

970:651 Green Buildings

Tuesdays 9:50 am to 12:30 pm
Spring 2012
Civic Square Building, Room CSB 168
Office Hours: Tuesdays 2-6 pm

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Class Sakai Site: <http://sakai.rutgers.edu> 34:970:651:01 S12

This graduate seminar focuses on the green building phenomenon. It provides a multidisciplinary, rigorous, and practical introduction to green building. Students will learn about the following:

- *Social context: post-materialism, sustainable development, ecological modernization, socially responsible business, eco-imagination
- *Planning issues in green building: global commons and market failure problems, nested decision-making, green technology promotion
- *Finance & markets: real estate finance, market structure, green premiums and discounts
- *Design: architecture 101, engineering 101, integrated design process
- *Building performance evaluation: case studies, best practices
- *LEED and other design guides: key systems and design choices

Each student will prepare a final paper that represents a major independent research effort. A student may propose their own topic or choose from among topics offered by the instructor, who directs the Rutgers Center for Green Building.

The course employs a research seminar-practicum format, in which the instructor provides a conceptual overview of the day's topic, and then students apply the concepts to a specific case or in-class exercise. Thus each class will address both conceptual and practical issues.

No special disciplinary or mathematical background is required but students will be encouraged to use whatever they have. Course requirements include active participation in classroom cases/exercises and discussions (5% of grade); leading the classroom discussion of one or more practicum topics depending on the size of the class (10%); preparing a 1,000-word (+/-) written reflection on the readings for each of Parts I, II, III, and IV of the course (10% each); and a final paper on an approved topic proposed by the student with a length of about 5,000 words excluding tables and figures (45%). No exams.

Learning Objectives

After taking this course, a student should have a good understanding of green building as a phenomenon and area of professional practice. This single class will not turn a student into a fully equipped architect or engineer if they do not already have such a background, but it should expose the student to the trends, vocabulary, methods, and current debates in this exciting field. Through exposure to multiple disciplinary perspectives, the student should develop the confidence to participate in planning, policy, business, and technical decision making about green buildings.

Academic Integrity

Rutgers' academic integrity policy will be strictly enforced in this course (see full text at <http://academicintegrity.rutgers.edu/>). Sanctions for breaches of academic integrity range up to and include expulsion from the university. Students shall not plagiarize, cheat, fabricate, facilitate dishonesty by others, perform academic sabotage, violate research or professional ethics, or violate the law. The principles of academic integrity require that a student:

- properly acknowledge and cite all use of the ideas, results, or words of others.
- properly acknowledge all contributors to a given piece of work.
- make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of unsanctioned materials or unsanctioned collaboration.
- obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
- treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
- uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Readings:

All of the assigned readings except those in the required books listed here are stored in electronic form as pdf files on the class Sakai site.

Required:

O'Gorman, J.F. 1998. *ABC of Architecture*, University of Pennsylvania Press: Philadelphia, PA.

Randolph, J. and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*. Washington, DC: Island Press.

Recommended:

Farr, D. 2007. *Sustainable Urbanism: Urban Design with Nature*, John Wiley & Sons: Hoboken, NJ.

Gissen, D., ed. 2002. *Big & Green: Toward Sustainable Architecture in the 21st Century*, Princeton Architectural Press, New York.

Johnston, D., and S. Gibson. 2008. *Green from the Ground Up*. Taunton Press: Newtown, CT.

McClintock, M. ed. 2006. *Ultimate Guide to Home Repair and Improvement*, 2nd ed. Upper Saddle River, NJ: Creative Homeowner.

Norman, D.A. 2002. *The Design of Everyday Things*, 2nd ed. Basic Books: New York.

