ECOLOGY *and* DESIGN

Ecological Literacy in Architecture Education

2006 Report and Proposal

The AIA Committee on the Environment

AIA

Cover photos (clockwise)

Cornell University's entry in the 2005 Solar Decathlon included an edible garden. This team earned second place overall in the competition. Photo by Stefano Paltera/Solar Decathlon

Students collaborating in John Quale's ecoMOD course (University of Virginia), which received special recognition in this report (see page 61). Photo by ecoMOD

Students in Jim Wasley's Green Design Studio and Professional Practice Seminar (University of Wisconsin-Milwaukee) prepare to present to their client; this course was one of the three Ecological Literacy in Architecture Education grant recipients (see page 50). Photo by Jim Wasley

ECOLOGY *and* DESIGN

Ecological Literacy in Architecture Education

2006 Report and Proposal

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The AIA Committee on the Environment

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The AIA Committee on the Environment
Ecological Literacy in Architecture Education Report and Proposal

CONTENTS

Chapter 1: INTRODUCTION 1

- Executive Summary—1
- Project Overview—3
- Education for a Sustainable Future—8

Chapter 2: SUSTAINABILITY AND ECOLOGICAL LITERACY 13

- Defining Our Terms—13
- A Conversation with David Orr—16

Chapter 3: SUSTAINABILITY AND ARCHITECTURE EDUCATION 21

- The Nature of Architecture Education—21
- Curricular Innovation for Environmental Sustainability—23
- A Survey of Architecture Schools' Web Sites—37
- Trends Toward Ecological Literacy in Other Disciplines—40

Chapter 4: TEACHING AND LEARNING 43

- Coursework Introduction—43
- The Call for Papers—45
- Grant Recipients—46
- Special Recognition Recipients—New and Promising—59
- Special Recognition Recipients—64

Chapter 5: PROPOSAL FOR ACTION 73

- The AIA COTE Center for Ecological Design—73

APPENDIX 85

- Reference Sources and Other Relevant Works—85
- Champions of Ecological Literacy in Architecture Education—87
- Reading for Learning: Sample Reading Lists from Submitted Coursework—99
- Coursework Reading List Matrix—102
- Submitted Coursework—127
- Coursework Matrix—134
- Top Ten Measures of Sustainable Design—137
- Top Ten Green Project Award Recipients—143
- SBSE Retreat—146
- The Web Survey Report—147
- Teaching Design That Goes from Cradle to Cradle—165

Chapter 1

Introduction

Ecology is becoming the way to understand the world. This is something that we are all going to have to learn how to do. Organizations and professions are set up in a mechanistic way, and that will have to evolve . . . it will be redesigned . . . and this applies to the ways of teaching and learning.

— Thomas Fisher, Assoc. AIA, Professor and Dean, University of Minnesota College of Architecture and Landscape Architecture, 2005

Chapter 1 captions (clockwise)

Students in Michael Berk's Passive Building Systems Course (Mississippi State University) end the semester with a team-designed and -built solar box. Photo by Russ Houston

Students from California Polytechnic State University-San Luis Obispo building on the Mall at the Solar Decathlon (October 2005). Photo by Stefano Paltera/Solar Decathlon

The Rhode Island School of Design house at the 2005 Solar Decathlon included a roof garden; the team dined on the roof one evening during the competition. Photo by Chris Gunn/ Solar Decathlon

Students on the job site for John Quale's ecoMOD course. Photo by Dan Addison

CHAPTER 1: INTRODUCTION

EXECUTIVE SUMMARY

This report and proposal are the result of the American Institute of Architects (AIA) Committee on the Environment (COTE) Ecological Literacy in Architecture Education (ELAE) project. The seeds for the idea began with Daniel E. Williams, FAIA, and Mark Rylander, AIA, who were the 2003 and 2004 chairs of the AIA COTE Advisory Group. Vivian Loftness, FAIA, the 2005 chair, also played an important role in shaping the direction of the project.

COTE grew out of the AIA's Energy Committee and has been active since the 1980s, leading and coordinating the profession's involvement in environmental and energy-related issues and promoting the role of the architect in preserving and protecting our planet from environmental damage. The AIA COTE works to sustain and improve the environment by advancing and disseminating environmental knowledge and values and advocating the best design practices to integrate built and natural systems to the profession, industry, and the public.

Project Goal

A planning grant from the Tides Foundation's Kendeda Sustainability Fund set the project in motion. The goal was to assess the state of ecological literacy and the teaching of sustainable design in architecture education as part of a proposal for a large-scale, long-term effort, led by the AIA COTE, to inject ecological literacy and sustainability principles into architecture education in the United States. The education-focused effort would be concerned largely with schools of architecture, as well as other venues where students and practicing architects might learn about ecology and design.

Background and Terms

Chapter 1 provides background on efforts to bring environmental awareness into education across the board and recent efforts to bring issues of sustainability into architecture education. Chapter 2 includes a conversation with environmental educator David Orr as an important touchstone; his ideas are the underpinning of this report and proposal.

Chapter 2 defines sustainability, ecological literacy, and sustainable design for this document thus so: Sustainability envisions the prosperity of culture and nature. Discussions of sustainable design tend to be narrow in focus and vague in purpose so the broader goal of engaging various disciplines in the ecology of place tends to be misunderstood, marginalized, or dismissed altogether. Although architects now generally acknowledge that sustainability is important, many see it as a technical solution without fully understanding the mechanics or worth of green technologies. We posit that sustainable design must put as much emphasis on design as it does on sustainability.

Drawing on Orr's writings, we define ecological literacy as interdisciplinary education centered on direct interaction with the environment in which it occurs. The results are better minds and better places. We frame ecological design in Orr's words: "the careful meshing of human purposes with the larger patterns and flows of the natural world." To achieve this, designers need an intimate understanding of those patterns and flows, and they cannot attain that understanding within the conventionally narrow scope of their discipline. A broader, interdisciplinary education and process are essential.

Curriculum Catalysts and Current Snapshot
Chapter 3 addresses some of the leading examples of U.S. architecture departments where ecological literacy has made some or great impact. It points out where ecological literacy is seen in testing laboratories, history courses, community outreach, design-build, and green campuses. The chapter also covers organizations and programs that have been active in curriculum support in recent years. Chapter 4 profiles the winners of a call for coursework that yielded 44 submissions. Three were awarded grants and eight received special recognition.

Grant Recipients

- The Sustainable Environments Minor: Sustainable Environments and Implementing Sustainable Principles at California Polytechnic State University-San Luis Obispo, College of Architecture and Environmental Design; submitted by Jonathan Reich, AIA
- Comprehensive Green Design Studio and Professional Practice Seminar at the University of Wisconsin-Milwaukee, School of Architecture and Urban Planning; submitted by James Wasley
- Seminar in Architectural Technology and Technological Traditions at the University of Tennessee, College of Architecture and Design; submitted by Mark DeKay and Ted Shelton

Special Recognition

- Master of Science in Architecture: Sustainable Design Track at the University of Minnesota, College of Architecture and Landscape Architecture; submitted by Mary Guzowski
- ecoMOD Project at the University of Virginia, School of Architecture; submitted by John Quale
- Animated Architecture: Master of Architecture Thesis Research and Design Studio at Clemson University, School of Architecture; submitted by Keith Evan Green
- Arch 501 Graduate Design Studio and the Greening of the Campus Program at Ball State University, College of Architecture and Planning and the Center for Energy Research/Education/Service; submitted by Robert J. Koester
- Issues and Practices in Modern Architecture and Urbanism at Parsons School of Design at the New School, Department of Architecture, Interior Design, and Lighting; submitted by Jean Gardner
- Environmental Systems in Architecture and Other Coursework at Kansas State University, Department of Architecture; submitted by Gary Coates
- ARC 2713 Passive Building Systems (Ecological Design) at Mississippi State University, College of Architecture; submitted by Michael A. Berk
- Arch 316 Environmental Design and Mechanical Systems and Environmental Systems Laboratory at the University of Hawaii, School of Architecture; submitted by Stephen Meder

Proposal for the Center for Ecological Design
Chapter 5 is a proposal for the AIA COTE Center for Ecological Design (CED), which would focus on architecture education at all levels. The center would manage a series of activities and alliances, each aimed at advancing ecological literacy and the study of sustainability as an integral part of the study and practice of architecture.

This proposal is for the project to be housed within the AIA, largely guided by COTE and like-minded AIA constituencies, with its own staff and mission approved by the AIA Board of Directors (please note, however, the AIA has not accepted this proposal yet). It is the hope of

current AIA COTE leaders that this report will lead quickly to a deeper discussion with the Tides Foundation, COTE, and AIA leadership about how the center would fit into the AIA and how it would operate with outside funding. Several models exist that would work, and the discussion should involve all stakeholders. Not every recommendation in Chapter 5 would fit easily within the AIA; the full report will help the AIA identify priorities and synergies with initiatives currently under way.

That discussion would also include defining the key early priorities and initial relationships. The general priorities of the center can be understood in three umbrella areas: consolidation, advocacy, and consultancy. Specific priorities would include, for example, designing and producing an adaptable foundations course or courses that involve interdisciplinary collaboration. Partnerships and conversations with several organizations would commence immediately. This would lead to an articulation of where the center could best contribute, the resources required immediately and long term, a timeline, and a work plan for next steps.

Several of these activities could and should begin right away, even as the particulars of a center are assessed. As overall framework and budget issues are reviewed (the AIA declines to release specific budget details at this time), seed funding could be put to immediate use for workshops, research, publications, and curriculum development.

The pressing issue is to keep the dialogue active and move quickly to make positive change and lasting impact. This report is a snapshot in time and a call to action. Climate change, resource use, and building trends comprise an imperative for change for the profession and academia and for sustaining human life and quality of life on earth.

This is an unprecedented opportunity to have broad impact through modest and strategic initiatives; the possibility for overlapping benefits is great. Reinvigorating architectural research and creating opportunities for the profession to inform the academy will benefit practitioners, students, teachers, schools, and clients alike.

PROJECT OVERVIEW

The AIA Committee on the Environment (COTE) has long supported the study of sustainable design in architecture schools. A few years ago, AIA COTE leaders, including Daniel E. Williams, FAIA, Mark Rylander, AIA, and Vivian Loftness, FAIA, began talking about architecture education and ecological literacy, a deep understanding of the natural world, and systems that had emerged as the foundation for meaningful exploration of sustainable design. In 2004, the AIA COTE received a grant from the Tides Foundation to determine how the profession, through the AIA COTE, could affect the effort to bring sustainable design and ecological literacy into architecture education. “Progress has been made on sustainable design issues in the building professions,” Rylander said. “It is now important to make sense of the changes for educators and capitalize on the momentum of this practice trend.”

Rylander proposed that environmental educator David Orr’s ideas about ecological literacy be guideposts for the study and report. Orr proposed six foundations for ecological literacy in formal education or six principles to define what it would mean to educate people to live sustainably:

- All education is environmental education

- Environmental issues are complex and cannot be understood through a single discipline or department
- Education occurs in part as a dialogue with a place and has the characteristics of good conversation
- The way education occurs is as important as its content
- Experience in the natural world is an essential part of understanding the environment and conducive to good thinking
- Education relevant to the challenge of building a sustainable society will enhance the learner's competence with natural systems.[1]

These principles are further discussed in Chapter 2. The purpose of the Ecological Literacy in Architecture Education project was to

- Consider how Orr's ideas could or should affect the substance and process of architecture education
- Define sustainability and sustainable design as part of articulating why this subject is important to architects and their education and profession
- Evaluate current coursework for progress, profile leading examples, and provide an overview of existing and recent past efforts as the context to this planning effort
- Consider how sustainability and ecological literacy relate to the culture and values of architecture schools and the profession and consider ecology as the foundation for a transformative shift in architecture pedagogy and the architect's role in the collaborative process of design
- Propose a Center for Ecological Design and a series of events, research efforts, studies, and other activities to advance the goal.

In autumn 2004, a call for submittals was issued (through the Association of Collegiate Schools of Architecture and other channels) to collect a body of current coursework for examination. A second call was issued in early 2005 to increase the number of examples. Several volunteers joined the team and a process of analysis and discussion of the submitted coursework commenced. In May 2005, three examples were honored with grants and eight others were identified for special recognition; these programs are profiled in Chapter 4. Following publication of the report, the team will present the results and work with many of those profiled and mentioned herein to develop strategies to execute steps outlined in Chapter 5.

About the Project Team

The AIA Committee on the Environment (COTE) grew out of the AIA's Energy Committee, which was founded in the 1970s.[2] Today, the AIA COTE's purpose is to lead and coordinate the profession's involvement in environmental and energy-related issues and to promote the role of the architect in preserving and protecting our planet from environmental damage. The AIA COTE works to improve and sustain the environment by advancing and disseminating environmental knowledge and values, and advocating the best design practices to integrate built and natural systems to the profession, industry, and the public.

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[1] Orr, David. 1992. *Ecological Literacy*. Albany: State University of New York-Albany.

[2] That committee had ties to the AIA Research Corporation, an Institute organization that conducted significant building science and design research funded by several federal agencies. The effort was disbanded in the 1980s, and is widely understood as the last period during which the United States led the world in research on those topics.

The AIA COTE secures outside funding to sponsor project recognition programs, conferences, and other outreach and advocacy activities geared toward architects and related professionals. The national advisory group is made up of five volunteer professionals who plan major initiatives and work with volunteers to execute them. The AIA COTE's regional team is made up of six volunteer professionals (past chairs of local COTE chapters); there are 49 local chapters and more than 7,000 members nationwide. As an open committee (one that invites non-AIA member participation), the AIA COTE is a conduit to knowledge on environmental and energy-related issues and advises the Institute on related policy matters affecting the practice of architecture nationwide.

The AIA COTE seeks to

- Educate architects about the environment and the energy-related impact of design decisions and to encourage membership participation in these activities
- Communicate the AIA's environment and energy-related concerns to the public and private sectors and influence the decisions of the public, professionals, clients, and public officials on the impact of their environmental and energy-related decisions
- Foster leadership among architects in all facets of environmental decision-making
- Maintain alliances with organizations such as the U.S. Green Building Council, Urban Land Institute, American Solar Energy Society, Sustainable Buildings Industry Council, and UIA World Congress of Architects
- Promote and support the integration of sustainable design and ecological literacy in architecture education and practice as the key to the future of the profession and the planet.

Project Originator, Member of the Selection Team, and 2004 AIA COTE Advisory Group Chair

Mark Rylander, AIA, is an associate partner at William McDonough + Partners. He has worked there since 1995 on projects that advance eco-effective design and address issues of community health, which include the Nike Europe headquarters in the Netherlands and the recently completed Woods Hole Research Center Campus in Massachusetts. He has helped develop the AIA COTE's Top Ten Green Projects design awards program, initiated advocacy and education programs, and advised AIA leadership on policy issues. Mr. Rylander is an advisory board member, the sustainable design editor of *Architectural Graphic Standards,* and a guest speaker at conferences and architecture schools, including the University of Virginia.

ELAE Project Funder: The Tides Foundation

The Tides Foundation has worked with donors committed to positive social change since 1976. The Kendeda Sustainability Fund, a donor-advised fund at the Tides Foundation, was created in 2003 to explore how to live within the limits of the natural world in ways that promote community, equity, prosperity, and health. It funds organizations that focus on higher education, religion and faith, healthy buildings, materials and processes, and communications/media and the arts. Through its grant-making programs, the Tides Foundation strengthens social change organizations and increases the capacity and effectiveness of the nonprofit and public sectors. It supports activities in the areas of economic and social justice, environmental sustainability, and democratic renewal. In 2005, the Tides Foundation awarded almost $90 million to more than 2,000 nonprofit organizations. The ELAE project was managed by Catherine Lerza, senior philanthropic adviser with the Tides Foundation. She has worked with nonprofits on environmental, social justice, and women's issues for more than 30 years.

Project Advisor, 2005 AIA COTE Advisory Group Chair

Vivian Loftness, FAIA, is a professor and past department chair at the Carnegie Mellon University School of Architecture. She is an internationally known researcher, author, and educator with more than 30 years of focus on environmental design and sustainability, advanced building systems and systems integration, climate and regionalism in architecture, as well as design for performance in the workplace of the future. She is a key contributor to the development of the Intelligent Workplace, a living laboratory of commercial building innovations for performance, and has authored several publications on international advances in the workplace. She has worked to define the fundamental qualities of building performance, enhance the building delivery process, and inform critical design decision-making.

ELAE Project Originator, Member of Selection Team, and 2003 AIA COTE Advisory Group Chair

Daniel E. Williams, FAIA, is founder of Daniel Williams Architect, a Seattle architecture and planning firm specializing in sustainability. With more than 25 years experience in sustainable design in architecture, he has been appointed to the national advisory group for the U.S. Environmental Protection Agency's National Advisory Committee for Environmental Policy and Technology. He has also served on the United Nations Environment Programme, Sustainable Settlements Council. Mr. Williams was a leader on the urban design team for the Seattle monorail system; is a member of the Sustainable Seattle Advisory Council, a contributing adviser on the National Energy Policy; and was an adviser to the U.S. Green Building Council's LEED certification for site design.

ELAE Project Manager, Report Author, Member of Selection Team, and 2005 AIA COTE Advisory Group Member

Kira Gould, Assoc. AIA, is a senior associate in communications with Gould Evans, a 200-person, eight-office multidisciplinary design firm. She writes about architecture and sustainability for *Metropolis* (where she previously was managing editor), *Architectural Record*, *ArchitectureBoston*, *The Boston Globe*, and other publications. She earned a master's degree in architecture and design criticism from Parsons School of Design and undergraduate degrees in journalism and English from the University of Kansas.

ELAE Project Report Author and Member of Selection Team

Lance Hosey is the founder of ATMO/Atelier Modern, a Washington, D.C.-based design and architecture practice focusing on environmental innovation and interdisciplinary collaboration. He is a former associate with William McDonough + Partners, a pioneer of sustainable design. In 2005, Mr. Hosey was awarded a Next Generation Design Prize from *Metropolis* magazine, and in 2003 he was featured in *Architectural Record*'s "Emerging Architect" series. In 2002 he won the international competition to design the African-American Burial Ground Memorial at Monticello, the historic home of Thomas Jefferson in Charlottesville, Va. Currently he is working to found the Just Building Alliance, a nonprofit think tank and advocacy group dedicated to social justice in the construction industry. His essays on the environmental and social aspects of design have appeared in the *Washington Post*, *Metropolis*, *Architectural Record*, and *Architecture* magazine.

ELAE Project Volunteer

Greg Mella, AIA, LEED AP, is a principal with SmithGroup in Washington, D.C. Mr. Mella was the project architect for the Chesapeake Bay Foundation headquarters, which has been called the greenest office building in America and was the first building to earn the LEED platinum rating. The project was named one of the AIA COTE Top Ten Green Projects in 2001 and in the same year honored with a *Business Week/Architectural Record* award. His current projects include the Clemson University Institute for Economic and Community Development, which is targeted for a LEED platinum rating. He authored the Sustainable Design Guidelines for the University of

Connecticut. He has presented seminars on sustainable design at Catholic University, the University of Maryland, Syracuse University, Johns Hopkins University, the University of Arkansas, and Miami University of Ohio. He was a member of the U.S. team in the International Green Building Challenge 2002, an international effort to evaluate and improve the performance of buildings worldwide.

ELAE Project Volunteer
Kathleen Bakewell, LEED AP, is an associate principal at H. M. White Site Architects in New York City. Her design practice and academic work focus on the ecology and natural processes of public and institutional open space and green roofs. Her current projects include the Wildlife Conservation Society's Center for Global Conservation and the Sustainable South Bronx New Roof Demonstration Project, a cool and green roof project incorporating ideas of environmental justice, economic sustainability, public health, and permaculture. She holds a master's degree in landscape architecture from Harvard University and has taught at the New Jersey Institute of Technology's Graduate Architecture School, the Columbia University Graduate School of Architecture, Planning and Preservation, and the Yale School of Architecture.

ELAE Project Volunteer
Elizabeth Vandermark, AIA, LEED AP, is an associate with SmithGroup in Detroit. She has several years experience working in design, architecture, and project management. She received a master's degree in architecture from the University of Michigan and a bachelor's degree from the University of Virginia. Her recent projects include the University of Michigan Molecular, Cellular and Development Biology building and a renovation for Phizer. Ms. Vandermark has taught integrated design studios at Lawrence Technological University.

ELAE Project Volunteer
Eric Delss earned his bachelor of architecture degree from Virginia Polytechnic Institute and State University and his master of architecture in urban design from Harvard University. During his education, he began to realize the critical impact any built design has on the environment, though there was little emphasis on ecological literacy in his coursework. He believes ecological literacy studies should be integrated into all design curricula. He is currently working at Agoos/Lovera Architects in Philadelphia.

ELAE Project Volunteer: Emerging Professional
Matthew Wolf is in the Intern Development Program. He graduated from Southern Illinois University-Carbondale in 2003 with a bachelor's degree in applied sciences and arts/architectural studies. He works for Melotte Morse Leonatti (MML) Ltd. in Springfield, Ill. He was an undergraduate assistant for Jim Wright (former assistant professor at Southern Illinois University-Carbondale), who studied the pedagogy of sustainable design and the challenges of integrating sustainable design into mainstream architecture education. At MML, Mr. Wolf has worked on an affordable housing project (slated for LEED certification).

ELAE Project Volunteer
Peter Hind, Assoc. AIA, LEED AP, is a partner in an eight-member firm, Studio 951, in Lincoln, Nebr. He was previously director of the museum forum with Leo A. Daly in Omaha. Several of his projects have benefited from a whole systems approach to design and resulted in high performance. A recent project included close collaboration with the Rocky Mountain Institute. He also teaches a graduate-level course at the University of Nebraska, where he serves as visiting critic for foundation classes and a senior studio.

ELAE Project Researcher
Kate Bojsza, Assoc. AIA, holds a bachelor of architecture and bachelor of science degrees in social and cultural history from Carnegie Mellon University. In 2003–2004, she was the national vice president of the American Institute of Architecture Students (AIAS). Ms. Bojsza is employed with Pei Cobb Freed & Partners in New York City and is actively pursuing completion of the Intern Development Program. She also remains involved in the collateral architecture organizations as associate director (2005–2006) for AIA New York Chapter and as director (2004–2006) on the National Architectural Accrediting Board.

ELAE Project Support
John McRae, FAIA, joined the AIA in 2003 as senior director of grants and development, overseeing the Institute Research Agenda and securing sponsorship for Institute projects. Prior to this role, he was vice president for education and training at RTKL Associates. There, he was responsible for development and implementation of a comprehensive program of education and professional development and enrichment for the firm. Mr. McRae served as dean of the School of Architecture at Mississippi State University for 14 years prior to joining RTKL. He earlier served on the teaching faculty and in administrative positions at the College of Architecture at the University of Florida for 20 years. He is a past president of the Association of Collegiate Schools of Architecture. In August 2005, he returned to academia as dean of the College of Architecture and Design at the University of Tennessee.

ELAE Project Support
Vanessa Williamson is a knowledge community director at the AIA. In her role as director, she is responsible for high-level volunteer and resource management, grant project oversight, strategic and programmatic planning, and budget management for 10 knowledge communities, representing thousands of AIA members.

ELAE Project Support
Marsha Garcia is a project manager at the AIA. She provides support for the activities of several knowledge communities, working closely with volunteer leaders to develop knowledge in different areas of architectural specialty.

EDUCATION FOR A SUSTAINABLE FUTURE

The movement to bring ecological literacy into architecture education is occurring within a broader effort to "green" education. Efforts to impact early childhood, elementary, and secondary education have been under way for years through such groups as Fritjof Capra's Center for Ecoliteracy and the Cloud Institute for Sustainability Education.

David Orr is one of the best known thinkers and educators behind this movement. His many writings on the topic have inspired many people in this field. Orr has urged educators and administrators to foster campuswide dialogue about how they run their schools: Do four years here make your graduates better planetary citizens or do they make your graduates, in Wendell Berry's words, 'itinerant professional vandals'? Does this college contribute to the development of a sustainable regional economy or, in the name of efficiency, to the processes of destruction? He encourages them to examine resource flows on campus and seek ways to find healthier, less damaging energy sources and to "set a goal of ecological literacy for all of your students. No student should graduate from this or any other educational institution without a basic comprehension of the laws of thermodynamics and the basic principles of ecology, carrying

capacity, energetics, least-cost end-use analysis, how to live well in a place, limits of technology, appropriate scale, sustainable agriculture and forestry, steady-state economics, and environmental ethics."[3]

The Association of University Leaders for a Sustainable Future (ULSF), a program of the Center for Respect of Life and Environment, proposes to make sustainability a major focus of teaching, research, operations, and outreach at colleges and universities worldwide. Some 300 higher education institutions have signed the Talloires Declaration, committing them to sustainability and environmental literacy in teaching and practice. According to the ULSF, "Higher education is beginning to recognize the need to reflect the reality that humanity is affecting the environment in ways which are historically unprecedented and which are potentially devastating for both natural ecosystems and ourselves. Since colleges and universities are an integral part of the global economy and since they prepare most of the professionals who develop, manage, and teach in society's public, private, and nongovernmental institutions, they are uniquely positioned to influence the direction we choose to take as a society. As major contributors to the values, health, and well-being of society, higher education has a fundamental responsibility to teach, train, and do research for sustainability."

