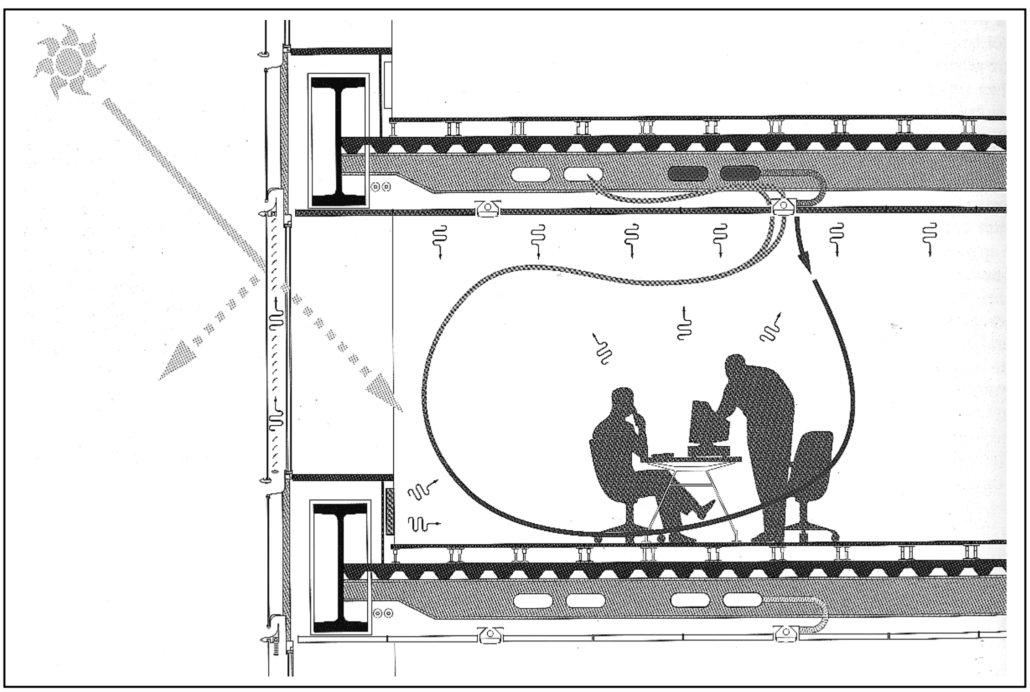
ARC 384K -- 00927

ENVIRONMENTAL CONTROL 2:

CASE STUDIES

Spring 2005
Dr. Steven Moore, AIA
Sutton 3.112
M/W 6:00-7:30



Contents:

1.0 Course Description:

This graduate course is a qualitative and quantitative survey of heating, cooling, ventilating, electrical, plumbing, solar, lighting, vertical transportation, and fire safety technologies. Following an introduction to the physical principles of environmental control, students will critically study the environmental control systems of selected cases so as to better understand the architectural, cultural, and ecological implications of the technological choices necessarily made in the process of design.

2.0 General Requirements:

2.1 Assumptions:

The assumption behind this course is that architectural practice requires knowledge that is both scientifically and culturally responsible. The best way to engage graduate students in the production of such knowledge is through the case study method.

2.2 Background

Technology courses in schools of architecture are commonly taught as *how-to* courses--*how to* size a beam, *how to* size a duct, and ultimately *how to* pass the NCARB registration examination. The positive aspect of this convention is that students are required to master a few quantitative design skills. Many educators now argue that, without such quantitative skills, the employment prospects of graduate architects will only slide further down the scale constructed by the consumers of design services. In this view, architectural education should re-emphasize quantifiable knowledge of physical systems so that our graduates might compete more effectively against engineers in the marketplace for design services.