Schedule of Classes

<u>WEEK</u>	<u>DATE</u>	<u>LECTURE TOPIC</u>
		<u>Part I The Context for Green Building</u>
1	Jan. 17	Introduction and Overview
2	Jan. 24	Local Field Trip
3	Jan. 31	Markets and Finance
4	Feb. 7	Public Policy and Planning
		<u>Part II The Language of Architecture</u>
5	Feb. 14	Function
6	Feb. 21	Form and Structure
		<u>Part III Analyzing Key Systems</u>
7	Feb. 28	Water
8	Mar. 6	Light
		Spring Break
9	Mar. 20	Air
10	Mar. 27	Infrastructure and Energy
		<u>Part IV The Design Process</u>
11	Apr. 3	Design Guides
12	Apr. 10	Designing for the Life Cycle
13	Apr. 17	Evaluating Green Buildings
14	Apr. 24	Student Presentations

Assignments

Feb. 13	Reflection on readings in Part I due
Feb. 21	One-page proposal for final paper due
Feb. 27	Reflection on readings in Part II due
Apr. 2	Reflection on readings in Part III due
Apr. 23	Reflection on readings in Part IV due
Apr. 24	Presentation on final paper in class
May 3	Final paper due

Schedule of Topics, Readings, and Assignments

Part I The Context for Green Building

January 17 Introduction and Overview

Introduction and course overview, the ecological analogy, central issues and perspectives; socio-economic context of post-materialism, ecological modernization, industrial ecology, and socially responsible business; green buildings; LEED

Practicum: Critically evaluate our own Civic Square Building

Required Reading:

Andrews, C.J. 1999. "Putting Industrial Ecology into Place: Evolving Roles for Planners." *Journal of the American Planning Association* **65** (4): 364-375.

Randolph, J. and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*. Washington, DC: Island Press. Chapter 1 (pp. 1-28).

U.S. Environmental Protection Agency. 2010. *Green Building*. Available at <http://www.epa.gov/greenbuilding>.

U.S. Green Building Council. 2010. *LEED Projects & Case Studies Directory* <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx?CMSPageID=247>.

Wikipedia. 2010. Green Building. Available at http://en.wikipedia.org/wiki/Green_building.

Recommended Reading:

Benyus, J.M. 2002. *Biomimicry: Innovation Inspired by Nature*. HarperCollins Publishers, Inc.: New York.

McDonough W. and Braungart M. 2002. *Cradle to Cradle: Remaking the Way We Make Things*. North Point Press: New York.

American Institute of Architects (AIA). 2008. *AIA 50 to 50*. Available at <http://www.aia.org/fiftytofifty>.

January 24 Local Field Trip

Note: Instead of meeting in our regular classroom, we will meet at the Rutgers Visitor Center, 100 Sutphen Road, Room 104, Piscataway, NJ (Busch Campus, near football stadium, campus bus "A"). <http://rumaps.rutgers.edu/?q=bnun:3904>.

We will tour Rutgers' new green building, the Visitor Center, guided by Michael Kornitas, Rutgers Sustainability Coordinator. Wear comfortable shoes. Consider bringing a camera.

After the tour, we will discuss the class projects in detail, organize ourselves to work on them, and begin that work. Each student will choose to become involved in one of four class project options: (1) the *Team New Jersey* Solar Decathlon entry, during which our student team designs and constructs a net-zero energy solar house as part of an international competition; (2) the New Jersey Green Building Guidelines project, in which students assess best practices and advise the State of New Jersey on new public policies to promote green building; (3) the Green Building Simulation project which involves the use of computer models to assess the relative cost-effectiveness and interactions among elements of bundled green building strategies; or (4) telling the story of the new green Rutgers Visitors Center in poster and website form. Students will allocate project activities so as to create individually-gradable work products to the extent possible.

Required Reading:

- (1) TeamNJ Solar Decathlon entry. Competition website is <http://www.solardecathlon.gov/>. TeamNJ website is <http://www.solarteamnj.com>.
- (2) New Jersey Green Building Guidelines. Visit project web page. <http://rcgb.rutgers.edu/projects.asp?Level2ItemID=64>.
- (3) Green Building Simulation. Visit REM/Design software website. http://www.archenergy.com/products/rem/rem_design/.
- (4) Rutgers Visitor Center green features poster project. Visit website. <http://www.rutgers.edu/visit-us/visitor-center>.

Randolph, J. and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*. Washington, DC: Island Press. Chapters 2-3 (pp. 29-114).