Second Nature was founded by Anthony Cortese, John and Teresa Kerry, and others to work toward a just and sustainable future through, among other things, promoting education for sustainability. Until it scaled back operations in 2002, it ran advocacy and outreach programs and a Web site (and curriculum database) and orchestrated workshops, conferences, and other gatherings. Cortese's work is now primarily with an organization called EFS West and he is working to develop alliances between professional organizations and others on the topic. Second Nature's mission has been to transform university education across the board although some efforts were directed specifically to architecture education.

But efforts to bring bioclimatic issues and passive solar architecture into the architecture classroom had begun years before. A great deal of important work began in the 1970s by a broad set of thinkers, educators, and authors. One project widely acknowledged as a significant milestone was a study by Harrison Fraker, FAIA, now dean at the University of California–Berkeley's College of Environmental Design, and Don Prowler, FAIA, an influential teacher who died in 2002. The study was funded by the U.S. Department of Energy and resulted in a framework and course modules for an important shift in architecture based on passive solar design and other environmentally based theories and practices. The volumes documenting this framework were honored in 1983 with a research award from *Progressive Architecture*.

Other organizations, far too many to mention here, have sponsored significant discussions of these topics in recent years. In 1998, Global Possibilities, the Earth Group, and the Cooper-Hewitt National Design Museum hosted the Second Annual Symposium for a Solar Future, Rethinking Design Curriculum: Integrating Solar Energy for a Sustainable Future. The Association of Collegiate Schools of Architecture (ACSA) had a Sustainability Task Force from 2000 to 2003 (after which it became a listserv). The task force held panel discussions at ACSA conferences, worked with the National Architectural Accrediting Board (NAAB) to update its criteria to include reference to sustainability, and hosted a Cranbrook teachers' seminar in 2003. The Society of Building Science Educators (SBSE), founded in 1982 by G. Z. Brown and Edward

[3] Orr, David. 1991, Winter. "What Is Education For? Six Myths about the Foundations of Modern Education and Six New Principles to Replace Them." *In Context*, p. 52.

Arens to support and connect educators working in this area, sponsors annual retreats and promotes research and pedagogical excellence in the areas of environmental science, building technologies, and design. (More details on several of these efforts can be found in Chapter 3.)

Students have participated in the conversation, too. The American Institute of Architecture Students (AIAS) is an organization of some 6,200 students; it serves as the student voice in decisions made at the AIA, ACSA, and NAAB. The 2002 AIAS conference in Pittsburgh, Going Beyond Green, focused on regional efforts, sustainable design, and environmental and quality-of-life initiatives (speakers included Pliny Fisk III, Ken Yeang, and James Wines; more than 800 students attended).

For some universities, the shift toward sustainability is almost nonexistent in the architecture classroom, but is happening in the campus physical plant—itself another "classroom" for students, faculty, and staff. The green campus movement has grown significantly in the last decade. An early leader, Ball State University hosted its sixth green campus conference in 2005. The Society for College and University Planning (SCUP) hosts an annual campus sustainability day. Orr has been an inspiration on this front, eloquently noting that architecture serves a pedagogical function. His work with William McDonough + Partners on the Adam Joseph Lewis Center for Environmental Studies at Oberlin was modeled on these ideas. A recent article in the *Washington Post* noted a sense of competition among leading universities to be most sustainable.

The media has a role, too. Mainstream media tends to report environmental issues only when a disaster has occurred, and then only in narrow terms. Coverage of climate issues, when it happens, rarely includes architecture and building—small wonder, given that American architecture and design media have been somewhat slow to seriously address sustainable design and rarely, if ever, address the subject of sustainability in design education. *Metropolis* magazine has embraced it more than most, with an ongoing interest in the state of design education across the disciplines and has used sustainability as a lens on contemporary design in general since the early 1990s. The magazine's 2003 survey of deans, educators, and students had 67 percent of respondents calling sustainability "relevant" to their design curricula, yet only 14 percent said their institutions were developing programs to address this. The year before, 70 percent of respondents in a *Metropolis* survey of practitioners said they believed they were "not equipped" to do a sustainable design job.

Within the profession of architecture, the importance of sustainability was clear to some as early as the 1970s and 1980s, when building research at the AIA focused on energy and related issues. But that focus shifted, and it wasn't until the 1990s that it would be embraced again. A report commissioned by such architecture organizations as the AIA, AIAS, NAAB, ACSA, and the National Council of Architectural Registration Boards was released in 1996. *Building Community: A New Future for Architecture Education and Practice* is usually referred to as the Boyer Report in honor of Ernest Boyer, the leading educational thinker who authored much of the text. Carnegie Senior Fellow Lee Mitgang coauthored the document and presented it to the profession at the AIA national convention. The document articulated seven goals, three of which relate directly to issues of ecological literacy:

> *An Enriched Mission*: "We recommend that schools of architecture should embrace, as their primary objectives, the education of future practitioners trained and dedicated to promoting the value of beauty in our society; the rebirth and preservation of our cities; the need to build for human needs and happiness; and the creation of a healthier, more environmentally sustainable architecture that respects precious resources . . [W]e urge schools of architecture to prepare future practitioners capable not only of creating beauty, but also able to

> communicate, clearly and convincingly, its value to the public. . . The profession, schools, and students should expand their knowledge, for example, of energy, the use of renewable resources, the recycling process, the use of carcinogenic materials, and the safe disposal of waste."
>
> *A Connected Curriculum*: "A connected curriculum would encourage the integration, application, and discovery of knowledge within and outside the architecture discipline, while effectively making the connections between architectural knowledge and the changing needs of the profession, clients, communities, and society as a whole. . . The need for a liberal architecture curriculum is particularly urgent for students who begin their professional programs directly from high school. . . Making the connections, both within the architecture curriculum and between architecture and other disciplines on campus, is, we believe, the single most important challenge confronting architectural programs."
>
> *Service to the Nation*: "To realize this last goal for renewal, schools should help increase the storehouse of new knowledge to build spaces that enrich communities, prepare architects to communicate more effectively the value of their knowledge and their craft to society, and practice their profession at all times with the highest ethical standards . . . Students and faculty alike should regard civic activism as an essential part of scholarship. . . For students to recognize the professional and ethical importance of civic engagement in their own lives, such behavior ought to govern the day-to-day conduct of each faculty member and the school as a whole."

Many of the sustainability-related goals outlined in the Boyer Report have not been met, nearly 10 years after its release. The profession is not a leader in interdisciplinary excellence and there is a long way to go toward understanding global climatic issues. But progress has been made in several areas. Broader interest in sustainable design has begun to change some schools of architecture in the same way it has begun to change many architecture firms and the process by which they work. There is demand for interdisciplinary collaboration, systems thinking, and an ability to think in nesting scales of responsibility. New courses, programs, schools, and institutes are cropping up to meet the need, even as some who have been teaching bioclimatic design since the 1970s are still doing so at some of the same or nearby institutions. It's a fertile and important moment for the academy and the profession, and the challenges to both are many.

Chapter 2

Sustainability and Ecological Literacy

What if higher education were to take a leadership role, as it did in the space race and the war on cancer, in preparing students and providing the information and knowledge to achieve a just and sustainable society? What would higher education look like? The education of all professionals would reflect a new approach to learning and practice. A college or university would operate as a fully integrated community that models social and biological sustainability itself in its interdependence with the local, regional, and global communities. In many cases, we think of teaching, research, operations, and relations with local communities as separate activities; they are not. All parts of the higher education system are critical to achieving transformative change that can only occur by connecting head, heart, and hand.

— Anthony D. Cortese, President, Second Nature, 2004

Chapter 2 captions (top to bottom)

Cornell University's entry in the 2005 Solar Decathlon included an edible garden. This team earned second place overall in the competition. Photo by Stefano Paltera/Solar Decathlon

Students and faculty at the Oberlin College Adam J. Lewis Center (William McDonough + Partners) for the August 2003 Agents of Change workshop. Photo courtesy of Agents of Change

The house designed and built by the Pittsburgh Synergy team (Carnegie Mellon University, the University of Pittsburgh, and the Art Institute of Pittsburgh) for the 2005 Solar Decathlon had a wall of windows and a porch. Photo by Chris Gunn/Solar Decathlon

CHAPTER 2: SUSTAINABILITY AND ECOLOGICAL LITERACY

DEFINING OUR TERMS

Sustainability

Architects often refer to sustainability as if there is wide consensus about its meaning and its implied strategies. In fact, the term has become so common and used in so many different ways that it almost eludes definition, which is why it is important to clarify what it means in the context of this report. The word itself is clear: to sustain something is to keep it in existence. (Sustain stems from roots meaning "to hold from below," to provide support.) Generally speaking, then, sustainability is the task of maintaining existence. But such a simple definition begs many questions, the most obvious of which is the existence of whom or of what?

On its Web site, the AIA COTE states it is "dedicated to preserving the earth's capability of sustaining human existence." This statement implies supporting the ability of both humanity and nature to exist, rather than supporting human activity at the expense of nature.

But existence alone does not ensure prosperity and, as it is popularly understood, sustainability is a hopeful agenda aiming for more than mere survival. The so-called "triple bottom line" of sustainability strives for maximum value, not just slight improvement, in three areas—ecology, economy, and society. In other words, sustainability envisions the prosperity of culture and nature. Both should thrive, not just survive.

The word sustainable came into widespread use after Lester Brown's seminal book, *Building a Sustainable Society,* appeared in 1980. While he offered insightful criticism and strategies "to put us on a sustainable path," he neglected to define the term itself. The most familiar explanation came seven years later when the United Nation's World Commission on Environment and Development published *Our Common Future*, also known as the Brundtland Report, after Norwegian Prime Minister Gro Harlem Brundtland, chair of the commission. A single phrase from this document has become the most widely quoted definition of sustainability, which, according to the report, "meets the needs of the present without compromising the ability of future generations to meet their own needs."

Typically, this line from Brundtland is cited out of context, while the report's focus on economic growth is rarely discussed in detail and its recommendations have not been widely embraced. David Orr, whose writing inspired the Ecological Literacy in Architecture Education (ELAE) program, takes issue with Brundtland. As Orr explains, unfettered growth cannot be maintained because every system has limits. Orr's complaint stems from his view that in popular discourse there are two views of sustainability—what he calls "technological sustainability" and "ecological sustainability." The former is quantitative and relies on doing the same things more efficiently. The latter is qualitative and requires a fundamentally new way of doing things. To explain the difference and demonstrate how both views are necessary, Orr gives a medical analogy: if a man suffers a heart attack, doctors must first attend to his vital signs so he may continue to live, but his recovery is followed by the longer process of dealing with deeper causes such as diet and lifestyle.[1]

[1] Orr, David. 1992. *Ecological Literacy.* Albany: State University of New York-Albany, p. 24.

While design must be informed by the quantitative aspects of technological sustainability, overemphasizing them loses sight of how systems flourish long term. Environmentalists now focus less on particular species and more on the health of whole ecosystems, for the fundamental revelation of ecology has been that all things are interwoven to a degree never imagined before. This realization leads to more expansive views. Many argue that the modernist tendency to study things in isolation—an all too familiar habit among architects and engineers—led to the problems that sustainability is now attempting to correct. The quality of all life is at stake.

Ecological Literacy

Though the concept of ecological literacy has been championed by many (including Alan Berkowitz and Fritjof Capra), the teachings of David Orr have most influenced the ELAE program. Orr writes that while every community implicitly understands the value of literacy—a basic knowledge of language and numbers—few understand the importance of ecological literacy, a basic knowledge of the earth. He cites Aldo Leopold, the American pioneer of wildlife ecology, as saying that the problem with environmental education is that it seeks harmony with nature among a people that has forgotten what nature is.

A basic definition of ecology is "the study of the relationships and interactions between living organisms and their natural or developed environment." Three important traits are clear: ecology concerns relationships, not strictly things; those relationships are between the organisms themselves and between the organisms and their environment; environment may be "natural" or "developed." Ecology encompasses the entire environment and its various systems.

An education founded on the principles of ecology is straightforward: education is the pursuit of knowledge, knowledge is intended to further human well-being, and human well-being depends on the health of all living systems. Without understanding the earth, the very purpose of education fails. And the study of the earth from an ecological perspective is not merely the study of things but an intense awareness of infinite interrelationships, of causes, effects, and limits, of beauty. No person may rightly be called educated without what Leopold calls "an intense consciousness of land."[2]

The challenge and the promise of ecological literacy is its breadth. How do we teach something that affects everything in ways we do not completely understand? Similarly, Orr asks whether pursuing ecological literacy requires adaptation or revolution: Is environmentalism simply another subject or academic department, or is it potentially an integrative principle leading to a radical reconceptualization of education?[3] He maintains that because current methods at every level typically treat subjects in isolation, students fail to see the connections between them. As a result, ecology appears unrelated to other fields, when in fact it informs every field. Orr calls for the substance and the process of education to be rethought. As the foundation for an "earth-centered education," he offers six principles (paraphrased here):

- All education is environmental education
- Environmental issues are too complex to be understood through a single discipline
- Education occurs as a dialogue with a place
- Method is as important as content
- Experience with nature promotes better intellects
- Experience with nature promotes practical competence.

[2] Orr, David. 1992. *Ecological Literacy.* Albany: State University of New York-Albany, p. 148
[3] Ibid., p. 140.

Ecological literacy, then, is interdisciplinary education centered on direct interaction with the environment in which it occurs. The results are better minds and better places.

Sustainable Design

If sustainability is a vague term, sustainable design presents an even greater challenge. Many architects use the term as if it applies only to buildings and not to all of human enterprise or even to other design professions although some of the most inspired examples have occurred in other fields, such as product design. Discussions of sustainable design tend to be narrow in focus and vague in purpose so the broader goal of engaging various disciplines in the ecology of place tends to be misunderstood, marginalized, or dismissed altogether. Although architects now generally acknowledge that sustainability is important, many tend to see it as a strictly technical solution without fully understanding the mechanics or worth of green technologies. As a result, the entire industry is abuzz with vague generalizations and valuable principles get reduced to marketing sound bites.

Because of this confusion, how designers may best incorporate sustainability is understandably a subject of some debate. Some emphasize energy. Eugene Odum argued that since everything is essentially energy, design should begin by establishing free power sources. This type of strategy focuses on effectively managing the earth's resources for the future. Others stress a present need to create healthful, uplifting environments for people by providing access to the outdoors, fresh air, abundant daylight, and healthful materials. Of course, all of these strategies are interrelated, and whether some take precedence over others is where the debate arises.

Within the building industry, many guidelines exist, but they are not completely consistent and some directly contradict each other. The most popular American standard, the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system, has helped raise public awareness but its very popularity risks perpetuating serious shortcomings because the public appears to believe LEED is synonymous with sustainability. As a result, more ambitious and arguably more effective strategies about place and culture may be overshadowed.

Despite common references to LEED as a "design tool," the system actually suggests very little about what architects conventionally consider the most fundamental facets of design—form, space, and image. From this point of view, LEED rewards buildings that save resources in the short run but may not survive in the long run because they fail to inspire the community around them. To paraphrase Orr, if it isn't beautiful, it isn't sustainable. If people do not love something, eventually they may abandon it. Sustainable design must put as much emphasis on design as it does on sustainability.

The AIA COTE has developed its own criteria[4] for defining sustainable design, which it describes as "an approach that holistically and creatively addresses land use, site ecology, community design and connections, water use, energy performance, energy security, materials and construction, light and air, bioclimatic design, and issues of long life and loose fit." Taken to its logical conclusion, the final phrase—"long life and loose fit"—implies not only durability and flexibility but also beauty. If buildings are to last, they should be built soundly but also planned strategically to accommodate possible future functions and outlive their immediate use and users so they may survive centuries rather than decades. If designed to be disassembled easily and safely, components may be adapted and reused even if the building as a whole does not endure. And from a design standpoint, aesthetic appeal increases the likelihood of longevity.

[4] See Appendix, Top Ten Measures of Sustainable Design

The AIA COTE description of sustainable design as a "holistic approach" indicates it is not a product but a process. It concerns not just more rigorous technical criteria for building but, instead, a complete attitude about how to practice design. This version of sustainability is "ecological" (Orr's term) because it considers the entire system of design. Arguably the single most important factor is the process known as integrated design: the close collaboration among all stakeholders (client, community, and regulatory agencies) and professional disciplines (architecture, landscape architecture, structural and mechanical engineering, and others) during all phases of the project, including predesign and concept design. This ensures that decisions are made with the necessary expertise in every area. For example, some decisions made even very early, such as building location, orientation, and massing, affect performance in ways for which even the most sophisticated technology cannot compensate. An interdisciplinary process with strong design leadership promotes not just better building performance but also more expansive knowledge. Integrated design is ecological literacy in practice.

Ecological Design

Because architects typically think of sustainable design as merely high-performance building, pedagogical methods emphasize technology. To integrate ecological literacy in architecture schools requires a different approach. Orr proposes an alternative he calls "ecological design" and describes in detail the proper education for designers:

> The old curriculum is shaped around the goal of extending human dominion over the earth to its fullest extent. The new curriculum must be organized around what can be called the "ecological design arts," around developing the analytic abilities, ecological wisdom, and practical wherewithal essential to making things fit in a world of microbes, plants, animals, and entropy. Ecological problems are in many ways design problems: our cities, cars, houses, and technologies often do not fit in the biosphere. Ecological design requires the ability to comprehend patterns that connect, which means looking beyond the boxes we call disciplines to see things in their larger context. Ecological design is the careful meshing of human purposes with the larger patterns and flows of the natural world; it is the careful study of those patterns and flows to inform human purposes. Competence in ecological design requires spreading ecological intelligence—knowledge about how nature works—throughout the curriculum. It means teaching students the basics of what they will need to know in order to stretch their horizons, to create a civilization that runs on sunlight; uses energy and materials with great efficiency; preserves biotic diversity, soils, and forests; develops sustainable local and regional economies; and restores the damage inflicted on the earth throughout the industrial era.[5]

Ecological design, then, is "the careful meshing of human purposes with the larger patterns and flows of the natural world." To achieve this, designers need an intimate understanding of those patterns and flows, and they cannot attain that understanding within the conventionally narrow scope of their discipline. A broader, interdisciplinary education and process are essential.

A CONVERSATION WITH DAVID ORR

The AIA COTE organizers of this project were deeply inspired by David Orr, whose words appear in every chapter of this report. Orr is professor and chair of the Environmental Studies

[5] David Orr. 1992, October. "Environmental Literacy: Education as If the Earth Mattered." E. F. Schumacher Lectures.

Program at Oberlin College, and he is perhaps the most influential living writer on ecology of place and environmental literacy in higher education. He was the force behind the Adam Joseph Lewis Center, a $7.2-million home to the Environmental Studies Program, designed by William McDonough + Partners and hailed as a milestone building by the U.S. Department of Energy. Orr is the author of four books: *The Last Refuge: The Corruption of Patriotism in the Age of Terror* (Island Press, 2004), *The Nature of Design* (Oxford, 2002), *Earth in Mind* (Island, 1994), and *Ecological Literacy* (SUNY, 1992). He is co-editor of *The Global Predicament* (North Carolina, 1979) and *The Campus and Environmental Responsibility* (Jossey-Bass, 1992). He serves on several boards, including those of Second Nature and the Center for Ecoliteracy, and is a trustee of the Educational Foundation of America. He spoke with Kira Gould in August 2005.

Gould: You have written about ecological literacy and a new way of approaching education. What role can architects play in this transformation?
Orr: Looking at the success of the high-performance building movement and the U.S. Green Building Council, we know architecture can play a huge role. Architecture could be the point of this spear if it so chooses. I believe architecture can play an enormously important catalytic role. Part of the reason for this is that people are visual creatures and architecture, as a visual art and science, is a powerful instructor. Architecture is crystallized pedagogy. The question to think about is, How can we make architecture a fluid and dynamic pedagogy?

That's what we've tried to do at the Adam Joseph Lewis Center. We use our building as a focal point for a wide range of research on many subjects. I have found that architecture is a gold mine as a teaching tool. It's powerful, visual, and compelling. We have just begun to scratch the surface on how and what architecture can teach. Architecture has to sip energy, not guzzle. A good building will be zero discharge and be made of materials that honor the earth and our children's prospects—there's a reality you cannot escape.

Gould: What can educators learn from the way architects think and work?
Orr: Vitruvius was one of the first systems thinkers in the Classical world. Having said that, I don't think I have a book on my shelf by an architect on pedagogy that I find really compelling. Architecture is itself a profound pedagogy but the book has yet to be written.

Being a part of a design team is incredibly exciting—it's an experience without borders, where you cannot dawdle, you have to be engaged in reality, and the building has to work. The conversation crosses all the bounds, addressing what people will do in the building; how it will be heated, cooled, and lit; what it will cost; and much more. This is the essence of interdisciplinary process. Every building that goes up on every campus is an educational opportunity.

On the Lewis Center, we slowed the process a bit to accommodate real, meaningful student involvement but the payoffs were enormous. Students were so inspired and they've gone on to a great many things. Awareness of the project expanded and the number of donors increased, which further expanded the possibilities. This kind of project is incredibly powerful. It builds bridges where there were barriers among the administration, faculty, staff, students, and into the community. I remember a certain insouciant freshman who insisted on calling Bill McDonough by his first name. He had a meaningful experience and has since gone on to architecture school and opened his own practice.

Gould: Despite the popularity of sustainable design, today's design professionals appear to lack a coherent values framework. Is sustainable design just the latest trend in schools?
Orr: No one can run the film fast forward and arrive at anything like a sustaining and decent future. We have to think about staying power; what it will take to get our civilization to basic

stability and resilience. If we fail to build a secure, durable civilization that operates within a recognizable moral framework and ecological limits, we are toast. If you have a sufficiently macroscopic vision, you cannot be optimistic right now. There are few grounds for optimism but there are good reasons for hope.

Seeing this as a trend or fashion is just not acceptable. We have to increase the ante so that it is not seen that way. It has to be the benchmark. We are talking about going from being an ephemeral civilization to one that does great things. The design professions should take the lead in that process.

There is good news ahead but it is 50 to 100 years out. It will get worse before it gets better. The decades ahead will be difficult, what E. O. Wilson calls "a bottleneck." But architecture has an important role in this, too. We need an architecture that builds hope.

Gould: The ELAE project and grant program recognizes courses and programs that make connections with nontraditional disciplines. Unfortunately, few courses tackled what may be one of the most important needs: a foundation for a design course steeped in ecology and earth awareness. What do you think such a course might provide?
Orr: Designing such a course would be an interesting challenge. Perhaps the best contribution I can offer is to mention the exercise I give students at the outset of my Ecological Design course. I pull out the Hippocratic Oath and ask the students, "What would be the comparable oath for designers?" I ask my students if they would work with Wal-Mart. "Are there situations from which designers should remain aloof? Or should they always try to bring sustainability to make something better than before?" That is their first challenge in my course and such thinking would be valuable in an architecture program as well.

Gould: In the current state of architecture and architecture education, do you see any opportunities or obstacles in pursuing ecological literacy?
Orr: There are certainly obstacles. These include an overblown sense of isolation and a strange sense of rigor that can become a kind of rigor mortis. The obstacles in any institution of higher learning are many. Higher education institutions have yet to become what Peter Senge calls "learning organizations."

One issue to question is the vehicle of the university. It has been very slow to change. Universities look like what General Motors might have looked like to a perceptive analyst of the auto industry in the 1970s—destined to fail. What will the new model be? Will it be something like Taliesin or the Ecosa Institute? These are two ends of a spectrum and there's a great deal between, all with challenges. Maybe it is time to design a truly new organizational structure that can educate students about architecture and ecological design in a new way.

Gould: How does your concept of ecological design relate to architecture and architecture education?
Orr*:* It seems to me that architecture is a subset of a larger field, ecological design. This is the larger art of fitting the pieces of a society into a coherent pattern of fairness, resilience, and sustainability. If architecture is a subfield of that, then its role is to lead the coalescing of the energy flows, water, and biota into something that meets those characteristics (fair, sustainable, resilient, and beautiful).

Then you face the question, Do you start the students with specifics or with the big picture? The conservative approach is to learn the basics first, then big picture. The other, perhaps more radical, view is to start with ethics and big picture. Actually, you have to do both. All education

should orient people to "here is where we are"—you are on planet earth, it has a biosphere—and then begin to relate architecture to the realities of the biosphere and learn about the evolution of the built world.

Understanding human evolution is an important part of this. This debate about evolution would never have happened in late 19th century because the scientists involved were familiar with the case that Darwin had made. The reasoning pattern was clear to them. In the late 20th century and early 21st century, they have forgotten how we got to that view. Any decent program would have to address this subject: the history of the process, creatively taught against the background of current realities, is critical. You need detail and big picture to arm students against facile forgetfulness.

Gould: What is your opinion of the way "green design" is being approached in mainstream architecture practice?
Orr: I have a fear that green design, not sustainability, could be taken as the latest fad. There's a growing assumption that if we design our buildings right, we'll have a cool future. To be clear, we are not going to build our way out of the mess we're in. That is not going to happen. Green design has to be part of a larger transformation.

