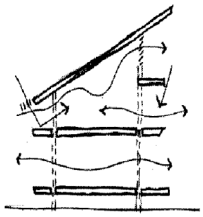


ARCHITECTURE 331/431

Environmental Control Systems
Spring 2008

SYLLABUS

INSTRUCTORS

Lecturer: Rob Peña, Associate Professor
rbpena@u.washington.edu • 206.543.7274
130n Architecture Hall

Lecture: 4:30 - 5:20 pm Tuesday & Thursday, 201 Gowan Hall

Discussions: ARCH 331: 5:30 - 6:20 pm Tuesday, 115 Smith Hall; Rob Peña
ARCH 431: 5:30 - 6:20; 6:30 - 7:20 Tuesday, Gould 440; Kevin van den Wymelenberg
ARCH 431: 5:30 - 6:20; 6:30 - 7:20 Thursday, Arch 110; Travis Anderson

UW COURSE CATALOG

ARCH 331 Environmental Control Systems: "*Description of thermal comfort needs and the means by which buildings can be designed to satisfy those needs. Consideration of how climate determines building forms, site analysis and planning vis-a-vis the local climate, basic heat transfer mechanisms, and design strategies for overcoming heat loss through the building envelope.*"

ARCH 431 Environmental Control Principles: "*Daylighting of buildings, reducing noise and enhancing sound for communication, and regulating heat transfer for occupant thermal comfort; description of passive means for environmental control, including presentation of scientific explanations and design guidelines for utilizing these means; design guidelines are intended for use in the preliminary schematic design phase.*"

OVERVIEW

Architecture 331/431 introduces the theory and application of climate, energy use, and comfort as determinants of architectural form. Emphasis is on architectural methods for climate adaptation using non-mechanical means of ventilating, cooling, heating, and lighting for envelope-load dominated buildings. There are two lectures and one discussion section weekly.

Some of the most interesting ways in which people interact with buildings involve lighting, heating, cooling, ventilation, sound, and water. Buildings are considered *successes* or *failures* in large part by how successfully they provide both the comfort and the inspiration promised by our senses of sight, sound, smell and taste. All these senses are involved in the person/ECS interaction. Environmental Control Systems address the interaction between people and forces of the environment as mediated by architecture and experienced through these senses. The emphasis of this course will be on sight (light), hearing (acoustics), and thermal comfort.

OBJECTIVES

The course objectives are to develop a deeper understanding of the relationship between architectural design and the environmental forces of sun, wind, and light. This design-centered course is intended to help you develop the ability to quickly test your architectural designs against fundamental ECS criteria informed by an understanding of effective and efficient ways to use energy and other environmental resources. Although these criteria are stated in a technical (easily calculated) way, they carry with them significant opportunities for social and esthetic development.

Students completing this course will

- Understand the environmental impact of buildings and implications of utilizing non-renewable and renewable energy sources.
- Understand how environmental adaptation is achieved through location, form and metabolism; that significant thermal and lighting requirements can be achieved architecturally rather than mechanically.
- Understand and apply principles of heat transfer.
- Understand the fundamentals of psychrometrics and apply this understanding to make appropriate architectural decisions related to climate.
- Understand how to achieve human comfort through climate-adapted design;
- Be able to collect, synthesize and communicate information about regional climate conditions;
- Be able to identify climatic characteristics of hot arid, hot humid, cold and temperate regions, as well as the appropriate architectural responses in those areas.
- Be able to design buildings that respond to climate, solar dynamics and daylight, to meet the fundamental requirements for heating, cooling and lighting.

COURSEWARE

Required Text:

Brown, Z.G., and DeKay, Mark. Sun, Wind & Light, 2nd Edition (2001). New York: John Wiley + Sons.

Recommended Texts:

Allen, Ed, and Iano, Joseph. The Architects Studio Companion, 3rd Edition (2001). New York: John Wiley + Sons.

Stein, Reynolds, Grondzik, Kwok. Mechanical and Electrical Equipment for Buildings, 10th edition (2006). New York: Wiley + Sons.

NOTEBOOK

It is recommended that lecture and discussion notes be organized into an 8-1/2" x 11", 3-ring notebook. The contents should include handwritten lecture notes, lecture slides (from PowerPoint presentations), handouts from lecture and discussion sections, design exercises, and notes from the readings.

COURSE REQUIREMENTS

Timely **attendance** and **participation** in lecture and discussion sections is essential to passing this course. **Readings** from *Sun, Wind & Light*, along with occasional supplemental readings to be made available on the course website, are designed as a baseline reference for the topics of the course. Students are expected to have completed the readings prior to class so that they can participate in discussions of the reading topics. **Design exercises** are aimed at reinforcing course concepts while supporting the work in your design studio. Weekly **quizzes** taken during lecture will further help reinforce course concepts and help prepare you for the **final exam**.

COURSE EVALUATION

Grades will be based on class attendance and participation, evaluation of the design exercises and their presentation, quizzes and a final exam, as follows:

Design Exercises	45%
Participation	5%
Quizzes	25%
Final Exam	25%

FOR FURTHER READING

Aronin, Jeffrey Ellis. (1953) *Climate & architecture*. New York: Reinhold.

Bourgeois, Jean-Louis. (1989) *Spectacular vernacular: the adobe tradition*. New York: Aperture, 1989.