January 31 Finance and Markets

Real estate finance, market structure, green premiums, life-cycle cost analysis

Practicum: Perform a life-cycle cost analysis of green elements of a new building in New Jersey.

Required Reading:

Steiner, Frederick, and Kent Butler. 2007. "Financial planning and analysis: The pro forma," Pp. 406-414 in *Planning and Urban Design Standards*, Student Edition. Hoboken, NJ: John Wiley & Sons.

Randolph, J. and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*. Washington, DC: Island Press. Chapter 5 (pp. 165-212).

Green Building Finance Consortium. 2008. Browse the research library at <http://www.greenbuildingfc.com>.

Recommended Reading:

Yeang, K. (1999) *The Green Skyscraper*, Prestel Verlag, Munich, "Preface," "Chapter 1: The skyscraper and other large buildings," and "Chapter 3: A Theory of ecological design," (pp. 7-30, 59-75).

Browse the following websites at

<http://www.emporis.com/en/wm/bu/?id=113942>

<http://science.howstuffworks.com/skyscraper.htm/printable>

<http://www.arch.hku.hk/research/BEER/sustain.htm>

February 7 Planning and Policy

Nested planning and policy framework: protecting global commons, correcting national market failures, regional smart growth, traditional neighborhood design, green technology promotion

Practicum: Consider the nested, interdependent relationships among green building and elements of urban planning, specifically: (1) density and corridors, (2) neighborhood design, (3) biophilia, and (4) high-performance infrastructures. Student groups will each tackle one of these public decision domains, and briefly present their findings to the class (10 minutes). These presentations should not merely regurgitate the required readings; they should go beyond them (i.e., rely on the recommended readings and your own sources).

Required Reading:

Cooper, G. 1998. *Air-Conditioning America: Engineers and the Controlled Environment 1900-1960*. Johns Hopkins University Press: Baltimore, MD, pp. 51-79.

Randolph, J. and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*. Washington, DC: Island Press. Chapters 16-18 (pp. 627-756).

Recommended Reading (discussion leaders start here):

Farr, D. 2007. *Sustainable Urbanism: Urban Design with Nature*, John Wiley & Sons: Hoboken, NJ. Pp. 18-101 (background), 102-111 (density), 112-123 (corridors), 124-167 (neighborhood design), 168-187 (biophilia), and 188-211 (high-performance buildings and infrastructure).

Part II The Language of Architecture

February 14 Function (Commodity)

Uses of buildings, architectural programming

Practicum: Guest lecture by the University Architect for Rutgers, Jeff Livingston. He will talk about how architects translate desired uses of buildings into specific architectural programs, using examples of recent projects at Rutgers.

Required Reading:

O'Gorman, J.F. 1998. *ABC of Architecture*, University of Pennsylvania Press: Philadelphia, PA, pp. 1-30

Norman, D.A. 2002. *The Design of Everyday Things*, Basic Books: New York, vii-xv, 1-33.

Brand, S. 1994. *How Buildings Learn*. Penguin Books: New York, pp. viii-23.

Recommended Reading:

Gissen, D., ed. (2002) *Big & Green: Toward Sustainable Architecture in the 21st Century*, Princeton Architectural Press, New York, pp. 10-78.

Yeang, K. (1999) *The Green Skyscraper*, Prestel Verlag, Munich, "Chapter 7: Designing the skyscraper's operational systems," (pp. 197-278).

February 21 Structure (Firmness) and Form (Delight)

Types and origins of structural systems, building materials, architectural aesthetics, revisiting usability

Practicum: Are green buildings ugly? Bring to class your nomination for (1) the most beautiful green building, and (2) the most beautiful conventional building. Place photos of them next to one another on one Powerpoint slide. Be prepared to discuss your aesthetic criteria.

Required Reading:

O'Gorman, J.F. 1998. *ABC of Architecture*, University of Pennsylvania Press: Philadelphia, PA, pp. 31-122.

Recommended Reading:

Owens, L.J. 1999. *A Green Vitruvius - Principles and Practice of Sustainable Architectural Design*. EarthScan: London.

Hildebrand G. 1999. *Origins of Architectural Pleasure*. University of California Press: Berkeley, CA.