Pretty soon we'll have lots of green office buildings and then green Wal-Marts. But a green Wal-Mart relying on exploitive labor and underpriced oil cannot be sustained. In a larger perspective, a green Wal-Mart would need to undermine mass consumption. In fact, at the end of peak oil, the Wal-Mart model fails when it can't get cheap goods from China. The biophysical basis upon which Wal-Mart exists is about to come to an end. I fear that we may wind up with hundreds of thousands of green buildings existing in a very brown social and economic fabric.

Green design should be a catalyst to something still bigger, which is one reason why monitoring is so important. Every green building should tell a story about how it is connected to the wider world and what that means—the story of how that link works and why it matters so that we learn to understand buildings as systems that are part of larger systems.

Gould: Ecological literacy suggests blurring the lines between professional disciplines. How does this relate to the practice of architecture?
Orr: In architecture projects, there are no disciplines. There are only questions, which take you to disciplines. Do we need a building? What is the quality of human experience in the building? What are the materials that might work and what are their real costs?

Chapter 3

Sustainability and Architecture Education

Interest in sustainable design has started to impact architecture education and practice. But there is a great need for systems thinking, interdisciplinary teaching and learning, and rigorous research. This is an important moment for the academy and the profession.

— Vivian Loftness, FAIA, University Professor, Carnegie Mellon University School of Architecture, 2005

Chapter 3 captions (clockwise)

Students on a building tour at the January 2004 Agents of Change workshop at the Burton Barr Central Library (Will Bruder) in Phoenix. Photo courtesy of Agents of Change

Visitors explore the house by the California Polytechnic State University-San Luis Obispo team at the 2005 Solar Decathlon. Photo by Stefano Paltera/Solar Decathlon

Students synthesized social, environmental, material, and economic issues in John Quale's ecoMOD course. Photo by ecoMOD

CHAPTER 3: SUSTAINABILITY AND ARCHITECTURE EDUCATION

THE NATURE OF ARCHITECTURE EDUCATION

As it is typically organized, architecture education presents significant challenges for incorporating the principles of ecological literacy.

The first challenge is simply time. Becoming a licensed architect requires a professional degree. While there are many variations on how to pursue this degree, the two most basic options entail five years at the undergraduate level or up to three and one-half years at the graduate level. The first option is often seen as the most convenient because of time, and many students choose the second option only because they decide late in college or after graduation to pursue architecture.

Many of the largest programs and most of the state universities offer the five-year path. Because the study of architecture is intensive and requires a large number of credits within the major, often there is very little opportunity to expand the curriculum to include more courses from other disciplines, even as electives. Ecological literacy's aim of a diverse interdisciplinary education becomes nearly impossible within the existing curriculum of architecture schools. But the lack of a broader liberal arts education is a long-standing criticism of architects, whose training typically is quite insular. Every architect and student can tell stories of rarely leaving the architecture building when they were in school.

The longer path might offer more time to pursue other subjects outside architecture, but this does not ensure that those subjects would be presented from an ecological perspective or that they apply well to the study of architecture. Many if not most students who obtain a four-year nonprofessional degree do so not knowing yet that they will go on to become architects later. The only completely effective solution would be to rethink not just architecture schools but all general education at every level along the lines of ecological literacy. In this way, any student in any subject would learn about the essential connections that subject has with others and with the natural world. Architecture would be just one thread.

Assuming the kind of radical overhaul of education that David Orr and others advocate will not occur in the near future, for the present architecture education can adapt on its own. One obstacle for doing so is the accreditation process. For licensure, states generally require architects to have graduated from a school accredited by the National Architectural Accrediting Board (NAAB), which is the sole agency authorized to do so in the United States. To obtain accreditation, architecture schools must conform to certain standards and guidelines outlined by the NAAB and, at the moment, these standards are not focused on environmental issues. The Association of Collegiate Schools of Architecture (ACSA), however, formed a Task Force on Sustainability that two years ago proposed ways to alter the NAAB's standards to reflect a commitment to sustainability. One of the recommendations was to add a preamble that introduces architecture education from the point of view of sustainability: "Architects in the 21st century will be expected to take a leadership role in stewardship of our global environment. To accomplish this goal, students of architecture should find, infused through their education, a philosophy that acknowledges the connected principles of ecology, social justice, and economics. This philosophy should be substantiated by the providing of future architects with the technical knowledge necessary for precise, expert and wise architectural action." While the NAAB did alter some of its criteria language in response to ACSA recommendations, the preamble has not been adopted.

Within current guidelines, NAAB-accredited degree programs often offer only one or two environmentally focused courses, and even the programs with more courses often treat the subject only in a lecture or seminar format, so it risks appearing incidental. Because of their length, undergraduate professional degree programs often have the most number of required environmental courses and introduce environmental issues earlier in the curriculum. On the other hand, at the graduate level, many students come from a different background that gives them a potentially more well-rounded view. A student with an undergraduate biology, material science, landscape, engineering, or similar degree brings a multidisciplinary perspective and academic maturity to the exploration of sustainable design, if the setting is supportive.

But relying on chance to create a diverse student body is no solution. And the importance of interdisciplinary thinking is rarely understood, much less formalized within a given curriculum (or practice). In *Metropolis* magazine's most recent annual survey of educators and practitioners (June 2005), responses to questions about subjects that "should undergo extensive design research" are telling. More than 80 percent of teachers and practitioners say sustainability is an important topic, but only 60 percent say "environmental impact" is, so a full one-fifth of respondents believe those subjects to be different. Other closely related fields, such as climate, biology, geography, systems theory, and economics, were emphasized by much smaller groups (30 to 40 percent for each). The meaning of sustainability becomes extremely doubtful when climate and environmental impact are deemed less urgent issues.

This narrow view of sustainable design is evident in the typical curriculum. While many schools of architecture are now seeing environmental courses as a necessary requirement, few if any treat sustainability as fundamental to the practice of design. Studio courses are the core of architecture education. When the environment is discussed only in "support" courses, students are likely to see it as inconsequential. Faculty who teach environmental courses are often not central to studio education, and vice versa. As a result, tenure may be difficult for them to achieve, and the school's commitment to environmental education becomes sporadic and weak.

Within the studio setting, the mentor system pairs a single instructor with up to 15 students, if not more. The teacher typically works with one student at a time to guide the development of a project, and the criteria used to judge success are often merely the individual taste of the instructor and/or the student. Personal expression rules in education and practice both, and this makes it difficult to embrace sustainable design's emphasis on logical principles and communal values. The integrated design process of working closely with all stakeholders and consulting experts at all stages of the project, including predesign, implies a model of collaboration that unfortunately is foreign to architects and students who are accustomed to working virtually alone, without significant influence from others.

This fact suggests that the essential conditions of ecological literacy and architecture education may contradict one another. According to Orr, the idea of "environmental education" is redundant because all education takes place in an environment, even if most subjects are not taught this way. Ecological literacy is about immersing the student in the world. By contrast, the architectural academy, which is still conducted in the Beaux Arts tradition, is traditionally about cultivating one's personal expression through an isolated studio experience. In other words, architecture education is about removing yourself from the world. So the two types of education arguably are governed by opposite values or conditions. Bringing them together requires either bridging the gap—not an insignificant task—or, even more difficult, completely altering architecture's pedagogical system and possibly its fundamental values. The result would be a design process

that is truly communal (rather than personal), collaborative (rather than individual), and based on rational principles (rather than subjective taste).

Restructuring architecture education to embrace ecological literacy will require these issues to be addressed within the core curriculum of the school if not the university at large. Among the Ecological Literacy in Architecture Education grant program submissions are many hints about how to go about this, even if none represents a comprehensive reorganization. To date, several models for new curricula have been proposed by others.

CURRICULAR INNOVATION FOR ENVIRONMENTAL SUSTAINABILITY

The curricular challenge for schools of architecture is significant: There should be a major transformation of education to enable architects to be the leaders of collaborative design processes with nesting scales of responsibility to ensure sustainable use of land, water, transportation, engineering, and building materials, assembly, and integrated systems, as well as building use and adaptive use.

Architecture schools have a long tradition of embracing environmental education in coursework, from lecture courses specifically required based on NAAB criteria to environmental laboratories to design studios focused on climate and cultural variations to design for passive solar heating or natural ventilation. These traditions exist at every university, fading in and out with the strength of the faculty.

Sustainability, as discussed in Chapter 2, goes far beyond energy and materials and involves land use, water, transportation, innovative engineering, landscape, and social justice. This broad array of issues and frameworks demands collaborative design processes and broad, multidisciplinary, linked thinking.

Over time, many catalysts have strengthened the environmental movement. Inspiring thinkers and authors have probed design implications of climate, land use, materials, and assembly. These include Reyner Banham, Viktor Olgyay, Ian McHarg, William Caudill, Baruch Givoni, Ed Allen, and G. Z. Brown, as well as leading educators from the passive solar movement of the 1970s—Don Prowler, Jeff Cook, Edward Mazria, and many others. Some environmentalists from the passive solar movement have become deans and department chairs, including Doug Kelbaugh, Harrison Fraker, and Vivian Loftness (see Appendix, Champions of Ecological Literacy in Architecture Education).

Research leaders from national laboratories have also been catalysts. These physicists, architects, and engineers—such as Doug Balcomb at Los Alamos and Steven Selkowitz at Lawrence Berkeley Labs, and others—focused on the challenges of passive conditioning, material detailing, and the calculation tools critical to their success.

Foundations have been catalysts, too, committed to raising awareness and hosting important gatherings and discussions. Some of the same foundations have also helped fund a new generation of buildings that demonstrate innovations in process and architecture for sustainability. These include the Tides Foundation (supporter of this report and plan), the Heinz Family Philanthropies, the Chesapeake Bay Foundation, the David and Lucile Packard Foundation, the Pew Charitable Trusts, and the Kresge Foundation.

The U.S. Green Building Council's LEED rating system has helped raise the profile of sustainable design as a part of current architecture practice and skill sets. The rating system has made it possible for many clients, architects, and allied professionals to engage in sustainable design in a way not possible before. LEED has been a part of creating university-wide awareness of sustainable design; the rating/certification system has had a role in the growing green campus movement and in shifting the focus of some faculty in many universities.

Most important, several sustainable practitioners in multiple disciplines have inspired students of architecture, authors, scientists, and foundations that propagate their works, from Buckminster Fuller, Ian McHarg, Ken Yeang, Guy Battle, and Christopher McCarthy to Glenn Murcutt, Renzo Piano, Richard Rogers, Norman Foster, Will Bruder, William McDonough, Stefan Behnisch, and many others, including some who have won AIA Top Ten Green Project awards (see Appendix).

Vehicles for Introducing Ecological Literacy in Schools of Architecture

These pages cite examples of universities, schools, departments, and individual teachers who have contributed to the growing presence of sustainable design subject matter—and in some cases ecological literacy—in architecture education. These examples are cited randomly and are not meant as a comprehensive list. In most cases, there are far too many examples to mention, which is certainly a positive condition. Inevitably, a seminal course or program may have been omitted; no significance should be concluded.

There are also several architecture schools that have long been known for their attention to issues of energy and building systems, environment, and sustainability. Some of these are mentioned below within one or more of the vehicles of architecture education. A significant number of innovative faculty is dedicated to sustainability across the country (and throughout the world), and many strong efforts are not mentioned here. This report was intended as a broad-brush background to the AIA COTE plan for the future (see Chapter 5).

Architect and sustainable design consultant Sandra Lebowitz Earley has undertaken a more comprehensive cataloging and analysis of sustainable design education. Her book, due out fall 2006, offers a recent historical survey and timeline, a full list of programs in the United States and Canada, and a comparison of curriculum efforts. It is also important to consider education efforts going on outside the architecture schools, especially those that are likely to affect architects in practice, such as real estate, construction management, urban design, landscape architecture, industrial and interior design, and other allied programs. The catalytic gains from these programs and leading sustainability faculty around the nation cannot be overstated.

The Studio

Studio-based education, with iterative design processes involving an ever-increasing number of critics, is an essential vehicle for environmental education and practice. Studios that focus on specific materials and their assembly (wood studios, masonry studios, and tensile studios) offer great opportunity to teach environmental detailing and aesthetic exploration centered on the craft of building. Some studios are designed to challenge students to design for comparative climates and are framed to erase the line between architecture and landscape; others directly explore passive solar design and natural ventilation as form givers and detail generators. Indeed, studios framed by sustainable design issues are no longer rare in part because they are usually inspired by a single faculty member whose own interests can guide the content. (By the same token, the autonomy of that arrangement usually means that sustainability-driven studios are still very much in the minority at most institutions.) Many of the submittals to the grant program associated with this report were descriptions of "green" studios.

Perhaps the biggest challenge of ecological literacy to the studio system is the need to teach design as a participatory and collaborative process. Neighborhood revitalization is critical to sustainability but can only be effective with inclusive, participatory processes, the type taught by David Lewis leading the Urban Lab at Carnegie Mellon University and formerly Yale, by Troy West at New Jersey Institute of Technology, Stroud Watson at the University of Tennessee, and many others. At the same time, other studios need to tackle the collaborative design and engineering processes that ensure systems integration for sustainability in complex buildings from hospitals to courthouses—with all disciplines involved from the early design stages. These innovative design processes are beginning to emerge in practice and need to be embraced in architecture education. The studio time to build neighborhood participation and the faculty cost of multidisciplinary expertise needs to be acknowledged by leaders of schools of architecture (and university leadership in general), with the realization that these skills and a focus on sustainability will position graduates as leading professionals.

History and Theory

A mostly untapped opportunity exists to explore sustainability in both history and theory classes. A few history classes use sustainability as the lens. At Parsons School of Design, Jean Gardner has woven sustainable design issues into her history courses (see Chapter 4). At Carnegie Mellon, Christine Mondor and Charle Rosenblum teach a History of Sustainable Architecture course that investigates approaches to building in nature that precede, critique, or supply the ideals of the Industrial Revolution (before which the natural environment was the only basis for building). This class sets out to formulate a history of sustainable architecture. Ethics courses, which exist at only a few schools and are rarely required, often address issues of ecology and equity; these represent another way of thinking about the breadth of sustainability to which most architecture students are not exposed.

Indeed, the major debate in the environmental design community about the definition of sustainability should be played out by historians and theorists in schools of architecture in dialogue with environmentally focused faculty and practicing architects. How can we capture the critical aspects of culture, climate, and place to sustainability? How can we capture the element of time and the engagement of people, or ensure the form-generating and system innovations so critical to the environment, or engage learning from nature in the design process itself? Can any of these things be measured in a rating system? The opportunity to expand the definition of design theory beyond artistic and literary theory is a frontier for architectural historians.

Laboratories

Environmental laboratories that offer the chance to test ideas are a very effective tool for architecture education. Daylighting labs, integrated systems labs, and materials labs have the potential to significantly advance sustainable design. University learning labs that enable students and professionals to test innovative technologies across the system types—enclosure, mechanical, lighting, networking, interior systems—are equally important to moving commercial and residential building solutions beyond conventional into the truly sustainable. From the earliest days of the General Electric lighting lab to present-day daylighting labs, hands-on learning about light is unparalleled and long lasting.

Building on the success of the laboratory tools developed by G. Z. Brown at the University of Oregon, the Northwest Energy Alliance has supported the development of multiple daylighting testing laboratories. Students and professionals learn to explore design alternatives in scale models, evaluate the comparative impacts, and detail materials and assemblies, with linked simulation tools and graphic evaluation techniques. The lessons learned become intuitive for the

design professionals, central to their design process, returning to the labs to address climate and building type variations on the best way to daylight, passively solar heat, and naturally ventilate buildings.

The School of Architecture at Carnegie Mellon University (CMU) has taken the position that future architects should be accountable for the measurable performance of the buildings they design. This accountability demands that architecture education must provide hands-on knowledge about thermal, air quality, visual, acoustic, and spatial performance, as well as long-term building integrity in a fully integrated, occupied setting. With support from a consortium of building industries, federal agencies, the university, and a major alumni donor, CMU built the 7,000-square-foot Robert L. Preger Intelligent Workplace (IW) to demonstrate innovations in each building subsystem—from structure, enclosure, heating, ventilation and air conditioning, and lighting to interior systems and telecommunications innovations that support the changing nature of work. The IW demonstrates a wide range of innovations in materials, components, and assemblies for environmental quality and conservation, as well as their relationship to the individual worker.

These are just two examples of successful environmental learning labs. Many others exist, from the thermal testing labs at the University of California-Berkeley, materials and lighting labs at the University of Michigan, and John Yellott's solar testing lab at Arizona State University to solar test beds at Massachusetts Institute of Technology.

Research Centers

Closely related to laboratories (one often includes the other, though the missions and strategies are distinct), are centers for environmental research. A few of these are on university campuses and elsewhere (often nonprofit associations off campus) that interface with students in various capacities.

The first National Science Foundation (NSF) Industry/University Cooperative Research Center (IUCRC) was the Center for Building Performance and Diagnostics at Carnegie Mellon. Led by Volker Hartkopf, the center explores innovations in the integration of advanced building systems for individual health and productivity, organizational and technological flexibility, and environmental sustainability. CMU's master of science degree in sustainable design is now in its third year (complementing master and PhD programs in building performance and diagnostics).

At the University of California-Berkeley, the Center for Built Environment (the second NSF IUCRC) explores new building design strategies and technologies and indoor environmental quality under the direction of Edward Arens and Gail Brager. Recently the team has been analyzing whether building occupants are more productive and satisfied in green buildings than conventional ones using survey results from 20 buildings.

At the University of Minnesota, John Carmody directs the Center for Sustainable Building Research, conducting building research on sustainable design, energy efficiency, innovative building components and building design processes, as well as research on postoccupancy evaluation and human responses to buildings. Carmody and his colleagues are currently launching a master of science in architecture sustainable design track this fall.

Pliny Fisk III and Gail Vittori are codirectors of the Center for Maximum Potential Building Systems, more commonly known as MaxPot, which Fisk founded while he was on faculty at the University of Texas-Austin's School of Architecture and Planning. The center uses "life cycle design to foster ecological balance … and engages in interdisciplinary collaborations with a

common vision of healthful environments, economic prosperity, and social equity," according to its Web site. The mission was to focus on relationships between natural and built environments with an emphasis on local economic development and the sustainable community. Fisk recently joined the College of Architecture faculty at Texas A&M University as a visiting professor (in addition to University of Texas-Austin, he has also taught at Ball State University, the University of New Mexico, the University of Oklahoma, and Mississippi State University). Fisk and MaxPot led the University of Texas-Austin 2002 entry in the Solar Decathlon.

Design-Build

Design-build and community outreach projects are also critical to sustainability education. As with testing labs, hands-on learning is among the most powerful teaching tools and provides the most durable lessons—but sustainability must be central for the long-term success of the project. Every generation of students begs for the opportunity to undertake a design-build effort, yet the time commitment, the cost, and the liability make this curricular alternative difficult. The success of some of the best-known examples, such as Auburn University's Rural Studio, illustrates the importance of these efforts and their focus on equity as a key factor in sustainability. The Solar Decathlon has also prompted many schools of architecture to team with other departments and pursue multiyear design-build projects.

The Auburn University Rural Studio, founded in 1993 by D. K. Ruth and the late Samuel Mockbee, FAIA, and now led by Bruce Lindsey and Andrew Freear, was conceived as a way to improve the living conditions in rural Alabama and provide a meaningful hands-on experience in an architecture pedagogy. This "context-based learning" takes the students out of the classroom and into some of the poorest counties in the nation, where they build what they design as a way to learn for themselves the cultural, social, and technological aspects of designing and building. The studio has been highly successful and widely published, which attracted outside funding and ensured its continued survival. It also has helped attract students to the program and has had an impact on the community it serves.

Yale School of Architecture has run a First Year Building Project since 1966 when Charles W. Moore headed the school. The projects are designated for disadvantaged communities, partnering with Neighborhood Housing Services, a New Haven-based nonprofit developer. After a juried competition among the students, student-led working drawings, bidding, and then summer construction (with a team of 10 and two high school students), new or renovated homes are made available at affordable rates to first-time buyers. Studio 804, run by the University of Kansas School of Architecture and Urban Design's Dan Rockhill (and submitted to the grant program associated with this report), is a design-build studio for third-year graduate students with a goal of providing affordable housing in Lawrence, Kans., and surrounding communities. Rockhill's students have designed, built, and sold several houses receiving national recognition. With growing interest in sustainability among students and faculty, these design-build projects are increasingly incorporating environmental innovations from straw bale to green roofs to high-performance enclosures and mechanical systems.

Community Connections

Also important to environmental education are the tools for participatory design with communities and building occupants. These inform place-responsive programming and design and engage communities in cherishing and owning the results. The AIA has long realized the importance of community and participator design for professionals, establishing Regional/Urban Design Assistance Teams (R/UDATs) in 1967 as a multidisciplinary, grassroots approach to community development. More recently, Sustainable Design Assistance Teams (SDATs) bring

multidisciplinary, participatory design teams to communities to create sustainable visions for communities and their ecosystems.

Yet few schools introduce participatory and/or multidisciplinary early design decision-making in the studio setting. Do we still believe in the design genius working in isolation? Certainly, as we work around the world, often clueless to the particulars of climate, culture, or place, participatory design processes will continue to become increasingly critical to effective practice. Moreover, the participatory process may be equally central to ensuring the commitment of the larger community to sustainable goals and to engaging the citizenry in a powerful educational experience.

One leader in participatory design, Henry Sanoff of North Carolina State University, has written numerous books and developed many interactive games and tools that have helped to transform the way professionals work with communities and given clarity and method to participatory courses in several schools of architecture.

One of the oldest participatory community design studios in a school of architecture was developed by David Lewis and Ray Gindroz at Yale University. These Urban Lab studios engaged students in learning "in the streets" gathering insights and visions to inspire neighborhood interventions that might heal communities in distress. (The Urban Lab studios were brought to Carnegie Mellon University when Lewis and Gindroz established their practice, Urban Design Associates, in Pittsburgh in 1964.)

At the University of Arkansas School of Architecture, Stephen Luoni teaches an elective fifth-year studio through the Community Design Center, which is engaged in developing new design methodologies applicable to community development issues in Arkansas, with currency at the national level. According to Luoni, the program "introduces a multiple bottom line, integrating social and environmental measures into economic development. Integrative design solutions add long-term value and offer collateral benefits related to sustained economic capacity, enhanced ecologies, and improved public health—the foundations of creative development." The center works with other groups such as the Center for Business and Economic Research, the Delta Research and Design Center, and the Arkansas Forestry Commission.

The Pratt Institute Center for Community and Environmental Development brings professional planning, architecture, and public policy skills to support community based organizations' efforts to improve neighborhoods and address social and environmental justice issues. Participatory engagement with community residents is a central theme of nearly every project. Sustainable development is the key goal that has driven this advocacy center for more than four decades.

Postoccupancy Evaluation: Learning in Existing Buildings

Postoccupancy evaluation (POE) is critical to ensuring that field performance is iteratively advanced, especially in the face of increasing complexity in buildings and rapidly emerging materials and technologies. POE is key to performance-based programming and to improving systems integration and design detailing for sustainability. Sustainability is based on the life cycles of materials and integrated systems and their adaptation to support the changing needs of occupants over time. Yet there is remarkably little comprehensive POE undertaken by professionals or students of architecture.

One major exception is the Vital Signs curriculum initiated by Charles Benton at Georgia Institute of Technology and then University of California-Berkeley, which evolved into the Agents of Change curriculum supported by Oregon for engaging students in the exploration of the

performance of occupied buildings.

The Green Campus Movement

The green campus movement has grown significantly in the last decade. The Center for Energy Research, Education, and Service (CERES) at Ball State University is an interdisciplinary academic support unit focused on issues related to energy and resource use, alternatives, and conservation. The center hosts a Green Campus Conference every other year at which an increasing number of institutions participate. Its fifth conference was last fall (September 2005). The Society for College and University Planning hosted its third annual Campus Sustainability Day in October 2005, Anthony Cortese was the keynote speaker.

The green campus movement at some universities, such as Harvard, involves some architecture and landscape architecture faculty (Ken Kao and Niall Kirkwood, respectively), but is driven largely by other schools, such as the School for Public Health. After Carnegie Mellon University, Harvard University is the second largest purchaser of renewable energy among universities in the United States. The university's Green Campus Loan Fund offers interest-free loans for onsite renewable projects, such as a recent PV installation at the Harvard Business School. Tufts University pledged in 1999 to meet or beat Kyoto Protocol levels and, in 2003, the president pledged to cut emissions further. At Berea College, ambitious plans to reduce energy consumption by 45 percent by 2015 involve building retrofits and the creation of "ecovillage" housing.

Though not all of the green campus leaders have schools of architecture, the design learning side of green campus activities is poised to expand as the movement matures past recycling efforts, stormwater issues, and energy and emissions targets to include indoor air quality targets and retrofits of existing buildings. Many of the campuses that have architecture programs are already bringing those activities directly into the classroom.