One difficulty with this argument is that an emphasis upon knowledge that is always abstract and quantitative fails to reflect the situated and qualitative conditions of architectural practice. In practice, environmental control decisions are not made on the basis of purely quantitative criteria. Rather, such decisions are made in an atmosphere confused by rapidly changing culturally variables and the traditional compositional, or formal concerns of architecture. These conflicting variables include such difficult to quantify categories as *habit*, *regional availability*, *client preference*, *environmental impact* and *perceived benefit*. If architects must respond to such unquantifiable pressures it suggests that we need a different knowledge than that required of engineers. The irony here is that most architecture students now receive some quantitative training for which there is a decreasing demand, and no qualitative training for which there is an increasing demand. Scholars in Science and Technology Studies argue that the changing market for design services is proof, not of the contested division of labor between engineers and architects, but of the changing nature of technology itself. In this view, technology has become so complex that even the most optimistic client has developed concern for the unintended consequences of “good” engineering, i.e., sick building syndrome or worker discontent. These clients are, of course, concerned that designers quantify environmental controls efficiently. They are, however, more concerned that designers first critically evaluate the ecological and cultural impacts of technological choices before they are reduced to quantified strategies. There is, in other words, an unsatisfied market for design professionals who possess the skills to evaluate technology in quantitative *and* cultural terms.

2.3 Objectives:

The objective of this course is for graduate students to learn how environmental control systems are integrated into the design process. Successful completion of the course will give students the critical skills required to predict the architectural, environmental, and cultural implications of their design decisions. The systems to be investigated include:

2.3.1 The building envelope as the primary environmental control system.
2.3.2 The sizing and integration of mechanical and passive heating, ventilating, and cooling systems.
2.3.3 The organization of building electrical systems.
2.3.4 The organization and integration of plumbing systems.
2.3.5 The integration of building mechanical systems with available natural energy sources.
2.3.6 Basic fire protection strategies and exiting requirements.

2.4 Study methods:

The semester is structured around weekly topics that are investigated in lecture and case study format. Following three weeks of introductory material, Monday classes will be lectures by the instructor and Wednesday classes will generally be case study presentations by one or two students. Lectures and case studies presentations will examine the same issues from differing perspectives. Where lectures will emphasize theoretical concepts, case studies will emphasize how the various technological systems modify their architectural, social, and environmental contexts.

The texts and bibliographic resources listed below are by no means the limits of required research. Rather than feed graduate students the answers to predetermined “how-to” questions, one purpose of this course is to prepare students to locate the study resources required for the design of complex environmental systems. Think of this class as “joint research.” The team case study format is intended to, first, reflect the cooperative conditions of office practice, and second, provide team members with a forum to exchange ideas about the technological strategies that make the inhabitation of buildings viable.

2.5 Books:

2.5.1 Required books:

These texts are available at the Co-op:

Norbert Lechner, *Heating, Cooling, and Lighting: Design Methods for Architects*, second edition (New York: Wiley, 2001).

Edward Allen and Joseph Iano, *The Architect's Studio Companion: Rules of Thumb for Preliminary Design* (New York: Wiley, **1995**). [note edition]

2.5.2 Recommended books:

These texts are available at the Co-op, but will also be held on reserve at the Architecture and Planning Library:

Benjamin Stein, *Mechanical and Electrical Equipment for Buildings, 9th Ed.* (New York: Wiley, 2000). (This text is the official reference for the NCARB professional registration examination. It is a text that you should own.)

2.5.3 Reserve books:

The following reference books will be on reserve in the Architecture and Planning Library:

Battle McCarthy Consulting Engineers. "Wind Towers" (New York: John Wiley, Academy Editions, 1999).

Edward Allen, *How Buildings Work: The Natural Order of Architecture* (New York: Wiley).

William Bobenhausen, *Simplified Design of HVAC Systems* (New York: Wiley).

E.Z. Brown, Et. Al., *Insideout: Design Procedures for Passive Environmental Technologies, 2nd Ed*. (New York: Wiley).

Margaret Cottom-Winslow, *Environmental Design: Architecture and Technology* (New York: Wiley).