Fathy, Hassan. (1986) *Natural energy and vernacular architecture: principles and examples with reference to hot arid climates*. Chicago: University of Chicago Press

Givoni, Baruch. (1998) *Climate Considerations in Buildings and Urban Design*. New York: Van Nostrand Reinhold.

Givoni, Baruch. (1976) *Man, Climate, Architecture*. London: Applied Science Publishers

Golany, Gideon. (1982) *Desert Planning*. London: Architectural Press.

Heschong, Lisa. (1979) *Thermal delight in architecture*. Cambridge, Mass.: MIT Press.

Lynch, Kevin and Gary Hack. (1984) *Site planning*, 3rd ed. Cambridge, Mass.: MIT Press.

Koenigsberger, O. H. (1973) *Manual of tropical housing and building*. London: Longman. TH153 .M35

Matus, Vladimir. (1988) *Design for northern climate: cold climate planning and environmental design*. New York: Van Nostrand Reinhold.

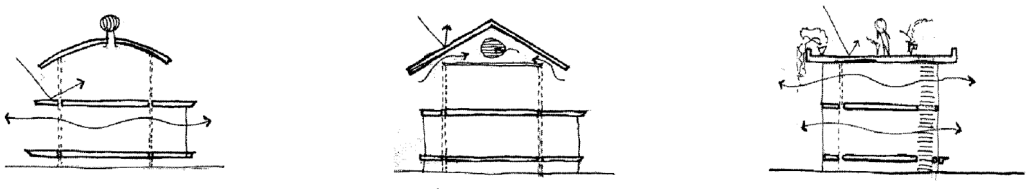
Olgyay, Victor. (1963) *Design with Climate*. Princeton, N.J.: Princeton University Press.

Oliver, Paul. (1987) *Dwellings : the house across the world*. Austin: University of Texas Press.

Strub, Harold. (1996) *Bare Poles: building design for high latitudes*. Ottawa : Carleton University Press.

Tan, Hock Beng. (1994) *Tropical architecture and interiors: tradition-based design of Indonesia, Malaysia, Singapore, Thailand*. Singapore: Page One Publications.

Watson, Donald and Kenneth Labs. (1983) *Climatic design: energy-efficient building principles and practices*. New York: McGraw-Hill.



Illustrations from Climate-responsive architecture, Richard Hyde, 2000.

PRELIMINARY COURSE SCHEDULE

DATES	*LECTURE TOPICS*	*READINGS*	*ASSIGNMENTS*
WEEK 1	**Ecological Design**		
T 4/1 R 4/3	1. Design and ECS 2. Environmental Adaptation	Reading Set 1 SWL: Introduction; 38, 43, 46-47, 49.	A1: Case Study of Climate-Responsive Design
WEEK 2	**Climate and Design**		
T 4/8 R 4/10	3. Climate Analysis 4. Psychrometrics & Design Strategies	SWL: 4-11, 18, 26-28.	A2: Climate Analysis: Graphics & Interpretation (A1 due in sections)
WEEK 3	**Thermal Transfer**		
T 4/15 R 4/17	5. Thermal Comfort 6. Heat Transfer + Building Envelope	SWL: 12-17, 19, 21-23.	A3: Envelope Heat Transfer (A2 due in sections)
WEEK 4	**Thermal Transfer**		
T 4/22 R 4/24	7. Whole Building Heat Transfer I 8. Whole Building Heat Transfer II	SWL: 76, 87-88, 97.	
WEEK 5	**Sun and Architecture**		
T 4/29 R 5/1	9. Solar Geometry 10. Analysis and Design Tools	SWL: 1-3, 29, 35, 42, 52-53.	A4: Shading Model Studies (A3 due in sections)
WEEK 6	**Sun and Architecture**		
T 5/6 R 5/8	11. Solar Control & Shading Masks 12. Guest Lecture	SWL: 20, 41, 45.	A5: Thermal Optimization
WEEK 7	**Design for Heating & Cooling**		
T 5/13 R 5/15	13. Architectural Sailing 14. Solar Heating	SWL: 55-57, 60-64, 77, 82-83, 93, 95.	(A4 due in sections)
WEEK 8	**Design for Heating & Cooling**		
T 5/20 R 5/22	15. Passive Heating, Solar Thermal & PV 16. Passive Cooling and Glazing	SWL: 24-25, 30-34, 36-37, 39-40, 48, 50, 59, 65-69, 72-75, 80-81, 86, 89-90, 101.	A6: Daylighting Model Studies (A5 due in sections)
WEEK 9	**Daylighting**		
T 5/27 R 5/29	17. Theory and Perception of Light 18. Daylight Analysis & Design I	SWL: 51, 54, 58, 70-71, 78-79, 84-85, 91-92, 94, 96, 98-100.	
WEEK 10	**Daylighting**		
T 6/3 R 6/5	19. Daylight Analysis & Design II 20. Course Summary and Exam Review		(A6 due in sections)
WEEK 11	**Finals Week**		
R 6/13	**FINAL EXAM: Friday, June 13 4:30 - 6:20 pm, Gowen 201**		

NOTES:

1. All readings come from Sun, Wind and Light, 2nd edition (2001)
2. Students must author their own work according to University Guidelines.
3. Work from the course may be collected for accreditation purposes.