Certificates and Other Programs

There are also schools outside traditional universities, most of them lacking accreditation, but some offering a host of known experts and intensive coursework for young students or post-professional study. The Ecosa Institute is one example. The nonprofit offered its first immersion program in fall 2000. In many ways, what students get in one semester is a more holistic understanding of sustainability than they could presently get at any traditional design school. Founder Antony Brown, who worked with Paolo Soleri for years, says the vision behind the institute "is based on synthesizing the ethical and ecological values critical to the health of the environment, with the vitality and dynamism of the design arts." He contends that if designs are to be based on nature's complexities, it is absurd to educate designers in a compartmentalized, linear setting. Ecosa now offers spring and fall semester programs and several summer workshops. Brown hopes to evolve the program into a four-year design curriculum. The San Francisco Institute of Architecture is a second certificate program dedicated to green building, ecological design, and nature-based architecture.

Some schools of architecture are offering sustainable design certificate programs, such as the one at the Boston Architectural Center's (BAC) Continuing Education program. The BAC's program was developed with BuildingGreen Inc. (publishers of *Environmental Building News*) and is available online with courses managed through the BAC's courseware platform, Blackboard. The course requires Sustainable Design as a Way of Thinking, four Green Practice courses (site design, energy and air quality, interiors and materials selection, and whole building design and LEED), plus one sustainable design elective.

Such certificates strengthen professional understanding of environmental design but may not be able to ensure a full understanding of ecology, systems thinking, resource innovation, and regional frameworks that require the multiyear, multidisciplinary explorations.

Catalysts for Curricular Innovation

Over time, several federally supported efforts have catalyzed changes in architecture education with a focus on the environment. Three of them are highlighted here: Teaching Passive Design, and the Solar Decathlon, and Vital Signs and Agents of Change.

Teaching Passive Design

In 1981, the U.S. Department of Energy funded faculty at 12 schools of architecture[1] to develop innovative course modules; the volumes became Teaching Passive Design in Architecture. Led by Harrison Fraker and Don Prowler at the University of Pennsylvania, the course modules supported an important shift in architecture education to embrace passive solar design and other environmentally based theories and practices. University course modules were developed for a wide range of environmental subjects, from environmental postoccupancy evaluation (the seeds for Vital Signs), climate, and energy graphics to daylighting tools and graphic exercises and passive cooling techniques. The Association of Collegiate Schools of Architecture sent this documentation to faculty and libraries at every U.S. school of architecture.

The volumes documenting this framework were honored in 1983 with a research award from *Progressive Architecture*. Thomas Fisher, who was an editor then (he is now dean at the University of Minnesota's College of Architecture and Landscape Architecture), recalls the project as intellectually and graphically impressive: "It represented the first major attempt to integrate passive solar energy strategies into architecture education, and it stood as a model of cooperation among several schools of architecture to develop a joint curriculum. The submission had terrific graphics and a good sense of design in terms of how it talked about architecture, sending the message that *passive solar* and *good design* were compatible, something that many architects did not believe in at the time."

The Solar Decathlon: Student Demonstration Projects

The Solar Decathlon brings college and university teams from the United States, Canada, and beyond to compete to design and build houses that "demonstrate the advantages of a solar lifestyle." This massive undertaking, sponsored by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy in partnership with its National Renewable Energy Laboratory, the AIA, the National Association of Home Builders, BP, and the DIY Network, brought 14 universities to the National Mall in Washington, D.C., in 2002, and 18 in 2005.

The teams must transport their houses to Washington and then finish them to compete with their neighbors arrayed in a "solar village" on the Mall. There are 10 measures against which they are judged, including design quality, livability and comfort, as well as energy performance for space heating and cooling, hot water, lights, and appliances. The houses must be able to function completely off the electrical grid, relying on solar electric, solar thermal, and passive energies for all systems.

[1] University of California-Los Angeles, Carnegie Mellon University, Georgia Institute of Technology, Kent State University, Massachusetts Institute of Technology, New Jersey Institute of Technology, North Carolina State University, University of Oregon, Rensselaer Polytechnic Institute, Rice University, University of Pennsylvania, and Yale University

John Quale of the University of Virginia was the faculty adviser to a team in 2002. The team won the design and livability contest with a simple plan, copper and wood cladding, rooftop photovoltaics, and an elegant, well-detailed interior. But his group had to raise about $300,000 to create this 800-square-foot gem, which made him think twice about embarking on this project a second time (instead he started ecoMOD, a studio dedicated toward affordable housing; see Chapter 4).

The solar neighborhood was dismantled after two weeks, which is a factor that bothers some educators. One of last year's teams wanted to compete but didn't like the tear-it-down-at-the-end idea and teamed with Habitat for Humanity so that the house could be rebuilt and put into use after its time on the Mall. Another will rebuild the Decathlon house as an environmental study center on campus.

One thing the program advances effectively is interdisciplinary participation—the nature of the program is such that participation from multiple schools and departments within a university is the usual result. In most cases, at least three or more schools participate, usually with engineers or architects in the lead. Some programs have found ways to engage business students, nursing students, industrial and interior design, and journalism students as well.

Architect Edward Mazria, author of *The Passive Solar House*, was a member of the design jury for the 2002 Solar Decathlon. He told *Metropolis* he found the decathlon successful and disappointing: "Successful in that the students who participated came away with a deep understanding of how to create an architecture for today's world. Disappointing because only about half of the participants were from architecture schools. The architecture community, both schools and professionals, do not yet realize the pivotal role the profession must play in addressing pressing global issues." In 2005 there was some progress in that respect: two-thirds of the 18 teams were led by architecture schools.

The Solar Decathlon has proven to be an excellent venue for universities to undertake sustainable design-build projects with innovative goals and bring national attention to renewable energy and design to the National Mall in Washington. However, the resources for these projects are left to each university; students and faculty must spend a tremendous amount of time raising funds. For those few dozen faculty members across the 120 schools of architecture who have taken on the challenges of designing, engineering, and building with students, as well as fund-raising, external partner-building, and handling liabilities, there really should be some greater and longer-term support available. Some professors and departments avoid the competition because of the incredible demands on teacher and student time, a large portion of which is spent on fund-raising and material procurement.

2005 Solar Decathlon Participants

- California Polytechnic State University-San Luis Obispo (architecture and engineering students; faculty adviser, Rob Peña), *www.solardecathlon.calpoly.edu/*
- Canadian Solar Decathlon: Concordia University and Université de Montréal (engineering, architecture, industrial design, and communications students; faculty adviser, Andreas K. Athienitis), *www.canadiansolar.org/*
- Cornell University (architecture, engineering, business, and graphics/communications students; faculty adviser, Zellman Warhaft), *http://cusd.cornell.edu/*
- Crowder College (art, computer science, and other students; faculty adviser, Art D. Boyt), *www.crowder.edu/solar/2005/*

- Florida International University (architecture, engineering, construction management, and computer science students; faculty adviser, Yong X. Tao), *http://htd.fiu.edu/fiusolar/the_team.html*
- New York Institute of Technology (architecture, engineering, interior design, and communications students; faculty adviser, Michele Bertomen), *http://iris.nyit.edu/solardecathlon/*
- Pittsburgh Synergy: Carnegie Mellon University, University of Pittsburgh, and the Art Institute of Pittsburgh (architecture, engineering, interior design, industrial design, and communications students; faculty adviser, Stephen Lee), *www.arc.cmu.edu/sd/index.html*
- Rhode Island School of Design (architecture, textile design, and other students; faculty adviser, Jonathan R. Knowles) *www.eere.energy.gov/solar_decathlon/team_rhode_island.html*
- Universidad Politécnica de Madrid (architecture students with the Institute of Solar Energy and the Center for Integral Domotics; faculty adviser, Estefania Caamano Martin), *www.solardecathlon.upm.es/*
- Universidad de Puerto Rico (architecture, business administration, and engineering students; faculty adviser, Gerson Beauchamp), *http://solar.uprm.edu/*
- University of Colorado-Denver and Boulder (architecture and engineering students; faculty adviser, Julee Herdt), *http://solar.colorado.edu/*
- University of Maryland (engineering, architecture, business, landscape architecture, art, and journalism students; faculty adviser, Kaye Brubaker), *http://solarhouse.umd.edu/page.php?id=65*
- University of Massachusetts-Dartmouth (engineering, arts and sciences, nursing, visual and performing arts, and business students; faculty adviser, Gerald Lemay), *www.umassd.edu/solar/*
- University of Michigan (architecture, urban planning, engineering, art, natural resources and environment, business, and film/video students; faculty adviser, Jonas Hauptman), *www.umich.edu/~miso/*
- University of Missouri-Rolla and Rolla Technical Institute (faculty adviser, Jeff Birt), *http://solarhouse.umr.edu/*
- University of Texas at Austin (architecture, engineering students; faculty adviser, Michael Garrison), *www.ar.utexas.edu/utsolard/*
- Viirginia Polytechnic Institute and State University (architecture, engineering, and industrial design students; faculty adviser, Robert P. Schubert), *http://vtsolar.arch.vt.edu/*
- Washington State University (architecture, engineering, interior design, and construction management students; faculty adviser, Matthew Taylor), *www.arch.wsu.edu/solardec/index.html*

Vital Signs and Agents of Change

Professor Charles Benton of the University of California-Berkeley was the project investigator for the Vital Signs Curriculum Project (1992–1998). The effort was funded by the Energy Foundation, Pacific Gas & Electric, and the National Science Foundation and run from the Center for Environmental Design Research. The idea for the project developed many years earlier at a Society of Building Science Educators (SBSE) retreat to discuss case studies in architecture education. The Vital Signs Project reframed architecture as a science and provided a process to investigate real buildings to see their physical performance through a hands-on program that promotes the value of measurement and postoccupancy evaluation to inform design.

The project encourages architecture students to examine architectural, lighting, and mechanical systems in existing buildings with attention to energy use, occupant well-being, and architectural

space-making. The organizers developed measurement techniques designed to reveal operational patterns in contemporary buildings. The project developed and implemented several resources for faculty: resource packages on specific topics, training sessions, tool kits (worth $25,000) that were loaned to schools, case study templates, national case study juried competitions, and case study incentive grants for faculty. The project offered protocols in each of the resource packages; these describe how to make real-time observations and take short- and long-term measurements using equipment in the tool kits.

The Agents of Change (AoC) Project, headed by Associate Professor Alison Kwok of the University of Oregon (formerly principal graduate assistant for the Vital Signs project), secured two grants from the U.S. Department of Education Fund for the Improvement of Postsecondary Education (FIPSE). The first awarded in 2000, to evaluate Vital Signs and to test the AoC training model and the second (2002–2005), to disseminate the AoC training model that incorporates the Vital Signs methodology and postoccupancy evaluation in architectural curricula, prepares current and future faculty (students interested in teaching) to teach in schools and in practice. This project has been coordinated by Kwok and supported by the efforts of graduate teaching fellows and SBSE members as faculty trainers and advisers.

AoC builds on the Vital Signs project but brings in teams of faculty and teaching assistants for training workshops, where they learn to use data acquisition systems and handheld equipment; conduct a mini, field-based case study of a notable building; practice learned teaching skills through teaching peers; develop case-study exercises tailored for use at their home institution; and learn to train future teaching assistants (TAs). Faculty and teaching assistant trainees are expected to incorporate the case study methodology in their coursework, participate in project evaluations, revise and share teaching exercises, submit course syllabi, evaluate case studies, and train other TAs and faculty.

Ben Spencer, a graduate student at the University of Virginia and a participant at the Agents of Change workshop in Phoenix, characterizes the AoC experience:

> The Agents of Change conference in Phoenix was an informative and rewarding experience. It allowed me to translate the impressions I had of the Phoenix Public Library, based mostly on photographs, into an understanding of its spatial qualities and the way energy flows through the building. It helped substantiate my belief that on site, hands-on architectural analysis should be an integral part of architecture education and should complement more the abstract analysis of plan, section and diagram. . . . working with a team, rooming with people from other institutions and group discussions involving everyone at the conference allowed me to establish connections with people who have interests similar to mine. Universities can be insular places. The more we branch out and communicate with one another, the more progress we will make in transforming the environmental ethics of architecture.

During the past five years the project has held seven training sessions at notable buildings, trained more than 100 faculty and 140 TAs, ran 15 Tool Days with SBSE (one–day, intensive training sessions for practitioners), made more than 50 tool kit loans to faculty, and developed hundreds of case studies.

The success of the project is based on peer-to-peer learning. “We always considered that the graduate students were important ambassadors for this approach,” Kwok says. “There’s an important ‘passing-of-the-baton’ to this curricular innovation that we think will give it longevity.”

She notes that although not all the graduate students who receive this training actually teach, she hopes many will. If not teaching in academia, many of these graduate students/AoC alumni are transferring the knowledge in practice.

The FIPSE grant expired in 2005 but Kwok believes another chapter is possible. “We’re looking for ways to make closer links with the professionals and the firms,” she says. “We are seeking funding to continue our tool-lending and training programs, but foresee how AoC could also have application in firms.” She is also considering the continuing education angle, considering retreat sessions where architects and other design professionals could be trained to train their office colleagues (and earn continuing education credits).

Organizational Catalysts

Society of Building Science Educators

In 1983, University of Oregon Professor G. Z. Brown and University of California-Berkeley Professor Edward Arens hatched the idea for the Society of Building Science Educators (SBSE) in response to the need for professional exchange of ideas, materials, and resources on the integration of environmental technology and design. The first SBSE meeting was held at a daylighting conference at the University of New Mexico's School of Architecture in September 1983. After its incorporation as a nonprofit organization, the SBSE’s first curriculum development retreat was held at the Heceta Head Light Keeper’s House in Oregon in 1986.

The SBSE serves five basic purposes: represent the subject areas of architectural technology, building sciences, and design integration to its members and outside interests; offer a network for exchange of information; promote research and pedagogical excellence and scholarship; act as a support network for members; and promote the institutional needs of technical education within professional curricula in architecture. The organization operates a listserv, distributes a quarterly newsletter, runs a peer review service for promotion and tenure cases, and organizes mentoring and scholarship opportunities for students interested in teaching. Curriculum resources include digital slide library on CDs, sun angle calculators, and links to course offerings. Annual business meetings are held in conjunction with the American Solar Energy Society Solar conference, as well as the annual curriculum development retreat held during the summer. Most recently, the 2005 retreat, Greener Foundations: Environmental Technology and the Beginning Design Student, was held at the Savannah College of Art and Design with more than 40 participants in attendance. (See Appendix for a report from the 2005 SBSE Retreat.)

The Leading Edge Design Competition

The Leading Edge Student Design Competition is administered by the New Buildings Institute and sponsored by a consortium of California utility organizations and the Building America Program. The international competition has for 12 years offered students the learning experiences needed to consider the environmental impacts of design decisions, to explore the use of new materials and strategies for building, and to explore the integration of aesthetics and technology for high-performing, cutting-edge architecture.

The competition objectives are to encourage and reward excellence in architectural planning and design that integrates environmentally responsive design strategies. Competition participants are encouraged to incorporate principles of sustainability in building material choices, building design, and siting; investigate new building materials that contribute to sustainable or energy-efficient building design; explore energy efficiency as a basic premise of building design; understand the impact of siting, solar orientation, wind orientation, building massing, construction methods, and material choices on building function and energy use; develop an awareness of appropriate technology for particular building type, regional climate, and site

location; explore computer modeling methods for predicting and evaluating the impact of design decisions on building performance; and explore the full integration of sophisticated design strategies and environmental design thinking in building.

Organizations for Curricular Innovation

Association of Collegiate Schools of Architecture

The Association of Collegiate Schools of Architecture (ACSA) is a nonprofit association dedicated to advancing the quality of architecture education; 250 schools are members, representing some 4,000 architecture faculty. Activities include conferences, workshops, publications (including the *Journal of Architectural Education*), awards, and competitions, as well as general support for architecture research and collaborations with allied organizations. Several ACSA competitions have been dedicated to design for the environment, encouraging faculty and students to explore the technological, ecological, and sociological challenges of sustainability in outstanding design.

From 2000 to 2003, ACSA ran a Task Force on Sustainability, chaired by Kim Tanzer of the University of Florida, then cochaired by Jean Gardner of Parsons School of Design/The New School. ACSA's 2003 Teachers' Seminar Conference was devoted to sustainability. The meeting was chaired by Tanzer, Gardner, and John McRae, then with RTKL (now dean of the College of Architecture and Design at the University of Tennessee), and Jean Gardner of Parsons School of Design/The New School. The conference included a sustainable design evaluation of some Cranbrook buildings using the Whole Building Matrix, a teaching/learning method Gardner developed.

One of the goals was to bring sustainability language into the National Architectural Accrediting Board (NAAB) criteria. "We formulated a strategy to include sustainability among the NAAB criteria and proposed some language," Tanzer says. The task force suggestions included several edits to the existing criteria, and a new preamble:

> Architects in the 21st century will be expected to take a leadership role in stewardship of our global environment. To accomplish this goal, students of architecture should find, infused through their education, a philosophy that acknowledges the connected principles of ecology, social justice, and economies. This philosophy should be substantiated by providing the future architects with the technical knowledge necessary for precise, expert and wide architectural action.

The NAAB elected not to include this preamble but did make some of the changes suggested by the task force. "Our proposal was morphed during the process of updating the criteria, as we expected it would," Tanzer says. "Overall, we were pleased to see that sustainability is explicitly written into the most comprehensive design criteria and also has a stand-alone criterion." Those portions of the student criteria:

> 15. Sustainable Design. Understanding of the principles of sustainability in making architecture and urban design decisions that conserve natural and built resources, including culturally important buildings and sites, and in the creation of healthful buildings and communities.[2]

[2] NAAB Conditions for Accreditation, 2004, p. 14.

> 28. Comprehensive Design. Ability to produce a comprehensive architectural project based on a building program and site that includes development of programmed spaces demonstrating an understanding of structural and environmental systems, building envelope systems, life-safety provisions, wall sections and building assemblies and the principles of sustainability.[3]

While the revised NAAB criteria seem to represent a commitment to sustainability, a definition of that term is not included (the task force itself generally relied on a broad definition derived from the Brundtland report). Furthermore, the impact of specific criteria (and the wordsmithing of same) on educators and classroom coursework is far less clear.

The American Institute of Architects and the American Institute of Architecture Students

There are efforts under way at the American Institute of Architects (AIA) that engage educators and seek to make connections between educators and practitioners, as well as to focus the profession and the academy on research efforts that would be beneficial to both. Some of these efforts would be natural partners for future educational innovation for ecological literacy.

The Educator/Practitioner Network (EPN) is a knowledge community at the AIA. It is a facilitation organization for educators who are interested in practice and practitioners who are interested in education. The EPN supports the emerging Case Study Initiative as a way to promote collaboration between educators and practitioners. The EPN runs the AIA Education Honor Awards, presents programs about educator/practitioner collaborations, and publishes a newsletter (that goes to all faculty who teach practice-related topics in U.S. architecture schools). According to David Hinson, 2005 EPN chair, sustainability has not been a focus because they focus more on collaboration models rather than subject areas, though it has shown up in the Educational Honor Awards program. Several award recipients have been leaders in this area.

The Case Study Initiative is a project of the AIA's Large Firm Roundtable and the EPN, and it has functioned in a task force capacity since 2001. Practitioners for large, mid-size, and small firms as well as representatives from schools of architecture have developed a framework for the case study in architecture. The goal is an online database of case studies that analyze and document projects in the context of professional practice. The case studies can originate in firms or schools but would involve input from both. A series of open meetings considered the case study as a tool for scholarship, research, and academic advancement. The AIA Web site describes the effort's aims:

> It is intended that a broad collection of case studies will begin to alter the understanding we have of practice while assisting the most recent graduate to gain insight. The case study format is intended to structure a body of knowledge that is easily accessible, including stories of practice from various perspectives, measures of success, analysis of lessons learned, and a learning plan for students and others. This information will be available to students, educators, interns, practicing architects, and the public, in an attempt to better inform all of these constituencies.

The 2004 ACSA Teachers' Seminar was dedicated to the consideration of case studies in architecture as an important tool in education and in practice. It was chaired by Marvin Malecha, FAIA, dean of the College of Design at North Carolina State University; Laura Lee, FAIA, head of the Architecture Department at Carnegie Mellon University; and Richard Green, FAIA, of Stubbins Associates (and the University of Hawaii). The conference involved discussion of

[3] NAAB Conditions for Accreditation, 2004, p. 15.

research methods, the importance of postoccupancy evaluations (with a presentation of 35 years of postoccupancy evaluations from Henry Sanoff of North Carolina State University), and a review of the case study starter kit, the materials provided to those who want to create case studies and submit them for review and possible inclusion in the AIA collection.

At present, seven case studies are available online and another batch is under review. The framework does not as yet include sustainable design criteria, though there is room for some reference to these issues at the discretion of the field team. The organization and detail of the case study format seems highly appropriate for the inclusion of sustainable design goals, methods, and outcomes. For example, postoccupancy evaluation, a tool critical to sustainable design, is only mentioned briefly. An opportunity may arise to work with this group to augment the case studies in a meaningful way.

The EPIC Project is an AIA project (organized by Continuing Education Systems and Stakeholder Relations) established to link educational institutions to commercial/industry organizations (mostly product manufacturers) and practice groups (such as local AIA components and individual firms). (Partners include ACSA, NAAB, and the American Institute of Architecture Students.) At present, there is no sustainability focus to this effort but it is an interesting database of potential partners, and those looking to partner on sustainability-driven projects could tap into this.

The American Institute of Architecture Students (AIAS) is a nonprofit, student-run organization with some 6,200 members and 132 chapters. One major event of the AIAS is its annual Forum conference, bringing 500–1,000 students together each year. Forum 2001, Going Beyond Green, was held in Pittsburgh (hosted by the Carnegie Mellon University chapter), and focused on sustainable design with keynote speakers, including Kenneth Yeang, James Wines, Pliny Fisk III, Eric Owen Moss, and Will Bruder. While the AIAS has not devoted conferences to this subject since then, there are potentially productive links to be made with this group that would further the goal to increase ecological literacy in architecture education. Indeed, students may be the most active catalysts for enriching university education to embrace the richness of ecological literacy because they have already begun to discover the wealth of multidisciplinary expertise available on campus and the urgency of the global environmental challenge.

A SURVEY OF ARCHITECTURE SCHOOLS' WEB SITES

The Web sites of the 115 accredited (and candidate) architecture schools in the United States were surveyed. The following were identified for each program: type of curriculum information available online; amount of curriculum information related to ecological literacy and sustainability; and key courses, programs, and faculty focusing on ecological literacy and sustainability. Using the collected information, each program was rated based upon the amount of ecological literacy information found in the curriculum. To rate programs, the following guidelines were employed:

None No information about ecological literacy is stated or can be inferred by the curriculum information provided

Low Information about programs or courses may imply issues of ecological literacy without stating these concepts directly

Mid Information about one to three programs or courses state issues of ecological literacy directly

High Information about three or more programs or courses state issues of ecological literacy directly

Each course and program relating to ecological literacy was then categorized according to overall themes. The focus areas of Site/Land, Studio, Daylighting, Energy Systems, Integrated Design Process, LEED, Materials, and Community Involvement were employed and curriculum information was used to match each course to the appropriate grouping.

In general, courses and programs were identified to some degree on the Web, while names of key faculty members were less commonly found online. The majority of ecological literacy curriculum information identified in this study was found to be related to Energy Systems. In addition, evidence showed that many programs offer some form of the Site/Land or Community Involvement approaches. Conversely, the more specific topics of Daylighting, Integrated Design Process, LEED, and Materials did not prove to be consistantly evident in the curriculum information collected.

There are drawbacks to this kind of survey and rating system. First, there is the lack of parity between online resources schools are able to provide. It is fair to assume that some programs may currently offer courses related to ecological literacy, yet if this information was not listed on the Web at the time this research effort took place, it was not recognized. In addition, Web research only allows us to look at information the program itself chooses to report to the public. By relying on self-identification, we are at the mercy of individuals who may not want to use labels like "ecological literacy" or even "sustainable design." Other information that is difficult to identify is whether the courses and programs listed are required for all students or electives that students with interest can choose. That is, it is nearly impossible to say if every student at a school is really being exposed to ecological literacy, even if that school offers areas of the curriculum that address these issues.

A different kind of rating system, published annually by DesignIntelligence,[4] uses design professionals rather than the Internet as a tool for gauging the skill and success of architecture school graduates. DesignIntelligence separates accredited architecture programs by degree offered and the final product is a list of the top 15 bachelor of architecture programs and the top 15 graduate programs in architecture. Arizona State University, California Polytechnic State University, Carnegie Mellon University, Frank Lloyd Wright School of Architecture, Georgia Institute of Technology, Lawrence Technological University, Massachusetts Institute of Technology, Texas A&M University, University of Arizona, University of California-Berkeley, University of Colorado, University of Illinois at Urbana-Champaign, University of Kentucky, University of Maryland, University of Oklahoma, University of Oregon, University of Texas–Austin, University of Virginia, and University of Wisconsin-Milwaukee were all identified by the Web survey to have a high amount of ecological literacy included in their curriculum information. Of these 19 "top" schools, just nine made it to the DesignIntelligence list of the best 15 in their respective categories. According to DesignIntelligence, the nation's best bachelor of architecture program is Cornell University and the number one graduate program is Harvard University. Both programs were found by the Web survey to present a medium level of ecological literacy information.