Kellert S., Heerwagen J., Mador M. 2008. *Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life*. John Wiley: Hoboken, NJ.

McClintock, M. ed. 2006. *Ultimate Guide to Home Repair and Improvement*, 2nd ed. Upper Saddle River, NJ: Creative Homeowner. Pp. 24-63, 76-135, 456-513, 532-545.

Gissen, D., ed. (2002) *Big & Green: Toward Sustainable Architecture in the 21st Century*, Princeton Architectural Press, New York, pp. 78-143.

Yeang, K. (1999) *The Green Skyscraper*, Prestel Verlag, Munich, “Chapter 6: Design regarded as management of energy and materials,” (pp. 127-196).

Part III Analyzing Key Systems

February 28 Water

Plumbing, potable water, wastewater, stormwater

Practicum: Guest lecture by Francis Jordan on water use in green buildings.

Required Reading:

Krogmann, U., C.J. Andrews, M. Kim, G. Kiss, C. Mifflin. 2007. “Water mass balances for the Solaire and the 2020 Tower: Implications for closing the water loop in high-rise buildings,” *Journal of the American Water Resources Association* .

Recommended Reading:

Johnston, D., and S. Gibson. 2008. *Green from the Ground Up*. Taunton Press: Newtown, CT, pp. 155-172, 251-272.

McClintock, M. ed. 2006. *Ultimate Guide to Home Repair and Improvement*, 2nd ed. Upper Saddle River, NJ: Creative Homeowner. Pp. 304-409.

March 6 Light

Guest lecture, Daylighting, artificial lighting

Practicum: Measure lighting, daylighting and occupancy sensor performance at the Civic Square Building

Required Reading:

Randolph, J. and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*. Washington, DC: Island Press. Chapter 7 (pp. 263-306).

Recommended Reading:

Johnston, D., and S. Gibson. 2008. *Green from the Ground Up*. Taunton Press: Newtown, CT, pp. 43-66, 199-202.

McClintock, M. ed. 2006. *Ultimate Guide to Home Repair and Improvement*, 2nd ed. Upper Saddle River, NJ: Creative Homeowner. Pp. 514-529.

Spring Break—No Class

March 20 Air

Heating, ventilating, air-conditioning, indoor air quality

Practicum: Design an HVAC system retrofit for the Civic Square Building.

Required Reading:

Randolph, J. and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*. Washington, DC: Island Press. Chapters 6 & 7 (pp. 213-262).

Recommended Reading:

Johnston, D., and S. Gibson. 2008. *Green from the Ground Up*. Taunton Press: Newtown, CT, pp. 173-196, 273-286.

McClintock, M. ed. 2006. *Ultimate Guide to Home Repair and Improvement*, 2nd ed. Upper Saddle River, NJ: Creative Homeowner. Pp. 290-303, 410-437.

Cooper, G. 1998. *Air-Conditioning America: Engineers and the Controlled Environment 1900-1960*. Johns Hopkins University Press: Baltimore, MD.

March 27 Infrastructure and Energy

Electrical systems, civil works, district energy, energy science fundamentals

Practicum: Design a district energy system for downtown New Brunswick

Required Reading:

Andrews, C.J. 2008. "Energy conversion goes local: Implications for planners," *Journal of the American Planning Association* 74(2): 24 pp.

Randolph, J. and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*. Washington, DC: Island Press. Chapters 4 & 10 (pp. 117-164, 393-428).

Recommended Reading:

McClintock, M. ed. 2006. *Ultimate Guide to Home Repair and Improvement*, 2nd ed. Upper Saddle River, NJ: Creative Homeowner. Pp. 212-275.

Randolph, J. and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*. Washington, DC: Island Press. Chapter 9 (pp. 357-392).

Part IV The Design Process

April 3 Design Guides

LEED and other design guides: key systems and design choices

Practicum: Apply the LEED-EB framework to Civic Square Building.

Required Reading:

Randolph, J. and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*. Washington, DC: Island Press. Chapter 8 (pp. 307-356).

U.S. Green Building Council. 2008. LEED-EB Manual.