Klaus Daniels, *The Technology of Ecological Building* (Basel, Switzerland: Birkhauser, 1995).

Klaus Daniels, *Low-Tech, Light-Tech, High-Tech* (Basel, Switzerland: Birkhauser, 1998).

Davies, Colin and Ian Lambot. *Commerzbank Frankfurt: Prototype for an Ecological High-rise* (Basel, Switzerland: Birkhauser, 1997).

Cecil Eliot, *Technics and Architecture* (Cambridge, MA: MIT Press, 1994).

P.O. Fanger, *Thermal Comfort* (New York: McGraw Hill, 1970).

Givoni, Baruch. *Passive and Low Energy Cooling of Buildings* (New York: Van Nostrand Reinhold, 1994).

Guzowski, Mary. *Daylighting for Sustainable Design* (New york: McGraw-Hill, 1999).

Lisa Heschong, *Thermal Delight in Architecture* (Cambridge, MA: MIT Press, 1979).

John Tillman Lyle, *Regenerative Design for Sustainable Development* (New York: Wiley, 1994).

Mendler, Sandra F. and William Odell, *The HOK Guidebook to Sustainable Design* (New York: Wiley, 2000).

Olgyay, Victor. *Design With Climate: A Bioclimatic Approach to Architectural Regionalism* (New York: Van Nostrand Reinhold, 1992).

Catherine Slessor and John Linden, *Eco-Tech: Sustainable Architecture and High Technology* (New York: Wiley, 1998).

Benjamin Stein and John Reynolds, *Mechanical and Electrical Equipment for Buildings, 8th Ed.* (New York: Wiley, 1986).

Watson, Donald and Kenneth Labs. *Climatic Building Design: Energy Efficient* Building Principles and Practice (New York: McGraw-Hill, 1983).

2.5.4 Reserve articles:

The following articles will be held on reserve in the Architecture and planning library. These are not required reading, but should prove helpful to you in the qualitative interpretation of the selected cases. They will be collected in a three-ring binder and arranged alphabetically. After photocopying these for your own use, please take care to replace them in the correct order.

Mehdi Bahadoori, “Passive Cooling Systems in Iranian Architecture,” in *Scientific American 238/2* (February 1978): 144-154.

Eugenia Bone, “The House that Max Built, “ in *Metropolis* (December 1996): 37-47.

Ted Cavanagh, Balloon Houses: The Original Aspects of Conventional Wood-Frame Construction Re-examined,” in *JAE 51/1* (September 1997): 5-14.

Dunn, Seth. “Micropower: The Next Electrical Era,” Worldwatch Paper 151 (July 2000).

Andrew Feenberg, “Subversive Rationalization: Technology, Power, and Democracy,” in *Technology and the Politics of Knowledge*, Andrew Feenberg and Alistair Hannay, Eds., (Bloomington, IN: Indiana University Press, 1995), pp. 43-64.

Pliny Fisk III, “Bioregions and Biotechnologies,” in *New Perspectives in Planning in the West* (Arizona State University; May, 1983).

Garner, Andy. “Industrial Ecology: An Introduction” (Ann Arbor, MI: National Pollution Prevention Center for Higher Education.)

Thomas Hughes, “Edison and Electric Light,” in *The Social Shaping of Technology*, Donald MacKenzie and Judith Wajcman, Eds., (Philadelphia: Open University Press, 1985), pp. 39-52.

Frederic Jameson, “Spatial Equivalents in the World System,” in *Postmodernism, or The Cultural Logic of Late Capitalism* (Durham, NC: Duke University Press, 1991), pp., 97-130.

LEED Green Building Rating System, (Washington, DC: U.S. Green Building Council, 2000).

John Tillman Lyle, *Regenerative Design for Sustainable Development* (New York: Wiley, 1994), pp. 141-185.

-----. *Regenerative Design for Sustainable Development* (New York: Wiley, 1994), pp. 225-260.