[4] *www.di.net/archschools/schools.html*

The complete results of the Ecological Literacy in Architecture Education Web Survey is included in the Appendix.

What Might an Ecological Literacy Ranking of Architecture Schools Look Like?

In 2003, the World Resources Institute (WRI) published *Beyond Grey Pinstripes,* a ranking of the social and environmental stewardship curriculum of business schools—the only such ranking that includes assessment of environmental and social impact management. According to the WRI,

> The 2003 edition of *Beyond Grey Pinstripes*, coauthored by WRI and the Aspen Institute Business and Society Program, evaluated 188 schools and found that 100 schools from 20 countries include environmental and social stewardship topics in their curricula. The survey recognizes six schools on the cutting edge and another 30 schools with moderate to significant activity. Nevertheless, the study found the depth of coverage of these topics was severely limited in the core courses—accounting, finance, and marketing—that most powerfully shape the MBA experience.

Inspired by this ranking, several AIA COTE advisory group members—including Joyce Lee, Vivian Loftness, Daniel Williams, and Mark Rylander—discussed how a similar ranking system of architecture schools might be structured. A draft proposal has evolved from those discussions.

For each school of architecture (offering bachelor of architecture and masters of architecture degrees), the study would assess

- number of required courses dedicated to issues of ecological literacy and/or environmental sustainability (as central theme of course or greater than 50 percent of lectures or assignments)
- number of elective courses dedicated to issues of ecological literacy and/or environmental sustainability (as central theme of course or greater than 50 percent of lectures or assignments)
- number of required or elective courses that actively involve other disciplines in courses (designate whether it is true team teaching or guest lecture)
- number of studios dedicated to issues of ecological literacy and/or environmental sustainability (as central theme of course or greater than 50 percent of assignments)
- availability/number of graduate degrees/courses in environmental planning, design, science (MS and PhD)
- number of faculty members who
  - are involved with AIA COTE, U.S. Green Building Council, Society of Building Science Educators, Sustainable Buildings Industry Council, or other sustainable design-oriented organizations
  - are LEED accredited
  - have designed LEED-certified buildings or otherwise acknowledged leading sustainable design examples
- number (or percentage) of environmental sustainable operations and facility management practices in department/school/university
- presence of environmental building/learning center on campus
- index of green campus/green city characteristics: walking campus, mass-transit city, number of LEED buildings

- involvement of teaching/learning center in exploration of ecological learning models on campus and level of adoption of new pedagogies in the department/school/campus
- number of green design/sustainable conferences on campus in last five years
- number of lectures by ecology/sustainability experts or on sustainable design subjects (as a percentage of the department's total lectures)

This kind of ranking system could be an invaluable tool for prospective students, young educators, and others interested in this field, as well as an important benchmarking reference for institutions and departments themselves. While there are some limitations and some challenges regarding how certain indicators are calculated and (self) reported, those could be mitigated in various ways, depending on the groups behind the ranging, with an eye toward creating an objective and fair ranking system.

TRENDS TOWARD ECOLOGICAL LITERACY IN OTHER DISCIPLINES

Programs in higher education institutions reflect current trends in society toward specialization. In doing so, they frequently miss the profound interdependencies and interconnectivities between humans and the natural environment. Many examples exist, however, of a changing approach toward curricula that move from the conventional interdisciplinary teaching in which students take a group of standard courses from different disciplines and somehow tie them together. Many educators recognize the need for a more integrated approach that encompasses and bridges numerous disciplines, changing not just how people talk but, rather, how they live. In the words of David Orr, "Real ecological literacy is radicalizing in that it forces us to reckon with the roots of our ailments, not just with the symptoms…it leads to a revitalization and broadening of the concept of citizenship to include membership in a planet wide community of humans and living things."[5]

Transcending the boundaries of traditional areas of study is a key ingredient of ecological literacy. Frequently, environmental and sustainable studies spring from an attitude that the problems are solvable if only one were equipped with the right tools and methods. Constraints on ecological literacy, such as academic divisions and compartmentalization, are well established. Further, in professional programs, there are real limitations to introducing new approaches to understanding within a full load of core requirements. Overcoming these barriers will require a radical reshaping of institutions. There are already many encouraging signs of change. Many colleges and universities are developing areas of study that represent a significant shift toward integrating ecological literacy at the undergraduate and graduate levels. Those mentioned here are just a few such examples.

At Lesley University, the Master in Ecological Teaching and Learning provides educators with skills in ecology, advocacy, leadership, and research which they can apply to their respective learning communities. It stresses a bioregional perspective through field experience in a remote, wild setting followed by an urban, human-made one in recognition of one of the core tenets of ecological literacy: deemphasizing indoor, abstract learning in favor of a direct interaction with the environment. The program also examines ecological diversity as a basis for understanding diversity as a value of democracy in human communities.

[5] Orr, David. 1992. *Ecological Literacy*. Albany: State University of New York-Albany, p. 88.

The Environmental Studies Program at Redlands University encourages students to examine environmental issues within a systems perspective. It places as much emphasis on societal reform as it does on scientific rigor. The program acknowledges the bioregion as its lab and classroom, beginning with its physical campus which is set in a pristine western wilderness. Courses give students hands-on experiences with a variety of natural and built systems. The program emphasizes a problem-driven approach to promote thinking about the natural world and to find constructive ways of interacting with it. It appears to be less focused on a specific career direction than a way of thinking and working that could help lead toward major shifts in societies, to re-envision and reinvent a sustainable future.

The Gund Institute for Ecological Economics at the University of Vermont is proposing a graduate-level certificate program in ecological economics. The idea behind the certificate stems from an acknowledgement that ecological economics is inherently a transdisciplinary subject that can start to bridge the gulf that exists between the relevant disciplines. It is offered as an augmentation to existing degree programs. The certificate requires students to take two new core courses, Ecological Economics and Ecological Economic Modeling and Analysis, in collaboration with a degree program in natural resources, civil and environmental engineering, botany, biology, or community development and applied economics.

Presidio World College offers an MBA program in sustainable management that is defined as "the creative stewardship of resources to earn a profit while serving the common good." The program stresses intensive interpersonal instruction and interaction accompanied by online lecture presentations and discussions for remote participation. While the program encompasses studies of sustainability, culture, values, and ethics within a curriculum that includes accounting, finance, marketing, and economics, it does not stress a deeper understanding and competence in ecology and natural systems. The focus is on preparing professionals to position organizations—private, public, nonprofit—as leaders in the practice of sustainable management.

Rensselaer's program in ecological economics proposes a systems approach to studying human ecology as part of the global environmental system. It strives to bridge the traditional economist's concerns of efficiency and equity with environmental and social sustainability. The program embraces a transdisciplinary attitude that moves past classical economics into a "methodological pluralism" that brings together the fields of economic, social, and natural sciences, reflecting new perspectives on complex problems.

In the design professions, there is a wide range of sustainable curricula, from electives that are added into traditional course offerings to a deeper overhaul of how the concepts are taught. At Rocky Mountain College of Art + Design, the curriculum for fine art, interior design, graphic design, illustration, and liberal arts includes two "green" electives, Green Design 1 and 2, which expose students to environmental issues, sustainability, professional design standards for ecological projects, services, materials, production, and specifications of sustainable products. The focus is a pragmatic one, with less emphasis on the essential interrelatedness of humans, their work and the environment.

At the University of Washington, landscape architecture students study the fundamentals of natural processes, ecology, and regional landscape planning within a greater framework of the necessity to become citizens who comprehend interrelatedness, stewardship, and who have the practical competence required to act on the basis of knowledge and feeling—concepts inspired by Orr. By stressing community interaction outside the academic walls, the program encourages students to engage those around them in this endeavor:

> Through research and coursework, the development of ecological literacy is explored in terms of both how design processes may engage citizens in advancing their ecological literacy, and how a designed place may inspire citizens with new insights about, connections with, and stewardship for their environment.

These and other examples of learning are beginning to move from a conventional educational attitude based on a tradition of humans striving to dominate nature. Instead, they suggest a humility toward nature. Further, they represent steps toward Orr's ideas of teaching as a "true conversation" that "acknowledges the existence and interest of the other...in a dance in which the artistry is mutual."[6]

[6] Orr, David.1992. *Ecological Literacy*. Albany: State University of New York-Albany. p. 90.

Chapter 4

Teaching and Learning

Sustainability implies action. Many people teach sustainable design as if it is a value, but I want to teach it as a discipline.

— Jonathan Reich, AIA, Professor, California Polytechnic State University-San Luis Obispo College of Architecture and Environmental Design, 2005

I would like to reframe how *we teach. How can we teach ecologically? How we teach is as important as what we teach in terms of framing values and ethics.*

— Mary Guzowski, Associate Professor, University of Minnesota College of Architecture and Landscape Architecture, 2005

We had to think on many levels at the same time to find a way to create a building that would be pleasant to experience on a human scale, function effectively on the campus scale, and also strike a balance between the impact of the building on the environment and the environment on the building. The building had to relate to all *of its surroundings.*

— Nicole Nasjleti, Student, University of Wisconsin-Milwaukee School of Architecture and Urban Planning, 2005

Chapter 4 captions (top to bottom)

Students in Jim Wasley's Green Design Studio and Professional Practice Seminar (University of Wisconsin-Milwaukee) prepare to present to their client; this course was one of the three Ecological Literacy in Architecture Education grant recipients (see page 50). Photo by Jim Wasley

The University of Colorado team earned top honors at the 2005 Solar Decathlon. Photo by Chris Gunn/Solar Decathlon

Students designed affordable housing for a client as part of John Quale's ecoMOD course. Photo by Dan Addison

CHAPTER 4: TEACHING AND LEARNING

COURSEWORK INTRODUCTION

This project's calls for submissions yielded 44 courses and programs from universities all over the continental United States as well as Hawaii, Puerto Rico, and Canada. A peek into this many classrooms, as well as interviews with eight who received special recognition and visits to the campuses of the three winners, provides an interesting survey of activity. The selection committee included Daniel Williams, FAIA, Mark Rylander, AIA, Kira Gould, Assoc. AIA, and Lance Hosey, AIA, LEED AP; Vivian Loftness, FAIA, was an adviser to the process.

Less than one-fifth of the coursework represented required offerings, and many of those were environmental systems courses. There was a wide range of courses for undergraduates and graduates, several studios, many seminars (touching on theory), few history and survey courses, several design-build programs, and several community outreach or service learning courses.

Schools and teachers are discovering and creating new ways to incorporate sustainability into studios and other coursework. There appears to be more out there than there was 5 or 10 years ago and the efforts are deeper, more layered, and more complex. But our sample includes not a single example where the issues have informed a true transformation of the core curriculum. As promising as many of the courses are, it must be said that sustainable design remains a fringe activity in the schools.

Many of the most highly rated architecture schools show little interest in sustainable design, according to our research. The Ivy League schools, which consistently draw top applicants, have not made a noticeable effort to incorporate environmental strategies into their coursework. With few exceptions—notably California Polytechnic State University-San Luis Obispo, our top winner—the same may be said of all the programs listed in the 2005 Design Intelligence ranking of top schools. The implication is that ecology is not considered a design agenda but, rather, an ethical or technical concern. If the best programs, instructors, and students do not embrace ecology as an inspiration for good design, what chance does this endeavor have to transform the industry?

Among the Ecological Literacy in Architecture Education (ELAE) submissions themselves, there was very little evidence of innovative methods, particularly interdisciplinary teaching, and even less evidence of architects teaching with experts from beyond closely related fields such as urban design/planning and landscape architecture. For example, there were no courses team-taught by ecologists, biologists, or other scientists. Most teachers rely on guest lectures from those outside architecture, and only a few bring in scientists, economists, or others. This lack of linkages to science was disheartening to Williams. "Sustainable design education without a working knowledge of biology and ecology is not possible," he says.

The notion of trying to teach students to work collaboratively is seen as a big challenge and is rarely addressed substantively (with some exceptions). Many of the same barriers that have been discussed at various meetings and conferences in the past several years are still firmly in place it seems. This suggests there is a need for a coordinated effort toward broad and deep change.

There were many "green" studios, and a few of these were linked in meaningful ways to green campus efforts, often giving them a real site and client. Other courses sought this "reality check" by translating lecture coursework into a problem-solving project with a community angle.

Most of the studio projects seemed to be focused on single buildings and their immediate sites, leaving larger scales of responsibility aside. Water and bioregional issues are touched on in some survey-type courses, but they are generally minor points in a broad, shallow survey of issues.

Rylander was surprised that there didn't seem to be a true foundation course, though some of the reading lists were very impressive. "Generally, there seemed to be a lack of strong focus on a single issue, with few exceptions," he says. Mary Guzowski's Sustainable Design Theory and Practice course, part of a new program at the University of Minnesota that began in the 2005–2006 school year, is one of these exceptions.

Rylander was encouraged, however, "by the amount of design work being considered relative to sun, wind, topography and daylight. Lots of models and sections compared with professional practice. Surveying the design work broadly, it seemed to me that a lot of it was universally 'green,' rather than truly place-based."

Generally speaking, even among those programs and courses attempting to embrace sustainability, the focus is still quite narrow. If the ELAE submissions accurately represent the state of ecological literacy in U.S. architecture schools, the emphasis appears to be mostly on how ecology may be addressed in single courses, rather than entire curricula. And those courses typically deal exclusively with the techniques or mechanics of ecology, rather than the broader implications for culture and the study and practice of architecture. This becomes clear when these courses are measured by Orr's six principles of ecological literacy:

- *All education is environmental education*. Generally the ELAE submissions show that ecology is still treated as a special interest within architecture schools. Not a single program is attempting to define its core curriculum using ecology as a basis. These programs still see ecology as a fringe activity.
- *Environmental issues are too complex to be understood through a single discipline.* Among the submissions, true interdisciplinary collaboration that transcends the conventional boundaries of university departments is rare.
- *Education occurs as a dialogue with a place.* Many of these programs focus on the local community and environment, yet relatively few attempt to have a real impact on that place.
- *Method is as important as content.* While these programs are finding novel ways to study technological sustainability, few are embracing ecological sustainability by rethinking the departmental structure of academia, inside and outside architecture schools. Ecology typically is addressed within lecture and seminar courses.
- *Experience with nature promotes better intellects.*
- *Experience with nature promotes practical competence.* Few if any programs emphasize experience with nature through substantive field study; instead, they tend to focus on the ecology of the built environment.

While the submissions reflect serious effort to bring sustainable design principles and standards into the classroom, few if any demonstrate an attempt to rethink the habits and structure of architecture education. Not a single submission demonstrates a comprehensive attempt in any school to question the traditional role of the architect and the conventional design process.

Are these submissions representative of the broader body of active coursework today? Consultation with Susan Szenasy, editor-in-chief of *Metropolis* magazine, which has covered this topic for more than a decade, suggests they may be. Szenasy, who has also taught ethics to design students at Parsons School of Design for 17 years, says she sees and hears about a growing number of inventive architecture courses that focus on sustainability, which is encouraging. "These beginnings are hopeful," she says, "but academia and the profession have a lot more work ahead—work that involves rethinking architecture education and practice, not just adding palliative care to an out-of-date system."

Szenasy suggests deans, teachers, and architects ask some hard questions: How do we integrate sustainability issues seamlessly into architecture education? How do we redesign the studio so that it becomes infused with questions of sustainability? What supportive coursework do we develop—in the life sciences, history, culture, and economics—to give students a better understanding of their world? And how do we make this information connect into a web of knowledge, rather than the fragmented information academia dispenses today? How do we capitalize on the sophisticated technical knowledge of young people and use this, in tandem with their innate humanism, to help rebuild the way architecture is learned?

THE CALL FOR PAPERS: ECOLOGICAL LITERACY IN ARCHITECTURE EDUCATION

Humans are part of nature. Borrowing the term from the book by David Orr of the same name, "ecological literacy" implies a broad understanding of the relationship between humans, societies, and the natural world. The AIA COTE seeks to improve the training of future architects by emphasizing such connections. It is the AIA COTE's belief that architecture needs to be understood as part of a sustaining world view based on an educational foundation that places the natural environment in the center of all learning. Orr has stated as a first principle, "All education is environmental education." Architects are uniquely suited as designers to be open to this perspective. Under a Tides Foundation grant, the AIA COTE is undertaking an initiative that focuses on developing and applying appropriate instructional tools—based on the real world experience the profession can provide—for use in schools of architecture. It is hoped the work undertaken through the Ecological Literacy initiative will identify education strategies that may be implemented by schools of architecture.

Schools of architecture are asked to submit descriptions of up to three pages for coursework and programs related to sustainability and ecological literacy. The range of acceptable submissions includes lecture, seminar, and studio coursework, as well as community-based programs such as building projects and design charrettes. Given the broad range of disciplines and issues that need to be integrated into architecture education, it is the AIA COTE's intention to recognize this diversity as essential to success. In addition to the syllabus material, schools are asked to provide the following: name of school and contact person (with contact information for key contact), course/program name, year level of the course, and subject/approach (please provide a paragraph description).

The AIA COTE will present three monetary awards of $3,000 to schools. We suggest schools categorize entries in one (or more) of the following broad categories:

- Environmental foundations in architecture: programs that specifically incorporate an ecological perspective as part of the introduction to architecture. This may be a required or elective course inside or outside the school that advances the view put forth by David Orr and others.
- Integrated systems design: innovative courses that capture and connect such key concepts as daylighting, natural ventilation, energy, and water flows through experiential simulated study models and historic reference. Note that the ongoing Agents of Change program and the Solar Decathlon will be featured in the grant as case studies. This category is an opportunity to demonstrate environmental science courses that have affected the design studio as well as interdisciplinary work with environmental engineering schools.
- Sustainable community design: projects that represent outstanding community design projects, including participation in charrettes and civic building projects. Programs that illustrate the seamless connections among landscape architecture, urban and regional design, and architecture are encouraged.

The description should address duration, application of knowledge to the profession, interdisciplinary focus, the form in which coursework is presented by students, how success is measured, and how this course/program promotes ecological literacy in architectural design.

GRANT RECIPIENTS

The Sustainable Environments Minor: Sustainable Environments and Implementing Sustainable Principles

California Polytechnic State University-San Luis Obispo, College of Architecture and Environmental Design
Submitted by Jonathan Reich, AIA

The Sustainable Environments program at Cal Poly San Luis Obispo exemplifies the concept of ecological literacy in architecture education and provides a unique curricular model for design schools everywhere. An optional minor within the College of Architecture and Environmental Design (CAED), the program consists of an interdisciplinary set of courses spread throughout various university departments, including Architecture, Anthropology, Agriculture, Biology, Botany, City and Regional Planning, English, Economics, Forestry and Natural Resources, Geography, Humanities, Landscape Architecture, Philosophy, Political Science, Psychology, and Sociology. According to Professor Jonathan Reich, AIA, the interdepartmental structure follows the first principle of ecology—that "all things are connected." The program's broad scope offers students comprehensive exposure to the close relationships between the environment and every field of human endeavor.

Consisting of 27 course units, the Sustainable Environments minor typically is completed in the last two years of the undergraduate bachelor of architecture degree program, though many graduate students also take the two core courses. The centerpiece of the curriculum is a team-taught, two-course sequence split loosely between theory and practice. Sustainable Environments: An Interdisciplinary Overview (EDES 406), a lecture course offered annually in the fall quarter, serves as a broad introduction to ecology on global, regional, and local scales. The seminar meets once per week in the evening with approximately 75 students. Speakers from diverse backgrounds discuss the environmental impact on and by their respective disciplines, and students write several "thinking papers" to demonstrate their comprehension and personal views of the topics presented in lectures, field trips, and readings. Students interviewed for this report

unanimously say the course opened their eyes to the critical importance of this subject. When asked what "this subject" is, their answers are ambitious—"our future," "quality of life," "the need for youth to lead." Fifth-year architecture major Tammi Wright said that the course "introduced us to all the issues our generation will face. The more we are aware, the more impact we can have."

During the winter quarter, the same students take Implementing Sustainable Principles: Global Concepts to Local Actions (EDES 408). As the subtitle suggests, students propose practical methods for enacting ideas from the previous course in the local context, including the Cal Poly campus, San Luis Obispo, and/or the larger region. This approach moves the subject from head to hands. "Sustainability implies action," says Reich. "Many people teach sustainable design as if it is a value, but I want to teach it as a discipline." In the winter term, students join into teams that usually consist of one architecture student and four or five students from other majors, such as landscape architecture, planning, engineering, and construction management. The teams identify critical needs in the surrounding community and develop ways to address those needs. The projects are organized around larger themes that vary from term to term and in recent years have included "consumption," "energy," and "water." The scope of the proposals has ranged from communication and policy to design and technology. After the term, the projects are exhibited publicly and often presented to local regulatory and community groups.

In many cases the student projects are actually being adopted. San Luis Obispo developers are considering student proposals for higher density infill construction in the downtown district. On campus, research into biodegradable drinking cups, as well as a "foodshed" study on the distance traveled by various foods consumed, have influenced procurement policies of the university dining services. Similarly, the university has implemented a student proposal to control the volume of discarded plastic by issuing water bottles for students to keep during their entire tenure on campus. Other campus initiatives include biodiesel fuel for student buses and administrative vehicles, alternative transportation methods to reduce the ecological footprint of this suburban commuter campus, and new student and faculty housing to increase residency on campus. Students say the impact of these projects makes them think they can make a tangible difference. After going through the program, Tylor Middlestadt won the presidency of the Cal Poly student government association by running on a platform to green the campus, and currently he is working with the chancellor's office to promote clean energy policies on all 23 campuses of the California State University system.

The ability to spur change on campus may be aided by the fact that key figures at the departmental and university levels are trained to understand sensitive environmental issues in the region. Linda Dalton, vice provost and chief planning officer, is former chair of the Seattle City Planning Commission. R. Thomas Jones, who joined CAED as dean in 2003, is a nationally recognized expert on "smart growth" and previously was executive director of the California Futures Network, where he worked closely with the California legislature and governor's office on planning policies. Jones sees the Sustainable Environments curriculum as part of a wider effort to strengthen the region: "This program is helping prepare students to deal with the future of California."

The program actually grew out of a 1993 competition-winning proposal to rethink the local and regional areas with sustainable principles in mind. A collaborative, interdisciplinary team that included Professor Margot McDonald, who now coordinates the sustainable environments minor, outlined an ecologically driven development plan for the Los Osos Valley. The competition, Sustainable Community Solutions, was cosponsored by the AIA and the International Union of

Architects (IUA), so the AIA indirectly influenced the birth of the Sustainable Environments program.

In its current form, the program helped spur a university-wide effort to integrate sustainable policies into the campus and curriculum. Cal Poly signed the Talloires Declaration, a 10-point environmental commitment program outlined by University Leaders for a Sustainable Future (ULSF) and adopted by more than 300 institutions in 40 countries. Its principles include fostering environmental literacy at every level of education and, more important, extensive interdisciplinary methods.

President Warren Baker has remarked that signing the declaration was meant "to communicate Cal Poly's commitment to play a strong and positive role in applying sustainability principles locally, in our education, research and in the further development of our campus."

Examples of this effort include the interdepartmental curriculum known as UNIV (University Interdisciplinary Courses), which includes classes such as Global Environment and World Food Systems. Within other departments outside CAED, the College of Science and Mathematics sponsors a cross-disciplinary environmental studies minor, and the College of Engineering stresses the environmental consequences of design in every subject rather than through dedicated courses.

Students say the variety of topics is what energizes the Sustainable Environments program. Among the four dozen courses from other departments eligible for credit in the minor are Environmental Ethics (Philosophy), Human Impact on the Earth (Geography), Physics of Energy (Physics), Native Plant Materials (Botany), and the popular Eco-Lit, Steve Marx's English course in which students read everything from *Genesis* to Emerson to John Muir. Not only do CAED students benefit from multidisciplinary exposure, the other departments benefit from including them. "Architecture students in these classes tend to approach the subject matter and assignments with remarkable enthusiasm and creativity," Marx says. "Despite their often overwhelming workloads, they generally do more than what is expected of them, more even than what's required to get a high grade. I love having them as students."

Despite the program's interdisciplinary ambitions, the logistics of the curriculum may undermine its goals. First, to fulfill the number of credits required for the minor, students need not leave the architecture department. Because the CAED offers a sufficient number of in-house courses that qualify, the program does not necessarily expose all students to the larger university. More important, an interdepartmental curriculum may not be as effective as a truly *interdisciplinary* method. While the two introductory courses (406 and 408) are taught by interdisciplinary teams, the remainder of the curriculum is filled with courses confined to single departments. As a result, the bulk of the program becomes a "grab bag" of environmentally oriented subjects whose interconnections may or may not be studied in depth. The two introductory courses themselves draw students primarily from the CAED, so collaboration among disciplines is confined mostly to design and engineering majors, rather than a more diverse body of students from across the university.

