides. Sweetland Writing Center: <http://lsa.umich.edu/sweetland>

ASSISTANCE IN MENTAL HEALTH AND WELLBEING

If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, please contact the instructor or Karen Henry (karhenry@umich.edu), the College counseling psychologist and therapist.

DIVERSITY, EQUITY AND INCLUSION

Taubman College affirms the principles of diversity, equity, and inclusion as we organize resources and priorities that align with our values. We seek to have a diverse group of persons at all levels of the college -- students, faculty, staff and administrators -- including persons of different race and ethnicity, national origin, gender and gender expression, socioeconomic status, sexual orientation, religious commitment, age, and disability status. We strive to create

a community of mutual respect and trust, a community in which all persons and their respective backgrounds, identities, and views are allowed to be made visible and communicated without the threat of bias, harassment, intimidation, or discrimination.

COURSE EVALUATION

Student participation in course evaluation at the end of the term is highly encouraged.

REFERENCES

- 1) Window 7 Program Download
<https://windows.lbl.gov/tools/window/software-download>
- 2) Window 7 Tutorial
<https://windows.lbl.gov/tools/window/documentation>
- 3) PVWatts Solar Calculator
<http://pvwatts.nrel.gov/>
- 4) Andrea Compagno, *Intelligent Glass Facades: Materials, Practice, Design*.
- 5) Curtainwall Primer
<http://www.pdhonline.org/courses/s119/s119.htm>
- 6) Building Envelope Design Guide – Wall System
http://www.wbdg.org/design/env_wall.php
- 7) T. R. Hamzah and Ken Yeang, *Bioclimatic Skyscrapers*, Ellipsis Ltd, London, 2000.
- 8) High Performance Commercial Façade, Selkowitz
<http://www.commercialwindows.org/autoshading.php>
- 9) Commercial Windows Org
<http://www.commercialwindows.org/autoshading.php>
- 10) Insulation Calculator
http://web.ornl.gov/sci/roofs+walls/insulation/ins_16.html
- 11) Jong-Jin Kim, Interactive Satellite Solar Lab, Project Report to the Third Century Initiative, University of Michigan, August, 2016.
- 12) Poirazis, H., Double Skin Facades for Office Buildings, http://www.lth.se/fileadmin/energi_byggnadsdesign/images/Publikationer/Bok-EBD-R3-G5_alt_2_Harris.pdf
- 13) Boake, T., M., The Tectonics of the Double Skin, <http://www.tboake.com/pdf/tectonic.pdf>
- 14) Zeleny, K. et. al., High Performance Facades, Center for the Built Environment, University of California, Berkeley, CA.