William McDonough, “Design, Ecology, and the Making of Things,” in *Theorizing a New Agenda for Architecture*, Kate Nesbitt, Ed., (New York: Princeton Architectural Press, 1996), p. 398-407.

-----. “The Next Industrial Revolution,” in *Atlantic Monthly* (October 1998): pp. 82-92.

Steven A. Moore, “Energy Efficient Design,” in *The Encyclopedia of Twentieth Century Architecture*, R. Stephen Sennott, ed. (Chicago: Fitzroy Dearborn Publishers, forthcoming).

-----. “Environmental Issues,” in *The Encyclopedia of Twentieth Century Architecture*, R. Stephen Sennott, ed. (Chicago: Fitzroy Dearborn Publishers, forthcoming).

-----. *The Politics of Technological Choice*, lecture at the Architectural League of New York, “Shades of Green” lecture series, New York City 16 March, 2000.

-----. “Competing Dualisms in Sustainable Technology,” in *Proceedings of the 86th ACSA Annual Meeting and Technology Conference* Washington, DC: ACSA, 1998), pp., 22-29.

David Nye, *Consuming Power: A Social History of American Energies* (Cambridge, MA: MIT Press, 1998), pp. 1-12 and 249-264.

David Nye, “The Electrical Sublime,” in *American Technological Sublime* (Cambridge, MA: MIT Press, 1994), pp. 143-172.

Tom Peters, “An American Culture of Construction,” i *Perspecta 25: The Yale Architectural Journal* (New York: Rizzoli, 1989), pp. 142-161.

William E. Rees, “Revisiting Carrying Capacity: Area-Based Indicators of Sustainability,” unpublished paper presented to the international Workshop on *Evaluation Criteria for Sustainable Economy*, Institue fur Verfahrenstechnik, Technische Universitat Graz; Graz, Austria; 6-7 April, 1994.

RTKL, *Case Study in Sustainable Design* (Washington, DC: RTKL, 1999).

Silberman, Steve. “Energy Web,” in *Wired* (July 2001): 115-127.

Robert Thayer, *Gray World Green Heart* (New York: Wiley, 1994), pp. 136-161.

Ronald Tobey, *Technology as Freedom* (Berkeley, CA: UC Press, 1994), pp., 1-9, 194-214.

World water Council, “World Water Vision Commission Report: A Water Secure World.”

2.5.5 **Reader:**
A reader that includes required supplementary reading material is available for purchase at the Texas Union Copy Center.

2.5.6 Bibliography:
A general bibliography will be provided electronically to assist you in your research.

2.5.7 **Web Site Subscription:**
It is recommended that you subscribe to “Green Clips,” a web-based list-serve that reports on environmentally responsible developments in architectural technology: GreenClips@aol.com