Within these two core courses, the potentially limited scope of collaboration is reflected in the potentially narrow focus of the subject matter, as well. Because EDES 408 organizes student projects around a different central theme each year (e.g., water, energy, consumption), students risk seeing sustainable design through a particular lens and not through a wider spectrum of concerns. Although the theme approach may help clarify the information for students so they may more easily identify coherent strategies, that clarity is itself inherently risky because it may over-

simplify things. Reich says the focus on a single theme does not exclude other subjects but many student projects, while laudable, do seem relatively narrow in scope. For instance, when "water" was the overarching theme in 2003, one team studied ways to improve local stormwater run-off and, a year later, under the "energy" theme, a different team redesigned the city bus system. Both projects resulted in smart, practical solutions, and their simple focus probably increases the likelihood of implementation. But these projects missed an opportunity to benefit from one another by considering the close relationships between stormwater management and transportation infrastructure. A more effective structure for the course would offer a comprehensive set of themes every year but divide students into theme-oriented teams so that one group focuses on water, another on energy, and so on. Eventually during a given term they could learn from each other about how their respective projects and themes overlap.

But the most significant drawback of the Sustainable Environments program is the fact that it is an elective minor and not an integral part of the core curriculum. Though enrollment in the program grows every year, currently only about 20 percent of CAED students take part. Even among those students, the courses occur late in their tenure (at the 400 level) so the program could appear supplementary or incidental, rather than essential to their education. To reinforce the basic principles of ecological literacy, programs such as the Sustainable Environments curriculum should become required for every student—not just CAED majors—beginning with 101-level courses if not K-12. Otherwise, no matter how effective the program is or becomes, it remains marginalized.

Dean Jones, who is new to the school, sees the Sustainable Environments minor as a pilot program for the entire department: "It is a long-term goal to integrate this kind of approach within the core curriculum." He portrays the program in the context of three general concerns: the need to be integrators, not separators; the need for interdisciplinary education; and the need to expose students to the larger community outside the university. Reminded that these aims perfectly coincide with David Orr's principles for ecological literacy, Jones acknowledges that Orr has spoken at Cal Poly (on Earth Day 2004) and has had a noticeable influence on students and faculty.

Clearly these principles are taking hold on campus, and Jones cites student surveys indicating a high level of interest in the environment. So if the aim is to reorganize the core curriculum accordingly, what is preventing this from happening? McDonald and other faculty blame inertia. First, universities are compartmentalized, and interdisciplinary programs are difficult to organize because financial and human resources traditionally are tied to specific departments. Second, architecture school curricula are themselves compartmentalized. Environmental issues often are introduced in technical or theory courses, which typically are considered secondary to design studios, so the subject in general may appear inconsequential. Third, many faculty and administration members do not understand the need for innovative methods, even when they sympathize with the program's goals. Jones says that overhauling a curriculum requires complete support at every level, from the top down. Next year, he anticipates a 35 percent faculty turnover, so there may be new opportunities to rethink the CAED's structure.

One reason for any resistance may be lack of interest or familiarity. Some students guess that perhaps two-thirds of architecture majors show a strong interest in sustainability but records show that only one-fifth enter the Sustainable Environments program. Dean Jones conducts an annual survey of incoming students and has found that 47 percent of freshman design students say the environment is "important but will not necessarily be the major focus" of their education or future profession, while 36 percent say the environment is "very important" and will be a "major focus."

Combined, these figures suggest that nearly one-half the students who say the environment is a "major focus" do not choose the Sustainable Environments minor. What accounts for this?

One reason students give is that their peers often misunderstand sustainability as a purely technical problem, so the minor program may appear redundant with required ECS courses. Those who do understand the breadth of the subject might be daunted by the program as too difficult to manage. Scheduling does not help: the EDES courses are taught at night, which presents difficulties for students, especially on a predominantly commuter campus. Another possibility is that many students who otherwise might choose the program do not learn about it early enough to enroll because minors must be declared by the third year. Students think if the school and university emphasized the program, enrollment would increase significantly. Some do not see this as a good thing, however, because they think the enthusiasm and motivation that currently drive the program might suffer if every student were required to follow this path, whether they want to or not.

Yet this concern says less about the drawbacks of a possible core curriculum than it does about the strength of the minor. Participants in the program unanimously rave about the passion of their fellow students, and everyone interviewed seems to believe in the urgency of this agenda. Tammi Wright says the program changed her motivation as a designer. "I can't justify being an architect without being more responsible." Her comment aptly sums up the point of the Sustainable Environments program—to help students become more responsible.

Comprehensive Green Design Studio and Professional Practice Seminar
University of Wisconsin-Milwaukee, School of Architecture and Urban Planning
Submitted by James Wasley

Associate professor James H. Wasley teaches several courses at the University of Wisconsin–Milwaukee's School of Architecture and Planning. A pair of courses he has taught since 2003—a studio and a seminar—stands out because of the breadth of issues presented in the seminar, its associated visiting lecturers, and the link between the studio and a real project, site, and client. Since 2003, these activities have benefited from "outside" funding of $12,500 from the Gaylord Nelson Institute for Environmental Studies. Wasley has also translated these courses into opportunities to present ideas to state and university leaders—people with the clout to ignite powerful green campus efforts and individual projects.

"Schools of architecture can and should take a proactive role in promoting ecological literacy through aggressive advocacy for green building projects in their own institutional communities," Wasley says. After organizing a statewide symposium on green campus activities in spring 2003, he was offered funding from the Gaylord Nelson Institute for Environmental Studies to help them develop concepts, through his graduate design studio, for their proposed new building on the Madison campus. Over two years, those funds helped support two such studios, the building of a model (for fund-raising), and a master planning study and site selection analysis.

Wasley, who is the 2004–2005 president of Society of Building Science Educators, has long nurtured an interest in sustainable design as a synthesis of energy efficiency, resources conservation, and human health concerns. His pedagogy addresses these three topics by focusing on the creation of ecologically sound buildings through site and climate responsive design.

To understand the setting for architecture education at the University of Wisconsin-Milwaukee, it is important to understand the University of Wisconsin system and its campuses. The University of Wisconsin-Milwaukee is second to the flagship Madison campus in a state university system of

eight four-year institutions. The 933-acre Madison campus serves some 41,000 students in a well-known college community. A 90-minute drive away, a little more than one-half that number of students attend courses at the more urban campus in Milwaukee, a mid-sized city with a post-industrial feel. The School of Architecture and Urban Planning (SARUP) is housed in Milwaukee, while the interior design department (within the School of Human Ecology), the Gaylord Nelson Institute for Environmental Studies, and the School of Natural Resources (including landscape architecture) are on the Madison campus. The departmental barrier to interdisciplinary team teaching that most schools faced is coupled here with a geographical barrier.

The Comprehensive Green Design Studio (Arch 825) focuses on the proposed 120,000-square-foot Gaylord Nelson Environmental Programs Building, which would house the institute and some other academic programs on the Madison campus. This is a graduate-level studio that Wasley has run twice; he is planning the third one for 2006 and it fulfills the comprehensive design requirement. At its core, this is a studio design course that is driven by a full complement of sustainable design issues. The innovation is that the design problem relates to a proposed project with a program, a few possible sites, and—most important—a client. Actually, it is a large client group, including the faculty and leaders of the institute, faculty, and leaders of other departments to be housed in the building, campus facilities representatives, and university leaders. The studio has an activist role in educating campus decision-makers about sustainability issues that relate to actual projects.

The studio itself begins with an intensive exploration of site that students say was far deeper than they find in other studios. Nicole Nasjleti says it was a new challenge for her to look at solar access, wind direction, pedestrian access, and many other issues simultaneously. “We had to think on many levels at the same time to find a way to create a building that would be pleasant to experience on a human scale, function effectively on the campus scale, and also strike a balance between the impact of the building on the environment and the environment on the building,” she says. “The building had to relate to *all* of its surroundings.” The site planning, former student Andrew Zimmer says, “was the first and largest design problem to solve, not just a ‘hurdle’ to get past in order to get on with the business of designing a building. The site is the building’s most permanent aspect. This way of thinking about site is something that I tried to take with me into subsequent studios and into my thesis project, and I think they were better for it.”

The first studio focused on a site selected by the campus planner, a large parking lot at the base of an important hill on campus. The key issues in the resulting student work were protecting the “view shed” from the hill and providing a daylit building form. After the following summer’s planning and site study efforts, two new potential sites were identified. These yielded three compositional starting points: a new building to replace existing ones in the center of a block, a new building to replace existing ones on the corner of the same block, or the adaptive use of an existing tower. Four students tackled each one.

Wasley tried to bring students from other disciplines together in the studio. Both the first and second studio involved working with landscape architecture students in Jim LaGro’s sophomore site design studio, which enabled the students to gain far more robust and detailed site information than they would have been able to assemble on their own. (Some of the discoveries changed the paths of the architecture students. A row of trees the students were struggling to save was not native or even appropriate vegetation for the site conditions. The possibility of remnants of a Native American burial ground beneath one of the sites also stirred up the possibility that one group would have to abandon its site altogether.) Interaction with undergraduate interior design students from Mark Nelson’s senior studio was somewhat less successful, mostly because the

course formats did not match well enough that a strong design connection between what each group was doing could be made. In both cases, the distance between Milwaukee and Madison made frequent contact more difficult.

Learning about collaboration with related disciplines and other designers could be a valuable addition to architecture coursework. But Wasley is not convinced there is time to effectively teach students about collaborative working, even though he acknowledges that collaborative process is a key element of the practice of sustainable design. There are already so many requirements in architecture school that even bringing ecological issues and sustainable design into the mix has to be handled delicately; adding collaboration as an additional element to address typically proves difficult. Wasley is not convinced that students still developing their own attitudes and knowledge are ready for true collaboration. He fears some personalities are subjugated, depending on how teams are set up, by students who are either more mature in terms of their design aptitude or more assertive by nature.

As far as exposure to a wide range of modeling programs and other software tools, Wasley's courses do not involve much in this area. For the studio, he uses the Energy Scheming program developed by G. Z. Brown at the University of Oregon (and also used by Mark DeKay and Ted Shelton at the University in Tennessee, profiled on the following pages); this is a program known for being quickly accessible to students. "This program is not widely in use," he says, "but it's a good conceptualization tool for teaching." (He is considering the use of Ecotect software in future courses.)

Wasley believes students benefit greatly from exposure to professional architects and to faculty and professionals from other disciplines. His crits often include structural engineers or interior designers. The mechanism for effecting this exposure is the guest lecture model, which he employed in the studios, seminars, and in the Green Symposia (part of the institute funding paid the expenses of these visitors). This is similar to what is happening in other schools; team teaching is difficult to arrange because of departmental politics and requirements, so guest lecturing by those within the faculty and beyond is the best way to get diverse viewpoints in front of the students. Wasley invited Don Watson, FAIA, of EarthRise, former professor and dean at Rensselaer Polytechnic Institute School of Architecture and author of *Climatic Building Design* and other books, to lecture in association with the first studio (fall 2003). Watson, who has been involved in the sustainable design movement from the late 1970s and has a broad and deep understanding of the subject, riveted the students and spent considerable time with them. Indoor environmental quality expert Anthony Bernheim, FAIA, of SMWM in San Francisco, met with students and spoke at the Green Campus Symposium in 2004, as did Jim Toothaker, AIA, former bureau director in Pennsylvania's Department of Environmental Protection. Seminar students met with landscape architecture professor Rob Thayer of University of California-Davis, and Herbert Dreiseitl, an ecologist and artist from Germany. Pliny Fisk III, codirector of the Center for Maximum Building Potential Building Systems, lectured on both campuses in spring 2004. Rich Franko, AIA, of Mithun in Seattle, lectured at SARUP and served as a 2004 studio guest critic.

Students also spend a good deal of time with professor of civil and environmental engineering and environmental studies Erhard Joeres, who was the interim director of the Gaylord Nelson Institute at the time of the first studio in 2003 (Frances Westley is at the helm now). He had done some of the important early emissions trading studies (some of the key market-based emissions-reduction strategies have emanated from the institute), and his accessible discussions of the science of global warming had a marked affect on some students who had come into the class unconvinced.

An important part of the studio is that the students presented their ideas to university leaders, the local professional community, and the state building department. “These include people who are curious about sustainability and some who have real hesitations about the implications of greening a campus or a community,” Wasley says. His students got to face a real-world problem, explore a range of sustainable design issues in response, and then had the opportunity to make a persuasive case to a diverse set of stakeholders. (In this way, the studio might be seen to contribute toward the professional practice requirement.)

Arch 790 is a Professional Practice Seminar on Green Building and Designing for Sustainability and Human Health, a graduate elective that fulfills the professional practice requirement. It is worth noting this was one of the only submittals to the ELAE grant program that fulfilled the professional practice requirement that is a part of all accredited graduate programs.

The seminar offers a detailed introduction to issues of human health and environmental sustainability in architectural design through lectures, discussions, and a research paper. “The course is oriented to achieving a basic level of ecological literacy relevant to design applications,” Wasley says.

Students report that the strength of the seminar was that it challenged them to think about sustainability through a broader lens than architecture. The reading assignments were many and varied. Several were from the *Environmental Building News* archives but also news stories, agency reports, trade journal publications, and building case studies.

The final research project of the seminar required each student to develop an in-depth analysis of a green issue of personal interest. The result is a collection of sustainability research project presentations on issues such as building insulation, stormwater management, and reuse of construction waste. Several students responded positively to this part of the course, which they thought exposed them to specific subjects in detail and allowed them autonomy in selecting those topics for themselves.

Skip Holschbach, AIA, went back to graduate school specifically to study sustainable design. He chose the SARUP program after discussions with Wasley and took both the studio and the seminar. He responded to Wasley’s very interactive teaching style, which he says was in play in both the studio and the seminar and depended on students being prepared for active group discussion.

Several other students say the greatest strengths of Wasley’s courses are the breadth and depth of information covered (this comes along with gripes about too much reading “for architecture students” in the seminar) and the level of Wasley’s commitment. Erin Russ most appreciated his effort to “show us the means to learn more, not just give us a specific set of material.”

Wasley’s greatest strength may be his ability to weave together coursework with campus activism; the courses and students are a mechanism for change on campus, and in the community and the state, and in the process, the students are getting exposure to a complex, real-world process in the context of which their design proposals are a meaningful contribution. Outside funding was an important catalyst for many of these activities. The institute funding covered the construction of a large model and master plan for the Gaylord Nelson Environmental Programs Building site selection. The studios and seminars also overlapped with the Green Campus Syposium II, another opportunity for students as well as campus leaders to hear the perspectives of national experts on sustainable design (which had separate funding raised by Wasley on the

strength of the first studio). Don Watson, Pliny Fisk, and others mentioned above lectured and worked with students as visiting critics.

"It was exciting to read about these pioneers and innovators in sustainable design and then be able to discuss your ideas with them," Andrew Zimmer says. "This kind of interaction between students and key players in the environmental movement was a great encouragement to us."

Several students say they tried to implement ideas from Wasley's studio in future courses. In the studio that followed Wasley's, Zimmer and Holschbach collaborated on a site plan that used rainwater retention, infiltration, and wastewater recycling as a major element in the design of the site and the buildings on it. Zimmer worked with an ecologist during work on his thesis project, which involved a major prairie restoration and native tree reforestation that became part of the design solution. Erin Russ took Wasley's seminar and another studio he taught. After those courses, she says that she always tried to bring sustainability concepts into studio projects, but it was sometimes a challenge to balance those with the intent of those studios. Part of her thesis project examined the relationship between people and places in suburban settings. "Focusing on issues such as daylighting, density, multimodal transit access, and stormwater management played a pivotal role in the final outcome of the project," Russ says.

One of Wasley's students, Jennifer Ott (who has more recently been working with Wasley to create a stormwater master plan for the Milwaukee campus), says she didn't encounter these principles and issues in any other classes or studios. Wasley notes that while the department is supportive of his work, only a few of his colleagues, notably associate professor Michael Utzinger, are tackling this subject in important ways on a regular basis. Utzinger teaches graduate design, architectural physics, and building ecology and has recently been the sustainable design consultant on the LEED gold-certified Schlitz Audubon Nature Center. Students in his Illumination and Thermal Comfort course did postoccupancy studies of lighting, ventilation, and thermal comfort of the nature center and the Urban Ecology Center. This fall, his students will do rain resource/stormwater management studies and HVAC system studies of another project he is doing, simulations for Alterra Coffee Roasters. Even with just two of them seriously into the subject, the school is planning to formalize a sustainability certificate program within the graduate degree.

Like the Cal Poly minor program profiled above, and several of the programs cited for special recognition, the biggest weakness of these courses is that they are not required. (Several students suggest the seminar should be a required course for all university students, not just all architecture students.) Of some 200 master of architecture students at SARUP, approximately 15 of those take the seminar each year and 12 took the studio in each of the two years it was offered. While the impact on some of these students has been significant, they simply represent too small a percentage of the graduating population.

Seminar in Architectural Technology and Technological Traditions
University of Tennessee, College of Architecture and Design
Submitted by Mark DeKay and Ted Shelton

The University of Tennessee's Seminar in Architectural Technology and Technological Traditions classes focus on providing students with a framework—a decision-making process—for approaching bioclimatic and sustainable design. Both courses are required curriculum in the second year spring semester for graduate students in a three-and-a-half-year master of architecture program. The first three semesters of the master's program expose students to the basics of design, as well as the architecture technologies—classes that include structural design

and mechanical, plumbing, and electrical systems. By offering the technology seminar and studio coursework in the fourth semester, students are prepared to focus on how those technologies are integrated into design and how design and form connect to site and technology. By combining seminar and design studio environments, professor Mark DeKay and lecturer Ted Shelton expose students to both the theory and practice of integrated and ecological design.

The two technology courses are linked, designed to be taught simultaneously. These linked courses have been offered at the University of Tennessee for the past four years. In many ways, the origin of this curriculum is G. Z. Brown's book, *Sun, Wind, and Light*: *Architectural Design Strategies,* coauthored by professor DeKay for the second edition. (Brown currently is a professor at the University of Oregon's Department of Architecture.) DeKay describes his book as a "resource for designers who want to consider the form-generating potential of climatic forces in the earliest stages of the design process." Prior to teaching at the University of Tennessee, DeKay taught at Virginia Tech and Washington University in St. Louis. Ted Shelton, an alumnus of the University of Tennessee, joined with DeKay to teach this class for the first time in spring 2005. He previously taught at Temple University and was a practicing architect in Philadelphia with a focus on sustainable design.

DeKay explains that students in a traditional class in structural design learn how to size beams and various structural members. Once architects have completed their licensing exams, they will never perform these calculations again. DeKay explains that students instead need to learn how to choose an appropriate structural system, how the selection of the system will affect the overall form of the design, and, ultimately, affect the ecological footprint of the design. The typical architecture curriculum is fragmented and specialized—students learn about the myriad of technologies that comprise a building. This program focuses on integrating these diverse technologies by examining a variety of processes to simplify the choices architects make, and provide students with tools to analyze problems, generate solutions, and evaluate the implications of those choices. Through design exploration and seminar discussion, students are exposed to a variety of approaches to making these choices and are provided with tools to understand the implications of those choices.

Because the seminar and design studio are linked, students not only learn the technical and philosophical approaches to sustainable design but are given an opportunity to explore these concepts in their studio design class. The courses' content, schedule, and assignments are closely integrated so that the concepts introduced in the seminar class supplement the exploration in the design studio. For instance, the seminar class might focus on daylighting—exploring the quantitative and the qualitative—not only the technical and practical applications for designing effective daylit environments but also how designers use natural light to impart meaning and to enrich the experience of their architecture. The studio class will apply these lessons through design projects where students are asked to fenestrate their designs to provide adequate daylight balanced with sun control and appropriate levels of solar heat gain. The idea of linked seminar and design studios is a recurring theme at the University of Tennessee. Other studios focus on ideas that are supported by seminar or lecture classes. This pairing creates an environment of intensive interaction, teaches students how to apply specific ideas to design, and fosters a more integrated approach to the curriculum. The fourth semester courses have a class size of 10 to 20 students. The studio meets on Monday, Wednesday, and Friday, while the seminar meets on Wednesday. Students remark they are with DeKay and Shelton all day on Wednesdays. The class size and structure provide a degree of dialogue and collaboration necessary for an intensive studio and a seminar environment.

Led by Shelton, the seminar begins by raising the student's awareness of the connection between building and the environment and of the impact of building on the earth's limits. This class exposes students to a wide range of sustainable design concepts and strategies, as well as how those concepts are manifested in built work. The seminar examines the variety of ways technology is integrated into architecture and the experiential impacts of these approaches. Using the text, *Sun, Wind, and Light*, students explore designs that harness the sun for natural (passive) heating and natural lighting and harness the wind for natural ventilation. The text provides tools and techniques to quantitatively approach these systems. Supplemental readings by architects and theorists explore the more qualitative aspects of these systems, examining how these approaches might enrich design. Additional texts expose students to sustainable design issues such as water quality and efficiency and the lifecycle of building materials.

Through a series of case study assignments, students are asked to examine built examples of sustainable design and to critically evaluate how each designer approached technological and bioclimatic integration. By dissecting each case study, students learn how the designer's approach to implementation of each strategy has enriched or hampered an overall aesthetic. Each case study examines the various layers of systems within a design and asks the students to make connections between these systems and the contexts of each building (program, site, or other). As more case studies are examined, Shelton hopes to create a classification system that examines the variety of approaches to integrating specific technologies such as daylighting or stack ventilation. Shelton says "the application of technology can be an intimidating topic to students." The case studies provide examples of "how to put the parts together," which can be empowering to students. Thus, the focus of the course parallels the concept of integrated design—students learn not only about the components but also how they interact and create a cohesive whole.

The concurrent studio class is led by professors DeKay and Shelton. It is structured around two sequential design problems that allow students to explore bioclimatic design and the application of technologies into design. The first project is intended to be fairly unrestricted and features a design task with a simple program. Students must "learn to walk, before they can learn to run," explains DeKay. The first studio project is often the first time students are asked to select and schematically design a structural system, select building materials, or design a wall system. Sample programs have included a bus shelter or a small, off-the-grid cabin. The project's size and program result in a skin-loaded (climate-sensitive) design with small internal loads. Working in teams of three, students are given a site and a specific regional climate. Each team explores its climate, selects and locates vegetation for its site, and performs a site analysis that identifies environmental factors, including sun path, solar aspect, and predominate wind directions. Each team gains a specific understanding of their given climate, from which students work individually to create their own designs. The team structure allows students to assemble and analyze a variety of climates quickly and in depth, allowing adequate time for students to move on to create specific designs.

Using a simple energy modeling computer tool, Energy Scheming, students can input their design to create a basic computer model. The software, developed by *Sun, Wind, and Light* creator G. Z. Brown, recognizes a variety of climates and produces a summary of the energy loads that result from each individual design. DeKay has created online Web pages to support the software, including an online user manual. Students can also download regional climate data that can be entered into the Scheming software, allowing analysis of designs in expanded climates. The software is user friendly, allowing students to quickly input wall, roof, floor, and window systems using basic sketches of their design. McKay says, "You can enter a building in about an hour." The software produces a summary of the individual loads associated with the design. The software models the impact of solar gain, as well as the cooling potential of cross and stack

ventilations strategies, modeling the impact of the size and the location of windows. Students see firsthand not only how to harness bioclimatic forces but also how a design must balance each of these forces with the goal of creating zero-energy designs. Students can see directly how their choices affect heating, lighting, and cooling loads. Students aim for designs that "flat-line," i.e., the design's demand for heating, cooling, and lighting are balanced and can be met without use of supplemental energy.

The software is simple enough that students can model different scenarios to test the relationship between their designs and associated energy use. The software makes recommendations on improvements to the design to improve performance. Changes might include relocating windows, reorienting the design, or improving the insulation values in roof assemblies. Although lacking the sophistication of more cumbersome energy modeling software, students found the Scheming software to be user friendly and to quickly demonstrate the relationship between the myriad of design decisions they make and the environmental performance associated with those decisions.

Upon completion of this first design project, students have a basic understanding of a new design process and an elementary ease using the new tools presented to them. Building upon these newly acquired skills, the next design problem introduces more restraints so that students can apply what they have learned to more complicated programs and sites. Students are asked to design a duplex housing unit in a restrained, urban sight. Again students work in groups of three, but hand off their climate to another student group, exposing each student to a broader range of climate design-related issues. The students serve as resources to the new students taking on their former climate. Analysis tasks now include more urban design issues, including demographics and economic building constraints. The students find that many of the design techniques previously available to them on their unrestricted sight were no longer feasible given the restrictions of the urban sight, including solar availability restrictions from shadowing adjacent structures. Again designs were modeled and evaluated using the Energy Scheming software. Students modified their designs based on output and recommendations from the software. Rather than viewing the modifications as a design compromise, they embraced the changes as providing more justification for their solutions. Critiques of the design from professors DeKay and Shelton were supplemented by student-peer critiques. Outside jurors participated in the final jury and students had to defend their decisions less from an environmental perspective and more from a design perspective. Some students felt unprepared for the final jury's design focus because the studio professor's reviews were more environmentally focused.