U.K. Green Building Council. 2008. Toolkit: An international review of design guides. Available at <http://www.ukgbc.org/site/toolkit>.

Recommended Reading:

Mendler S.F., Odell, W. and Lazarus M.A. 2000. *The HOK Guidebook to Sustainable Design*. John Wiley & Sons: New York.

EPA Energy Star Portfolio Manager

http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Tool sets available from LBNL <http://btech.lbl.gov/btd.html>

Tool sets available from RMI <http://bet.rmi.org/press-and-resources/resources.html>

April 10 Designing for the Life Cycle

Integrated design processes, life-cycle assessment

Practicum: In-class exercise applying a life-cycle assessment tool to analyze the design of the Meadowlands Environmental Education Center.

Required Reading:

Scientific Applications International Corporation. 2006. *Life Cycle Assessment: Principles and Practice*. Report EPA/600/R-06/060 prepared for the U.S. Environmental Protection Agency, Washington, DC. 88 pp.

Brand, S. 1994. *How Buildings Learn*. Penguin Books: New York, pp. 110-131.

Minderman, Krogmann et al. 2008. Assessment of the Meadowlands Environmental Education Center. Rutgers Center for Green Building.

Recommended Reading:

Blanchard, S. and P. Reppe. 1998. *Life Cycle Analysis of a Residential Home in Michigan*. Center for Sustainable Systems Report No. 1998-5. Ann Arbor, MI: University of Michigan. 71 pp.

April 17 Evaluating Green Buildings

Building performance evaluation methods, case studies, best practices, behaviorally-robust designs

Practicum: Guest lecture by noted environmental psychologist Richard Wener on post-occupancy evaluation of green buildings

Required Reading:

- Wener, Richard. 2003. "Post Occupancy Evaluation of the Built Environment," in R. Fernancez Ballesteros (Ed.) *Encyclopedia of Psychological Assessment*. London: Sage.
- Wener, Richard. 1990. "Advances in Evaluation of the Built Environment," in *Evaluation of the Built Environment*.
- Brand, S. 1994. *How Buildings Learn*. Penguin Books: New York, pp. 156-177.
- Leamon, Adrian. 2003. *Post-occupancy evaluation*. Report prepared for Gaia Research Sustainable Construction Continuing Professional Development seminar. Available online at www.usablebuildings.co.uk or on Sakai.
- Stern, P. (2002) "Changing behavior in households and communities: What have we learned?" pp. 201-211 in T. Dietz and P.C. Stern, eds., *New Tools for Environmental Protection: Education, Information, and Voluntary Measures*, National Academy Press, Washington, DC. Available online at <http://www.nap.edu/books/0309084229/html/>.

Recommended Reading:

- Gissen, D., ed. (2002) *Big & Green: Toward Sustainable Architecture in the 21st Century*, Princeton Architectural Press, New York, pp. 144-169.
- Kleindorfer, P.R. (1999) "Understanding individuals' environmental decisions: A decision science approach," pp. 37-56 in K. Sexton, A.A. Marcus, K.W. Easter, and T.D. Burkhardt, eds., *Better Environmental Decisions: Strategies for Governments, Businesses, and Communities*, Island Press, Washington, DC.
- Lutzenhiser, L. (2002) "Marketing household energy conservation: The message and the reality," pp. 49-66 in T. Dietz and P.C. Stern, eds., *New Tools for Environmental Protection: Education, Information, and Voluntary Measures*, National Academy Press, Washington, DC. Available online at <http://www.nap.edu/books/0309084229/html/>.
- Schultz, P.W. (2002) "Knowledge, information, and household recycling: The knowledge-deficit model of behavior change," pp. 67-82 in T. Dietz and P.C. Stern, eds., *New Tools for Environmental Protection: Education, Information, and Voluntary Measures*, National Academy Press, Washington, DC. Available online at <http://www.nap.edu/books/0309084229/html/>.

April 24 Student Presentations

Present results of student projects in class; solicit feedback

Final written paper due at 12 midnight on Wednesday, May 3rd. Give me an electronic version and also a hard copy.