3.0 **Course Schedule and reading**

Week	Monday	Mon assnmt	Wednesday
1- Jan 19			Course introduction • B. Allen: "Speculations on …" • Bijker: "Do Technologies…" Select case study #1 topics
2- Jan 24, 26	Lecture—sustainable design 1 • Moore: "Energy Efficient …" • Moore: "Environmental Issues"		Lecture—sustainable design 2 • Lechner: pp. 1-36 • Campbell: "Green Cities, Growing Cities, Just Cities."
3- J 31, F 2	Lecture—basic principals • Lechner: pp. 37-50	#1	Lecture—thermal comfort • Lechner: pp. 51-66
4- Feb 7, 9	• Lecture—macro-climate analysis Lechner: pp. 67-124		Lecture—micro-climate analysis • Lechner: pp. 125-140
5- Feb 14, 16	Lecture—passive solar design • Lechner: pp. 141-170	#2	Case study—passive solar design
6- Feb 21, 23	Lecture—active solar design • Lechner: pp. 171-200	#3	Case study—active solar design
7- Feb 28, M 2	Lecture—passive cooling design • Lechner: pp. 245-278	#4	Case study—passive cooling design
8- Mar 7, 9	Lecture—daylighting • Lechner: pp. 325-405	#5	Case study—daylighting
9- Mar 14, 16	no class spring break		No class, Spring Break
10- Mar 21, 23	Lecture—elec. systems and codes • E. Allen: pp. 3-12 • Bilello, "Redefining Health .." • E. Allen: pp. 160-162, 215	#6	Case study—integrated systems
11- Mar 28, 30	Lecture—HVAC 1, basic systems • Lechner: pp. 471-495	#7	Case study—integrated systems
12- Apr 4, 6	Lecture---HVAC 2, basic systems • Lechner: pp. 495-520	#8	Case study--integrated systems
13- Apr 11, 13	Lecture—HVAC 3, load control • Lechner: pp. 521-562	#9	Case study--integrated systems
14- Apr 18, 20	Lecture—water systems 1 • E. Allen: pp. 212-214		Case study--water systems
15- Apr 25, 27	Lecture—water systems 2 and fire protection systems • E. Allen: pp. 167, 174, 182, 214, 247, 436-438	#10	Case study--water harvesting
16- May 2, 4	Field trip		Case study—Commerzbank Frankfurt (Moore) • Davies: "Commerzbank …" • Pepchinski: :Commerzbank …"

4.0 Requirements:
Course requirements include 10 weekly assignments, two case studies, and class participation.

4.1 Weekly assignments:
On Mondays during the 10 weeks in the middle of the term, each student shall hand in a 2-page critical analysis, in 8 ½" x 11" format, that applies class discussion and your reading to the studio design project that is the subject of your case study #2. Your analysis should be principally graphic rather than in the textual format of a "book report." Quantitative analysis should be used wherever appropriate. You are at liberty to explore topics that will aid your design investigation, however, the topics listed below are intended as a helpful guide:

#1	Select and document in 8 ½ x 11" format a project from a previous studio for analysis. Document area, program, and a statement of design intent.
#2	Illustrate your macro-climate and micro-climate analysis. Clearly state the climatic problems that require resolution.
#3	Analyze how your building envelope responds to solar geometry and articulate problems that require resolution.
#4	Analyze how your building might incorporate active solar technology. Articulate why you will, or will not employ it.
#5	Analyze and demonstrate how your building incorporates passive ventilation and cooling strategies.
#6	Analyze and demonstrate how your building incorporates daylighting.
#7	Diagram the basic electrical system proposed, including entrance, MDP and sub-panels.
#8	Make a preliminary HVAC system selection, diagram components of the system, and design the mechanical room.
#9	Refine the HVAC system and diagram distribution, including integration with architectural systems.
#10	Diagram water systems, including integration with architectural and mechanical systems.

4.2 The case studies:
Your case study investigations should be both quantitative and qualitative. Quantitative analysis should critically examine the natural and mechanical capacities of the system under investigation and make recommendations for improved efficiency. Qualitative analysis should critically examine the cultural and historical conditions that lead to the selection of the system under investigation.

Case study #1: Analysis of specific systems
Teams of 1 or 2 students will investigate projects that demonstrate specific technologies under investigation in class (as listed in the above schedule). Teams may wish to investigate multiple examples of a system type to compare and contrast or you may select one particularly good case to examine in depth. In

either case you should meet with me at least two weeks before your class presentation to get approval for your selected cases and analytical approach. I will have reading and research suggestions for you. Remember, selecting the correct case for analysis is more that 50% of the problem. Scheduling a meeting is up to you.

Your investigation should generally follow this format:

1.0 A brief description of the project, program and cultural context
2.0 Location, macro and micro site analysis
3.0 Description and critical analysis of constructional systems employed
4.0 Graphic and critical analysis of how the building envelope contributes to the production of human comfort.
5.0 Graphic and critical analysis of mechanical, electrical and natural systems employed to assure human comfort
6.0 The equivalent of a 5-7 page illustrated essay that critically evaluates the “sustainability” of the project.