DeKay and Shelton's two courses are well-integrated with each other and the timing of these courses is well-integrated in the overall architecture curriculum. Both teachers acknowledge that ecological literacy could better be integrated into the overall curriculum in the architecture program. They speculate that the obstacles to a fully integrated curriculum include the existence of a preestablished curriculum and an inability to "convert" the entire faculty to see the value of ecological literacy. Other schools' programs recognized in this study integrate other disciplines into the studio class, including engineering and landscape programs. DeKay and Shelton recognize this as a significant component to ecological thinking and acknowledged that the National Architectural Accrediting Board encourages this approach for accreditation. The University of Tennessee does not have a landscape architecture program or an engineering program that focuses on architectural engineering issues. For ecological literacy to flourish, it must pervade not only the architecture curriculum but the entire university's curriculum. Cross-discipline synergies might potentially exist within the university to broaden the focus of the architecture coursework. Perhaps integrating other disciplines beyond landscape and engineering, such as civil engineering, economics, or biology programs, might provide a connection. A notable cross-discipline program the University of Tennessee featured in spring 2005 was the

Environmental Semester—an environmentally-themed series of events and workshops and an outreach campaign that promoted books, films, Web sites, and other resources. The lecture series included noted environmentalist E. O. Wilson. The university also has a Committee on the Campus Environment, whose focus is to "advise the administration on institutional policies and behaviors that promote environmental stewardship."

Sustainable design is not just the incorporation of new technologies to minimize a building's impact on the environment. The University of Tennessee curriculum succeeds in that, even though it is called "architectural technology," it is about the *process* to approaching design that is in harmony with its environmental context. The teaching of a process is a challenging matter, especially when students have already developed their own methodologies for design. The studio format allows the instructors to break down the process into a series of steps: analysis, design, evaluation, redesign; and supplements this approach with essential tools to facilitate ecological design goals. The focus of the seminar class is not on components but on systems, not on solution but on *approach*. In many ways, the courses ask the students to start again—a step that arguably cannot be taken until students have been exposed to courses in structures, materials, and mechanical, electrical and plumbing engineering.

Students' reactions to this course have supported the instructors' goals of teaching process and approach. One student described the focus of the curriculum as teaching a "built-in process on how you design" and "not a formula, but a step-by-step way to design." Another student said she wanted to go back and redesign her projects from previous semesters based on the approach she learned in this class. By making the environmental impacts of design decisions evident, students thought their designs had meaning, had a justification. They recognized the value of design that is deeply connected to its site. In contrast to this revelation, many students were reluctant to include the designs from the coursework in their portfolios. They thought their designs were not "dazzlers." One can speculate that this belief demonstrates two things. First, that students grappled with learning a new approach to design and a mastery of that approach would come in time. Also students spent more time performing analysis and evaluation, cutting into time typically spent designing. The second thing this reluctance might demonstrate is that the professional architecture community does not always portray or see bioclimatic design as "high-design." It is not seen as cutting edge or avant-garde. This depiction is changing with many students relaying a strong passion for Glenn Murcutt's work.

For the students who complete these courses, the semesters that immediate follow include their thesis research and ultimately their thesis design. A lasting impact of the class is that many students proceed by embracing ecological thinking in their thesis topics. One student is pursuing the connection between architecture and health by studying the impact on human health from architectural materials and finishes. This demonstrates the courses success in implementing Orr's goal of seeing "things in their wholeness." Another student wanted to pursue the idea of "value" in design, focusing on how the lifecycle cost benefits must be accounted for when making design decisions so that our architecture reflects durability and value as a contrast to the disposable culture we live in today. This interest demonstrates the impact of the community and urban design aspects from the design studio, as well as the ability to evaluate decisions based on a whole-building approach—another impact from the Energy Scheming software. Students leave this class with a broader vision of the relationship between buildings and the environment; broader vision of what responsible, good architecture is; the ability to perform basic energy modeling; an arsenal of tools to help them approach design; and a new process for thinking about design that enriches their work.

DeKay and Shelton seek to make their coursework more transferable. *Sun, Wind, and Light* is taught in architecture schools all across the country. DeKay's current research projects include *Maps to Design Knowledge: The Sun, Wind and Light Applications Manual* and *Climatic Design Resources, Information for Architectural Design.* These projects create workbook-type problems and study materials in a Web-based environment to provide a self-guided learning environment of the material. His research is an extension of his goal of providing tools and resources to those who strive for bioclimatic designs. DeKay is keenly aware of the value of studio time and strives to develop means to teach the fundamentals of bioclimatic design in a self-guided format, in which students can learn outside the studio; freeing both professors to devote time in the studio interacting with students and exploring the potential of design. These efforts will not only provide students with tools to create ecological designs but also provide faculty across the world with tools to teach ecological design.

SPECIAL RECOGNITION—NEW AND PROMISING

University of Minnesota, College of Architecture and Landscape Architecture
Master of Science in Architecture: Sustainable Design Track
Submitted by Mary Guzowski

The College of Architecture and Landscape Architecture (CALA) at the University of Minnesota has developed a new Sustainable Design Track for the master of science in architecture degree. The coursework is centered on ecological literacy. The philosophy of the program is drawn directly from principles of ecological education as defined by David Orr and Fritjof Capra. Capra's Center for Ecoliteracy uses an eight-principle definition of ecology: interdependence, sustainability, ecological cycles, energy flow, partnership, flexibility, diversity, and co-evolution. This framework is the basis of course content, learning and teaching methods, and evaluation and assessment.

Because the master of architecture program is already so tight, the master of science format was the path of less resistance. "This is a rich discipline," says associate professor Mary Guzowski, who chaired the curriculum committee for the track, "and not everyone agrees that sustainability should be the lens." All courses are available as electives to master of architecture students. CALA dean Thomas Fisher adds that interest in post-professional degrees was another reason for the format. "This is a first step and an interim solution," Guzowski says. "It really should be integrated, but that's not possible now. Maybe in 5 or 10 years, the special degree will be gone."

Guzowki and her colleagues have been working closely with the university's Center for Teaching and Learning Services to create something that will be evaluated carefully in its first years. "I would like to reframe *how* we teach," Guzowski says. "How can we teach ecologically? How we teach is as important as what we teach in terms of framing values and ethics."

The track involves 34 credits to be completed over three semesters. This includes four foundation courses, six architecture elective credits, six non-architecture elective credits, and 10 credits for thesis or projects. The program links coursework to research at the Center for Sustainable Building Research (CSBR), which has recently developed performance standards for the state of Minnesota and done research for the U.S. Department of Energy and other groups on glazing, roof systems, postoccupancy evaluations, as well as guidelines for sustainable affordable housing. There is a strong emphasis on connection to real projects and practicing professionals—in the spirit of the Ralph Rapson-founded department—two things that Guzowski and her colleagues believe their students consistently want and appreciate.

Activities concurrent with coursework are designed to provide opportunities to connect with professional practice, other disciplines, and research throughout the semesters. These include a Bi-Semester Forum (a student/faculty/professional gathering to share coursework and research), the optional Green Practicum (student work with a design firm as an elective or directed study), the GreenLight Discussion Series (talks with practitioners, researchers, and faculty from various disciplines), and the Sustainable Design Knowledge Database (Web-based library of student and faculty work and research). The Theory and Practice course includes introduction to tools such as DOE2 (which most students know because they have a thermal course), LCA analysis, LEED, and Malcolm Wells' Wilderness Checklist. Other courses include BEES, Athena, RetScreen, and the suite of software called EcoTech. Electives delve deeper in energy analysis.

"There is a lot of talk about interdisciplinary teaching, but it's a real challenge," Fisher says. "Most universities are set up to protect their faculty and their time and they frown on faculty spending time in other departments. Sometimes a project out in the community can be the best way to make this happen." But he is convinced this is a challenge that must be tackled immediately. "The world is increasingly interdisciplinary and the complex, layered problems must to be solved in this way."

Associate professor John Carmody, also director of CSBR, taught the sequence's first pilot course in spring 2005 with 10 students who had already taken courses covering technology and the environment. His course, Energy and Indoor Environmental Quality in Sustainable Design, allowed students to "get down to the details of real buildings and see how the energy flows worked." The university was treated as the client who was looking for recommendations to make some existing buildings more efficient and effective. The second part of the course allowed the students to choose a research topic and explore it in relation to a new project being designed for the campus. The design team for the project joined the class and the students participated in one of the team's charrettes; this provided a strong link to professional practice.

Graduate student Corri Kluba took Carmody's course and found the interaction with campus architects and facilities teams a welcome departure from typical studios. "We worked with the campus energy management team, and it was stimulating to talk to someone who was in a position to actually apply some of our ideas," she says. "We developed a language that enabled us to communicate effectively with the mechanical engineers." She appreciated the inclusion of many guest lecturers in the class. Peter Herzog, author of the *Building Manager's Guide to Operations*, was a frequent guest at the start. "His book lays out a simple way of looking at drawings, counting what's there, and making assessments," Kluba says. Student teams posed questions to the facility managers, studied utility and water bills, and calculated where energy was being used and wasted. They also did lifecycle costing and made net present value assessments that they presented to university representatives.

Carmody will partner with a landscape architect for his next course, which focuses on site and water issues. Guzowski is keen to work with the forestry and biological sciences departments as well, and has been working with author Janine Benyus on ideas to bring biomimicry into the curriculum.

Fisher expects the new degree track to be successful. He and his faculty have noted student and professional demand. "Ecology is becoming the way to understand the world," he says. "This is something that we are all going to have to learn how to do. Organizations and professions are set up in a mechanistic way, and that will have to evolve… it will be redesigned … and this applies to the ways of teaching and learning."

University of Virginia, School of Architecture
ecoMOD Project
Submitted by John Quale

The University of Virginia's (UVA) ecoMOD course is a design-build studio focusing on creating well-designed, environmentally sensitive, and affordable modular housing. The origin of the studio is linked to the U.S. Department of Energy's 2002 Solar Decathlon in which 18 architecture and engineering schools from around the world competed to design and build a prototype for energy-efficient, completely solar-powered homes. Professor John Quale led the UVA team's entry in the Solar Decathlon. Quale wanted the experience to better balance the hands-on, technical and engineering aspects of the Solar Decathlon program with a more formal design studio environment. Quale also wanted the end product to explore affordable housing. Quale explains that in the Solar Decathlon, "We spent over $300,000 on a 750-square-foot house—not exactly affordable." Quale recognized that for environmentally sensitive, modular housing to transform the housing market, it needed to also address more realistic housing budgets.

The ecoMOD program was conceived of as a multiyear, three-part project. Its structure parallels a typical process of sustainable design: design, assess, and redesign. The first academic year is devoted to the creation of a modular affordable housing prototype. The second year is devoted to the assessment of that built design. The following academic years will draw from the lessons from prior semesters by creating new designs. The course is offered to final-year graduate architecture and landscape architecture students, fourth-year undergraduate architecture students, and third-year undergraduate students in civil, electrical, mechanical, and computer engineering. Undergraduate and graduate planning students are also included. Students have typically been exposed to sustainable design concepts prior to this class. The UVA architecture department offers classes in bioclimatic design and environmental control systems, which many of the ecoMOD students have taken. Working with interdisciplinary teams exposes students to a collaborative process. Quale describes his role as someone to "facilitate conversation and make sure all the issues are being considered so we could make solid decisions."

Students begin the course by researching and presenting specific sustainability topics, ranging from material selection to passive design strategies. Then teams begin to generate design ideas for a single-family house in modular units. The house is funded by the Piedmont Housing Alliance (PHA). The alliance provided the same amount of money they would typically provide for a single-family site-built home. Students create designs and work together to critique them, discovering which ideas best address site, budget, and climate. Ideas are synthesized after a few months and a final design evolves. The participation of mechanical engineering students allowed students to verify design assumptions using energy modeling software. Some additional grant money provided funding for environmental upgrades, including a rainwater collection system, but the design maintained the budget of a typical single-family home within the region. Students construct the final design in Fifeville, an established community in the Piedmont region, and will eventually sell the house.

The second year of the ecoMOD program will assess the performance of the design from the previous year. During this evaluation phase, students will perform a lifecycle analysis of the design and the construction process. The house will be monitored and data will be compared to an adjacent conventional house, which will serve as a baseline. Monitoring will examine energy performance, water consumption, and indoor air quality. The collected data will generate analytical reports and recommendations to inform future designs. The monitoring will include a postoccupancy evaluation developed from Berkeley's Center for the Built Environment. Quale

says he is "not sure if that will prove or disprove that the conventional wisdom from current literature is accurate. I suspect we will find some flaws in our thinking. Some of our strategies [may] not actually reduce environmental impact when we thought they would. If this happens, it is a unique teaching moment—and an opportunity to refocus the design process for the second and third prototype." The 2006–2007 and 2007–2008 academic years will build on this research to inform the design of a second and third prototypical home.

The first ecoMOD year began in fall 2004; the first prototype was completed in summer 2005. Student reactions to the program suggest that the course structure created a successful collaborative environment. A collaborative design process where students work in groups can be difficult to achieve successfully but is a critical element to the sustainable design process. One student remarked that "this project has given me the opportunity to learn how to work with others. I believe this is one of the most important skills in our field but we don't often have a chance to practice it in school." Another student comments that "this process is much more rigorous than a typical studio because you are constantly forced to question and defend design intentions, a process in which the stronger design intentions will remain and yield a more refined project." Students leave the course with a more realistic understanding of the complexity of issues surrounding both sustainable design and the design of affordable housing. One student observed that the course exposed her to the challenge of "trying to balance the issues of economy and ecology" and has realized why "people don't always build the way I think they should." The greatest outcomes of the class for the student will likely come in future years through the evaluation of their work. "The best possible design comes from a cyclic, reiterative effort," one student observes, "a process that I have come to firmly believe."

In addition to exposing students to a collaborative, reiterative, design process, perhaps the most significant outcome of the course will be its contributions outside the school of architecture. The development and evaluation of an environmentally sensitive, affordable home can transform the housing industry by sharing the lessons from the ecoMOD program. According to Mark Watson, director of project development for the Piedmont Housing Alliance, "Piedmont Housing Alliance has learned that it is possible to create a very energy-efficient, uncommonly sustainable home, at an affordable price in a very short time. The UVA student's tireless commitment to the project's timely completion and dedication to excellence in the home's construction has inspired the PHA to consider how to bring the project concept to the next level…large-scale production. With what appears to be another global energy crisis on the horizon, the ecoMOD house may be the prototype for future American housing. Energy-efficient, sustainable, healthy and flexible, the ecoMOD house may become what our grandchildren call home."

Clemson University, School of Architecture
Animated Architecture: Master of Architecture Thesis Research and Design Studio
Submitted by Keith Evan Green

Now in its third year, the Animated Architecture Studio is a two-semester thesis option in Clemson's master of architecture professional degree program. Organized by associate professor Keith Evan Green, the course illustrates how biomimicry principles can lead to compelling results in a design studio.

Inspired in part by David Orr's concept of ecological literacy, Green asks students not to design a single building or a project focused strictly on environmental performance. Instead, he proposes what he calls a "sustainable socioecological community: a dynamic and productive network of people, nature and artifice." Biomimicry, an increasingly popular idea in sustainable design, proposes that cultural artifacts should emulate the process of natural systems. Green compares

architecture to living beings that "grow, adapt, metabolize, evolve, breathe, mutate, camouflage, and reproduce." For instance, one student studied the resilience of slime mold and designed a mobile kiosk with similar traits.

The approach conceives of buildings as part of a specific ecosystem from which the features of the architecture directly evolve. With that in mind, Green emphasizes the importance of understanding a place comprehensively before designing for it. Accordingly, studio projects always focus on the region around Clemson, specifically the Interstate 85 corridor between Atlanta and Charlotte. This way, students can interact more substantively with the design context than they could with a remote site. Typically the focus is on problems with current development in the region. Students collaborate in teams to identify particular trends or areas that are of concern and propose critical strategies to correct the problems. One project, for instance, included a housing scheme that made use of land that conventional developers deemed unsuitable. Another began with the idea of improving the hydrological impact of typical suburban subdivisions. And another team found that a rapidly growing community along Interstate 85 suffered from piecemeal development, so they designed nine sites to be linked as a continuous, codependent network.

While the studio resides in the architecture school, it strives to bring an interdisciplinary perspective to the process by engaging faculty members from other departments. Students select a thesis committee of four to six people from various fields and meet with them six times over the course of the year. The thought is to evaluate student work from multiple perspectives, including political, social, cultural, and economic. The process attempts to circumvent curricular distinctions between studio, theory, history, technology, and professional practice courses by integrating deep research and practical solutions within the context of a design studio.

Green sees the course as an alternative not just to conventional approaches to teaching a studio but also to conventional understandings of sustainable design, which he says is conceived too narrowly and practiced as if it is a "club" for exclusive members. "What's remarkable about discussions of 'sustainability' in architecture," he says, "is that they almost always fail to mention the sustainability of people, the wider system of living things, and how all coexist and thrive. Sustainability is not just about nontoxic and recyclable materials and thermal control; it's about improving and expanding the well-being of living things across the built and natural environments."

To that end, Green has students focus on what he calls "urban-rural interface," where he thinks development has been least inspired. For example, one student project seeks to reconsider the economic and ecological potential of farming by combining agricultural and cultural activities in a "rurban" hybrid development. Green says these neglected areas should be a central topic for architects practicing in North America, and he sees his studio as training students to tackle these issues after graduation. "For me, academic courses in architecture should consider pressing issues for the built environment and forge directions and responses that might guide architectural practice. Architectural practitioners, meanwhile, might listen some to what the schools reflect on what being an architect means today, and work to avoid becoming irrelevant."

The Animated Architecture Studio is just one arm of the Animated Architecture Lab, a research/teaching unit Green organized with architects, planners, environmental scientists, biologists, and social scientists. The group studies how architecture can best grapple with issues such as accessibility, consumption, flexibility, and production—issues Green says are often neglected by designers, clients, and communities. His activity at Clemson "didn't set out to satisfy

a narrow definition of 'architectural sustainability'; it took on a larger crisis in the way we inhabit the environment."

To address this crisis more effectively, the Animated Architecture Studio would benefit from working closely not just with non-architecture faculty but also with students from other departments and with the larger community outside the university to ensure that a diversity of views informs the act of design and not just its review. However, the course is still very new and inevitably will evolve over time. As Green says, "We architects must tackle these difficult, complex problems with all our resources and welcome collaborators to help us where we lack the expertise. Sustainability demands this kind of interdisciplinary conversation."

For now, the studio represents some of the most compelling design work submitted to the Ecological Literacy in Architecture Education program, demonstrating that design excellence measured by any standard need not be sacrificed to address ecology. In academia as well as professional practice, some of the best designers have ignored sustainable design, possibly because they see it more as an ethical or technical agenda than as an aesthetic one. The work of these Clemson students shows the potential for sustainable design to create exciting forms.

SPECIAL RECOGNITION

Ball State University, College of Architecture and Planning and the Center for Energy Research/Education/Service
Arch 501 Graduate Design Studio and the Greening of the Campus Program
Submitted by Robert J. Koester

Professor Robert J. Koester, who is also director of Ball State University's (BSU) Center for Energy Research/Education/Service (CERES), has taught this graduate design studio for five years. The studio course examines the relationship between (environmental) context and design, addressing local resource availability and cultural context, culminating in the design of a Center for Regenerative Studies.

The front end assignments get at the allusions to natural process in terms of evolution and development. If there's a mantra in Koester's studio, it is that there is no right answer. "I think that this message is liberating for students," he says. "They have to realize that they are in control of the discovery process, and see it in those terms. They get a higher reward for making many transformations rather than shaping a single form." Even the best students are plagued by deeply embedded conventions and habits and struggle with urges toward iconography.

Students use ink and paper, physical models, and computer programs, including Energy-10, Rhino, Form-Z, and 3DMax. Koester pushes the students to discover distinctions between conventional design delivery process and a new model, one that benefits from stepping back and querying. "It's a breathing-in-breathing-out model—collapse and expansion," Koester says. "I try to show them how spending more time in schematic design would significantly shorten the time required if they were they to reach the construction documents phase because so much is already embedded in the design." This is an important connection to practice.

The site and "client" for the Center for Regenerative Studies changes for each studio; some offerings have provided chances for engagement with the profession. The year the studio had a Cincinnati site, AIA Cincinnati COTE was involved and members juried the student work. In spring 2005, the Ecosa Institute, in Prescott, Ariz., served as the client. Antony Brown, director,

visited the studio in Muncie to jury student work, and stayed in close touch with students throughout the semester, culminating in a Web conference critique of the final design work.

Graduate student Rita Macias says the studio exposed her to another layer of design that she was not aware of before. She wished there had been time for some analysis of existing buildings to understand how combinations of sustainability ideas could be effective or not. Student Aaron Paul Brakke found his results from this studio to be "more defined" than those of other studios. "I think we walk away from this studio with a deeper understanding of the complexity of building systems than we get elsewhere," he says. Koester was patient and persistent, Brakke says, and for him it paid off. "I learned that emphasizing the growth and development of a project through a rigorous editing process will yield much greater and complex results. We moved quite slowly at points as we negotiated our design methodology to include and, in some cases, revolve around environmental concerns." Brakke became fascinated with human psychological conditions and how people are affected by natural and constructed environments (and plunged into the work of the Heschong Mahone Group and the Rocky Mountain Institute on these issues). "I still struggle to adhere to the rigorous process Koester advocates," he says, "but I use passive design techniques in all of my projects. The idea of 'designing sustainably' no longer intimidates me; now it pushes me."

Koester asks faculty with other backgrounds—landscape, natural resources, environmental management, and business—to lecture and/or to be resources for the students. Institutional bureaucracy "conspires against interdisciplinary learning and teaching," he says, echoing a common complaint. Koester is nurturing an idea on this front. He proposes to challenge a college of architecture and planning to imagine and electronically build a new city over perhaps a five-year period. Faculty could choose sites and assign students projects, making it applicable to various classes; faculty members would have control over what they take on. During the five-year period, however, different faculty members would contribute in different ways and scales. The college would accumulate the results over time and that would provide the "neutral ground" on which to engage the subject of interdisciplinary learning and teaching. "This would remove the turf threat and over time," he says, "scholars could engage a conversation and share their insights through publication. Different models would develop at different institutions, and we could compare these collectively created prototypes." Some things about universities must change structurally, Koester says, suggesting that new units be set up to support many disciplines and are owned by none. "Our energy center has some of these qualities and involves some 50 faculty members in various disciplines from across the campus."

Koester also submitted Ball State's Greening the Campus Program, which is one of the nation's best. It has been in place for 14 years and includes a biannual conference that has a strong reputation in the green campus movement; the fifth conference, in 2003, was attended by more than 200 people representing more than 100 institutions (and was well-attended by BSU architecture students). The program leaders, including Koester, are trying to make ecology a part of what all students experience on campus. The first conference is one of the byproducts of the first Green Committee, appointed by the provost to address how to introduce environmental concerns into the curricular offerings/experiences of students campus-wide. That committee made some 35 recommendations and 20 were implemented. The second Green Committee charged with devising means to implement the tenets of the Talloires Declaration, which the university president had signed, resulted in 186 recommendations and two "top 10" goals, most of which have been implemented. The university has adopted a sustainability statement and written sustainability goals into its strategic plan. The more general Greening of the Campus effort promotes dialogue about sustainability and aims to address all aspects of campus life from curriculum to development to operations.

The tie between the Green Campus Program and the architecture curriculum is informal at present; Koester expects it will strengthen. The department is in the process of migrating curriculum from a bachelor of architecture to a master of architecture degree, which will offer sustainability as one of several graduate-level concentrations. "The long term goal of our new chair Jon Coddington is to see this so permeate the entire curriculum that there will be no need for a concentration," Koester says. "Sustainability will become second nature to all that we do."

Parsons School of Design at The New School, Department of Architecture, Interior Design, and Lighting
Issues and Practices in Modern Architecture and Urbanism
Submitted by Jean Gardner

Jean Gardner's Issues and Practices in Modern Architecture and Urbanism, a weekly seminar required of all first-year graduate architecture students over two semesters, represents an ambitious attempt to incorporate ecological literacy in a research-based course. Students conduct case studies of important building projects, typically in New York City, by reading and discussing texts, analyzing visual representations, and observing firsthand. Gardner introduces the seminar with a single question: "What are the ramifications for architecture of the global spread of modernity?" While sustainable development emphasizes local conditions, culture and commerce are becoming increasingly global in scale and are radically altering regional traditions. One way to begin to understand what Gardner calls "the co-evolution of nature and culture" is to see every act—in this case, the act of building—as existing simultaneously in many spheres, including natural and cultural, local and global, present and future. Students attempt to grasp the relationships between these conditions as a way to understand that buildings are more than bricks and mortar.

To aid the process, 15 years ago Gardner began developing what is now a trademarked guideline called the Whole Building Matrix. The idea is to combine different types of analysis in the hope that a more comprehensive understanding will emerge. Made up of 10 "research avatars," the matrix is meant to see a building through many lenses at once:

- Overall quality: How does the building affect us?
- Material sensations: How do we experience the materials?
- Surprising features: Why does the building startle us?
- Design details: What do formal elements reveal about the architect's intentions?
- Diagrams: What graphic images does the building relate to?
- Function: What is the purpose of the building?
- Environmental responses: What is the ecology of the building?
- Aesthetics: What makes it a work of art?
- Criticism: What judgments are made about it?
- Theory: What architectural premise underlies the building?