Your class presentation should be in Power-Point format. Please provide a CD-RW disk in a labeled container that will be kept in a SOA case study archive.

Case Study #2: Integration of studio and systems thinking

As architecture is experienced haptically, not just visually, this exercise is an opportunity for individual students to propose those environmental control strategies that will realize your design intentions for a current or previous studio project in thermal, auditory, and luminous terms. If you are not in a studio that lends itself to this exercise, or do not have a suitable prior project, I will assign a simple office building envelope that might serve as a point of departure for your study. Houses are not an acceptable building type for this study. Institutional or business occupancies of approximately 5-10,000 sf are ideal.

Your 10 weekly two-page analyses will contribute to this case study, but must be more than simply stapling them together at the semester’s conclusion. Your final proposal should respond to my comments made on weekly 2-pagers. The format should be both textual and graphic, but emphasis should be on graphic communication. All graphic material should be in 8 ½”x11” or 11”x17” format and bound into the report. Use the following outline as a general guide, but feel free to tailor the format to suit your purposes. Each of these categories of analysis should be very brief, but thoughtfully considered:

1.0 A brief description of the project program
2.0 Statement of your design intention
3.0 Location, macro and micro climatic analysis
4.0 Description of constructional systems proposed for walls, roofs, glazing, etc. Calculate thermal values.
5.0 Graphic and descriptive analysis of how the building envelope will serve as the principal environmental control system

6.0 Graphic and descriptive analysis of mechanical (heating, cooling, electrical and water) systems proposed to augment natural systems. Be as specific as possible about the systems selected, the proposed configuration, zoning, control type, and the criteria for your selection. Stress how natural and mechanical systems are integrated into the architecture.

7.0 Critical analysis and conclusion, ie. what did you learn from the analysis ... how might your building change?

5.0 Performance Evaluation

Work for the semester will be based upon the scale outlined below. If any student wishes to protest a grade, a request for review must be made within one week of its issuance, after which no grade revision will be considered. It is up to the student to request interim evaluations from the instructor if you are concerned about your progress.

Weekly individual assignments will be graded as follows:

"0" Adequate investigation—fulfills the requirement and will not effect the final course grade.
"+1" Exceptional investigation—exceeds the requirement and will improve the final course grade.
"-1" Inadequate investigation—does not fulfill the requirement and will detract from the final course grade.

In general, members of a team will receive the same grade for collaborative work in case studies. The instructor reserves the right, however, to modify the grade of team members who contribute either more, or less, to the investigation. Case studies will be evaluated as follows:

A: Students work is original and of exceptional intellectual quality, is very well written and graphically well presented, is supported by wide textual documentation, is structurally inventive, and is complete.

B: Students work is of high intellectual quality, is well written and well presented, is supported by textual documentation, progresses logically, and is complete.

C: Students work is of average intellectual quality, is written intelligibly and graphically clear, is supported by some textual documentation, progresses logically, and is complete.

D: Students work is of below average intellectual quality, is written and/or presented poorly, is not adequately supported by textual documentation, progresses illogically, and/or is incomplete.

F: Students work is of unacceptable intellectual quality, badly written and/or presented, unsupported, illogical, and/or incomplete.

Course requirements will contribute to the final grade as follows:

Case study 1	30%
Case study 2	50%
Participation in class discussion	20%
Total	100%

Absence from class will be considered in the final grade. Three or more unexcused absences will result in a course grade of “F.” Two unexcused absences will result in the lowering of the final grade. Tardiness may be considered an absence. Please note that class participation accounts for 20% of your final grade.

6.0 Office Hours: M/W 4:00-5:30 Goldsmith 4.134, or by appointment, Tel. 471-0131. E-mail samoore@mail.utexas.edu

The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641.