In providing in-depth answers to these questions, students develop their own theory about a work. One student's analysis of the classic modernist landmark Lever House finds that its "surprising features," material qualities, and aesthetic novelty are also the source of its functional and environmental problems. The compelling asymmetrical composition, allowed by new zoning ordinances at the time, nearly led to the building's demise when developers later tried to replace it with a more efficient use of real estate. And while the curtain wall took advantage of unconventional structural and glazing techniques, it also prevents people from getting direct

access to fresh air and has significant problems with heat gain and loss. The student concludes that using new technology and following current trends could hamper the long-term viability of a project if the consequences of change over time are not carefully weighed.

The ultimate aim of the process is to reconsider what it is that makes a building "sustainable," and with every project the students decides for themselves what criteria are most important. This approach demonstrates David Orr's concept of ecological (as opposed to technological) sustainability as a holistic effort that affects every area of culture. Gardner laments the fact that in architecture education "the playing field has narrowed dramatically" because educators focus on technical issues. "The dominance of the high-performance building as a type of sustainable design is in many people's minds only an opportunity for building energy efficient and secure buildings and that is it." Gardner sees her method as a way to counteract this trend by examining projects with a wide-angle lens instead of a microscope.

Gardner's method also reinforces Orr's ideas about interactive education as a way to promote intelligence, not just information. While the matrix guides students, it does not lead to preconceived conclusions. Rather than simply learning the consensus view of any given project, students develop their own interpretations that are at once highly personal and steeped in knowledge drawn from observation and literature.

Influenced by the theories of Gregory Bateson, Charles Peirce, and especially John Dewey, who thought that art can only be discovered over time through direct experience rather than abstract reflection, Gardner encourages students to go through a process she calls "autopoiesis" (literally "self-production") that "extends from their intention to their hands, then into their work and back through feedback loops into their intentions." This concept perfectly suits ecological literacy's emphasis on practical and cumulative learning.

Final assignments have focused on projects currently under development in New York City, an approach that offers many benefits. Gardner hopes to raise issues about how "sustainable" the city itself is and show students the urgent need to ask the right questions when planning for the future. In this way, students engage the surrounding community and apply their critical skills to their own place. They also begin to see the potential of the matrix as both an analytical and a synthetic tool because it can help shape new work rather than just clarifying existing buildings. Gardner is writing a book with Brian McGrath on how to incorporate these ideas in the design process.

For the moment, the research seminar format limits the ability for the discussion to be truly comprehensive because it does not officially extend into other types of courses. If a holistic process does not inform the curriculum at large, it risks being marginalized as a special interest pursued by particular students and teachers and not embraced as an essential part of education. Gardner hopes to address this problem by blurring the lines between subjects covered in different courses. "My course is an effort to put these distinctions back together. Some may argue that this is similar to all the kings' men trying to put Humpty Dumpty back together. In life as it is lived, these distinctions do not exist, so I would argue to let students experience the integration of design, theory, history, and technology, then they have personal knowledge as a ground from which to create an ecologically sound world."

This aim can only be effective if it is incorporated in entire curricula and not single courses, and Gardner has been active in efforts to do just that. She recently published an article in the journal *Thresholds* on sustainability's role in architecture education and writes that "every aspect of the building process—designing constructing, inhabiting, maintaining, renovating and tearing

down—has always had a relationship to our ability to sustain ourselves." She concludes that to bring sustainability into the academy forces us to reconsider the purposes of education. As cochair of the Association of Collegiate Schools of Architecture's Task Force on Sustainable Design, she was instrumental in organizing a conference to address that question, and the result was Sustainable Pedagogies and Practices, the 2003 ACSA/AIA Teachers' Seminar at the Cranbrook Academy of Art. And she also participated in the Second Nature Conference at Wingspread that eventually influenced the current Ecological Literacy in Architecture Education program.

Kansas State University, Department of Architecture
Environmental Systems in Architecture and Other Coursework
Submitted by Gary Coates

Professor Gary Coates has taught Environmental Systems in Architecture (ESA1) at Kansas State University for 28 years. ESA1 is the first in a series of three required courses that introduce students to sustainable design concepts and systems integration. ESA1 begins by illustrating the connection between architecture and global environmental problems, highlighting the importance of bioclimatic architecture to contribute toward a more sustainable society and to create an architecture of place. ESA1 is distinguished from other courses in environmental systems in that Coates structures the semester as a design course with technical content rather than a technical seminar course with design content. The class combines both studio and lecture environments, allowing students to both learn and apply their new understanding of bioclimatic design to specific design problems.

The course parallels several of the approaches found at the University of Tennessee. Both programs combine lecture/seminar with design studio. Both use the text, *Sun, Wind and Light,* to present the ideas behind bioclimatic design. Professor Coates has developed a workbook, *Bioclimatic Dwelling Design: A Workbook Companion to Sun, Wind, and Light,* to accompany this text. The workbook presents a step-by-step approach for designing a small house based on the principles of bioclimatic design. All students are given the same site but are assigned one of four climates: cold, hot arid, hot humid, or temperate. The workbook begins by asking students to explore the relationship between climate, site, and human comfort. Through a series of exercises, students chart how sun, wind, and light interact with the topographic features and vegetation of their site. Using specific techniques from *Sun, Wind, and Light,* students begin to identify design strategies that offset the liabilities of their site and climate while harnessing their assets. The workbook structures the site analysis giving students an opportunity to apply the knowledge from the course texts by creating bioclimatic charts, sun peg charts, and daylight availability analysis directly within the workbook.

Building from their site analysis, students adapt a basic design for the home to the assigned climate and site. These adaptations focus on three primary areas of bioclimatic design: passive solar heating, passive solar cooling, and daylighting. Workbook assignments ask students to site and orient the house; design landscape elements and outdoor rooms to shade or buffer the house; design appropriate wall assemblies; and design fenestration that balances insulation, solar gain, daylight access, and ventilation. The workbook also provides exercises for students to evaluate the effectiveness of their design decisions through calculations like measurement of a daylight factor or maximum heat loss. Unlike the University of Tennessee's program, students do not use computer modeling software to assess their designs. Coates says he wanted to avoid "the situation where the computers are smart and the students are dumb because they don't know what is going on in the black boxes of the software." Without the use of software, the analysis and evaluation calculations are more cumbersome but students gain a richer understanding of the relationship

between design and environmental impacts "providing them with a sense of grounding in hand and eye when they turn to the use of powerful modeling software." The workbook exercises are supported through lectures and readings, touching on a diversity of subjects from global health and our society's dependence on fossil fuels to key concepts in ecological design. Coates reinforces these concepts with case studies on bioclimatic design, examining both vernacular examples as well as contemporary designs.

ESA1 is required curriculum for all second semester, second-year undergraduate architecture students. Enrollment in the course typically ranges from 100 to 120 students. The large class size creates challenges to presenting this material through design problems. A studio environment typically relies on a direct faculty/student relationship. Coates counteracts this obstacle by dividing students into project teams—groups typically consisting of two or three students, and by relying on graduate teaching assistants. The group structure has the added benefit of teaching students to work effectively as a team. Coates points out there is a deficit of group experience in most architecture curricula. Coates acknowledges that he has had more success with two-person student teams than with three-person teams but group size is often a function of class size and the number of teaching assistants assigned to the course. Perhaps the large class size mandated the development of a workbook format, which facilitates more self-guided learning. While Coates cannot provide the one-on-one interaction typical of a studio course, the workbook creates a structured approach to design that is more directly transferable to both teaching assistants and students. The ESA1 course is distinguished in that the workbook can make the course approach replicable to others attempting to teach or learn bioclimatic design. Coates' workbook, in conjunction with Brown and McKay's *Sun, Wind, and Light,* are teaching tools that can be used in a variety of contexts, creating a pedagogy that can be transferred to other settings. Coates and DeKay are currently collaborating on a Web-based workbook that is a companion to the *Sun, Wind, and Light* book. The Web-based software presents similar exercises as those found in the print version but the computer format creates more direct links between the design problems and the resources and tools used to aid and assess those designs. The final product will be even more replicable and transferable than the print versions currently available.

Coates strives to integrate ecological awareness throughout Kansas State University's architecture program. "Ecological Design must come to pervade the entire curriculum, especially the design studios which remain the heart of architectural education," states Coates. As a studio teacher and studio coordinator, Coates strives to reinforce the design knowledge presented in ESA1 with concurrent and subsequent studios. Subsequent classes (ESA2 and ESA3) continue this linkage to studio projects, presenting content focused on more complicated sustainable design approaches such as active systems (HVAC, lighting, water and waste, and acoustics) as well as how those systems are integrated through design.

Student reactions to ESA1 illustrate the course's strengths. Many students said the course revealed a need for sustainable design and the relationship between buildings and the environment. Students gain a social consciousness and passionate recognition of the need for sustainable design. One student writes "ESA1 has provided me with the basics of sustainable design, and enabled me to take responsibility of the far-reaching environmental impacts of buildings. At the same time it has made me think more critically about the world around me." The course presents a new design process for implementing bioclimatic design. Another student explains that "it has left a permanent imprint on my design thought process. All of this info is very useful and important" and "this course has made me think differently about architecture." There is a sense that the students' motivations for sustainable design stem from an increased social awareness, and perhaps students' need to also see sustainable design as a way of enriching their designs aesthetically as well. The size and format of the ESA1 may limit this exploration but

it is encouraged through subsequent studios that have been coordinated to build upon the lessons of ESA1.

Mississippi State University, College of Architecture
ARC 2713 Passive Building Systems (Ecological Design)
Submitted by Michael A. Berk

Professor Michael A. Berk teaches this required course for all second-year architecture students as an introduction to ecology, sustainability, heat transfer, climate, energy, light, solar orientation, ventilation, vernacular design, ethics, alternative energy, lifecycle analysis, systems theory, site relationships, and acoustics. That is a very big order, and Berk tackles it with what students report to be very effective and well-illustrated lectures, several films, and a solar research construction and report project that is team executed.

The underlying notion Berk tries to communicate is the idea that "human intervention should respectfully work with the grain of their context, specifically the natural world, rather than relying on twentieth-century brute force technology to oppose it." Berk seeks to disabuse the notion that sustainability is a style or even a philosophy: "It is a fundamental principle of good design," he says. "Gravity is not a philosophical position… neither should sustainability be." Berk's course stresses passive strategies and regenerative solutions as the means to make building physically and psychologically comfortable.

Students from other disciplines occasionally take the course, which Berk has taught since 1996. The first third of the course is general enough that it could be a core curriculum course for the university. Two of the three main textbooks are written for a lay audience and most of the films are similarly accessible (such as *Koyaanisqatsi*). Berk sees his course as an ecological course on politics, economics, and biology and tries to weave in the architecture.

Berk notes that in the subsequent semester, all second-year students enroll in a design studio that emphasizes sustainable principles and the results in the work are mixed. "If they are in my studio, they cannot dance around the issue. Students are largely driven by grades and they know where I'm coming from. I get some excellent results from some people in my studios. If they are in the other studios, they may dance around the issue a bit more." In the studios that follow the class, the students are introduced to two- and three-dimensional modeling. They use SketchUp to model sun paths. "They see how quickly they can measure and demonstrate and study," Berk says. "It's powerful. Ninety percent of the performance will be in the general conceptual moves up front—site planning, orientation, shape issues. If they get close on those things, they will get the performance up there. And it's not easy. We are hot/humid in summer and temperate in winter. This is a difficult area to design for passively."

For this course, the students are required to design and build small solar elements. Berk tries to get them to think about every topic they have covered in class and bring them to these small "heaters" that must perform. This project is conducted in teams of students. The collaborative, hands-on application of the material presented in the earlier part of the course helps bring it to life (and brings the students outside to test their boxes).

Berk is indeed passionate, as so many of the educators who are struggling to bring ecological issues into architecture education are with little encouragement or camaraderie. He is particularly passionate about the issue of performance. "I want to eliminate the word aesthetics from architectural dialogue," he says. "I can look at Gehry's buildings as pieces of sculpture, and then maybe they are beautiful. But as a building, they are ugly if they do not perform well. One of the

sad things about architecture in the 20th and 21st centuries is that is has moved away from having to perform." This is why he is trying to get the students to think more deeply about choosing materials and creating forms, and trying to get them to avoid making choices of "cool" materials or those that can be beautiful.

Student Nick Hester says, "Working as a team was interesting in the sense that different people interpreted the information in different ways. You got to see how other students were learning and applying things." He found the project was relevant to his studio work. "It was really enlightening to think on that scale and think about what materials are. Understanding what a piece of wood really is and all the energy that is used to make the lumber and transport it."

Student Ralph Eide found the project "well-suited to teach us some of the principles that were discussed in class. It turned an otherwise traditional lecture-based course into one with similarities to a studio or laboratory experience. We had to carefully consider materials, embodied energy, and life cycles and still produce a solar-heated box in competition with our peers."

For student Jessica Lovelady, working in groups was a little frustrating but largely positive. "The solar box project gave the class an opportunity to test what we had been learning. We learned about coming together as a group, and how people can look at the same materials and the same problem and develop totally different ideas." She cites learning about lifecycle analysis as the most transformative aspect of the course. "It makes me feel responsible for what I propose in all of my projects, and as a very young designer it forces me to investigate and really challenges me."

University of Hawaii, School of Architecture
Arch 316 Environmental Design and Mechanical Systems and Environmental Systems Laboratory
Submitted by Stephen Meder

Assistant Professor Stephen Meder submitted Environmental Design and Mechanical Systems, a third-year course, and the related research and activities of the University of Hawaii's Environmental Systems Laboratory. In particular, Meder and the students working with the laboratory (having taken the design and systems course) were responding to a problem in the community: the portable classrooms that were being used long-term as K-12 learning environments were hot.

Meder saw this fundamental problem as an opportunity to build relationships between the professional design community, the state education agencies, architecture students, K-12 students, community groups, and others to bring about positive change and increase the environmental design and analysis capacity among the students and professionals.

The first phase of the project (conducted in 2003 by faculty and students and supported by the U.S. Department of Energy) involved monitoring and assessing the bioclimatic conditions within typical Hawaii Department of Education (DoED) portable classroom buildings. About 1,500 portable classrooms are in operation around the state. Some have been in use for 30 years. They house about 10 percent of the state's public school children. Instituting design improvements could also improve learning environments and the K-12 educational experience in Hawaii.

The investigation uncovered conditions well outside the comfort zone for classrooms. "The teachers told us, 'There's no learning after lunch,' " Meder says. "The kids and the teachers had

told us how distracting the heat could be. So we knew it was hot." In fact, temperatures near the ceiling were typically 100° and higher and nearly 90° at desk level.

These extremely poor conditions, Meder says, raised some difficult questions: How do we expect children or teachers to perform in such uncomfortable conditions? What values does this transfer to our children? How can we expect them to be contributing members of our community and caring parents when we are denying them the basic right of a healthy, satisfactory, and comfortable educational environment?

The team recommended some strategies for improvement in the report and then tested those using computer models and full-scale physical models constructed at the School of Architecture. Using both physical and computational models allowed the team to propose and then comprehensively test and verify design approaches.

Meder and his students presented their findings to the local COTE meeting. Together with AIA COTE, the Center for Better Communities, the state Department of Education, the state Energy Office, and other groups, they decided to design a portable classroom for the state Department of Education that will provide a comfortable, conducive learning environment that will improve the quality of life for the people within and around the building.

Three portable classroom designs are in schematic design at this writing. It is expected the computational modeling that was used to develop the recommendations in the first phase will be expanded to include computational fluid dynamic analysis to evaluate natural ventilation and thermal transfer. Daylighting, optimized siting, water conservation, and interior/exterior development will be included and encouraged on all of the campuses. The ongoing work is being supported by a grant from a local charitable foundation and *pro bono* contributions from local professionals.

Collaboration and partnership among the academy, professionals, disciplines, and government agencies are among the great lessons of this project. The impact students can see on a real-world problem is another strength. The students are learning to use measurement tools—physical and computer-based—to prove existing conditions and then propose viable solutions as a response. The limited nature of the course—focusing solely on thermal properties and comfort within—gives it less reach than some other courses but this is actually another strength because the students are free to cut more deeply and investigate the impact of very small design changes on this one factor.

That the building type is so banal and uninspired is another aspect of the course that leaves a bit to be desired but that, too, has another side: These banal boxes are where the next generation of Hawaii's children (and many other American children) are being educated. Recognizing that problem and working to mitigate it may not be glamorous but it is certainly worthy. The idea that a social and educational benefit can arise from the application of good design is also a good lesson to see in action for undergraduates. Meder calls it "sustainable design with real results."

Chapter 5

Proposal for Action

Architecture is a subset of a larger field, ecological design. This is the larger art of fitting the pieces of a society into a coherent pattern of fairness, resilience, and sustainability. If architecture is a subfield of that, then its role is to lead the coalescing of the energy flows, water, and biota into something that meets those characteristics (fair, sustainable, resilient, and beautiful).

Then you face the question, "Do you start the students with specifics or with the big picture?" The conservative approach is to learn the basics first, then big picture. The other, perhaps more radical, view is to start with ethics and big picture. Actually, you have to do both. All education should orient people to "here is where we are"—you are on planet earth, it has a biosphere—and then begin to relate architecture to the realities of the biosphere and learn about the evolution of the built world.

— David Orr, Environmental Educator/Author, Oberlin College, 2005

Chapter 5 captions (clockwise)

Students collaborating in John Quale's ecoMOD course (University of Virginia), which received special recognition in this report (see page 61). Photo by ecoMOD

A student records light levels at the January 2004 Agents of Change workshop at the Burton Barr Central Library (Will Bruder) in Phoenix. Photo courtesy of Agents of Change

The Solar Decathlon entry by the Virginia Polytechnic Institute and State University team earned top honors in the Architecture and Dwelling category and also earned the AIA Presidential Citation for excellence. Photo by Chris Gunn/ Solar Decathlon

Visitors, including hundreds of elementary school students, crowded the Mall to view the solar homes at the Solar Decathlon. Photo by Stefano Paltera/Solar Decathlon

CHAPTER 5: PROPOSAL FOR ACTION

THE AIA COTE CENTER FOR ECOLOGICAL DESIGN

The Kendeda Sustainability Fund, the donor-advised fund at the Tides Foundation that is behind this project, was created in 2003 to explore how to "live within the limits of the natural world in ways that promote community, equity, prosperity and health." These are symbiotic with the stated goals of the AIA and its Committee on the Environment. Throughout this report, we have opted to use a broad definition of sustainability. The impacts of various forms of human consumption are increasingly evident, and impacts of human-caused climate change are increasing.

The challenges are many and great. This is a moment for bold action. The AIA COTE and the authors of this report believe the most comprehensive way to advance the level of ecological literacy in architecture education and in practice is to establish a national Center for Ecological Design (CED), which would focus on this topic as a project of the AIA's Committee on the Environment.

The broad mission of the CED will be to investigate ways to elevate ecological literacy in architecture education and throughout practice. Specifically, the CED would generate projects, research efforts, and curriculum support mechanisms to bring ecological literacy to students training to be architects. The organization would be flexible in terms of collaboration, scope, and partnering.

By definition, the CED would partner with existing groups across disciplines and emphases. Some of the proposed groups focus on sustainability in education, others on bringing sustainability into architecture education and practice. A suggested (not comprehensive) list of such possible partners is included at the end of this chapter. While communication with some of these groups has occurred, not all groups mentioned here have been contacted about this report.

Perspective

Just how urgent is the problem? One practitioner, Edward Mazria, AIA, has been urging fellow architects to wake up to the science.[1] Mazria has called architects to task, citing the building industry as responsible for approximately one-half of all global warming emissions. Most climate scientists agree that since the beginning of the 20th century, the earth's mean surface temperature has increased by about 0.6° centigrade.[2] The 2° rise is widely acknowledged as a threshold between danger and disaster. If we continue on our present course of burning fossil fuels, we could reach 2° centigrade by 2050. To avoid reaching that threshold, Mazria suggests that "all new buildings and major renovation projects must be designed to use half the fossil fuel energy they would typically consume. This reduction standard for new buildings should increase by 10 percent in 2010 and another 10 percent every five years after that, to arrive at carbon-neutral buildings—those that use no fossil fuel energy to operate—by 2030."

[1] See Appendix for link to Pew Center on Global Climate Change Study: Towards a Climate Friendly Built Environment (Oak Ridge National Laboratories, June 2005) and the joint science academies' statement calling for global response to climate change (June 7, 2005)

[2] See Intergovernmental Panel on Climate Change, *www.ipcc.ch/,* and the Union of Concerned Scientists, *www.ucsusa.org/global_environment/global_warming/page.cfm?pageID=515*

Mazria calculates that each year in the United States, we tear down approximately 1.75 billion square feet of building, renovate 5 billion square feet, and build new another 5 billion square feet. During the next 30 years, some 50 billion square feet will be torn down, some 150 billion will be renovated, and another 150 billion will be built new. By 2030, three-quarters of the built environment will be either new or renovated. While that is a scary prospect, it also represents a unique opportunity. He believes architects can make a big change and have a huge impact in addressing what he calls "humanity's greatest challenge." Mazria calls for professional architecture and planning schools to establish "mandatory, innovative, studio-based, full-year programs relevant to climate change and incorporate a deep understanding of the relationship between nature and design in all core courses." Given the urgency of the challenge, continuing education for professionals along these lines should also be a priority.

Where there is clearly a need throughout architecture education (and more broadly in higher education in general and in youth education before that), Mazria's emphasis on the studio aspect of the architect's education is one that many other practitioners share. They are frustrated that the bulk of environmental information that students receive is relegated to environmental systems courses and the occasional sustainability-infused studio to which only a few students are exposed. (Many others, including many of those who are seeking the most rigorous design instruction, actually avoid these.) Studios are elective and subject matter is autonomously determined by instructors, yielding to a frustrating lack of permeation—this in the face of what some report to be a continuing growth in student awareness and desire for deep, thorough, studio investigation of such topics.

Randolph Croxton, FAIA, who participated in founding AIA COTE meetings and was a board member and liaison to the AIA COTE during the committee's first few years, is often asked to give lectures at campuses around the country. He notes the invitations emanate from student groups, green campus organizations, or deans, and rarely design faculty. The university schools and departments that are leading sustainability education—business, real estate, construction, forestry, and various branches of the natural sciences—are rarely the architecture schools. After lectures or juries, he is often asked by enthusiastic students what schools of architecture he can recommend with sustainability fully integrated within the design curriculum. "I can only give partial recommendations since the progress that has been made is usually in partial content of the main design studio, or more likely, a separate course or activity," Croxton says. "Until there are faculty who have fully integrated sustainability as a central design value, an inherent dimension of design excellence in the design studio, there will be no good answer to this request."

There is also an evident need to include systems ecology in the architect's education. "We must not set the table too small," reminds Daniel E. Williams, FAIA, 2003 AIA COTE chair. He champions the inclusion of the work and writings of E. O. Wilson, H. T. Odum, Eugene Odum, and Robert Costanza. "The integration of systems ecology into architecture education is absolutely critical."

Activities

For this report, a broad set of activities the CED could undertake has been outlined. The authors believe that being specific about the kinds of projects the CED would undertake would be the most effective way to illustrate how the center would work and the reach it would have.

Some of these ideas have emanated from conversations with people mentioned in this report; some are obvious outgrowths of existing groups (who may already be pursuing similar phases themselves). They range from practical and measurable to more strategic and far-reaching. It is

hoped the ideas illustrate the wide range of what is needed and what is possible. (In some cases, possible partners and consultants for specific projects have been identified.)

As currently defined, some of these activities overlap with one another and this list is by no means comprehensive. Subsequent planning with project partners would refine and shape the specific tasks and the structure of the CED itself.

Several of these activities could and should begin right away, even as the particulars of a center are assessed. As overall framework and budget issues are reviewed (the AIA declines to release specific budget details at this time), seed funding could be put to immediate use for workshops, research, publications, and curriculum development.

Planning the AIA COTE Center for Ecological Design

The coauthors of this report and the organizers of the ELAE program would meet with representatives from the Cloud Institute for Sustainability Education and the Center for Ecoliteracy. The meetings would facilitate a discussion of the ongoing initiatives aimed at broader education for sustainability, how these initiatives should inform design education, and what the first and long-term goals of the CED should be. There would be concurrent consultation with the Tides Foundation and Second Nature. A facilitated teleconference with the grant recipients/educators, their deans, and several other individuals would collect feedback and input following the publication of the report and proposal. It is possible this effort could be underwritten by remaining planning grant funds.

Hosting a Biannual Summit

Several influential sustainability conferences have occurred in the past, including annual conferences of the Society of Building Science Educators, the Association of Collegiate Schools of Architecture, the American Council for an Energy Efficient Economy, and the U.S. Green Building Council. Although these conferences raise overall awareness of sustainability, the AIA COTE Center for Ecological Design would focus on professional curriculum development for ensuring depth in sustainability through biannual conferences with specific goals and outcomes.

The conferences would address

- *Foundations of Design Education for Sustainability*: A look at best practices, a discussion of learning and teaching methods, and a structured workshop to design seminal foundations courses. The workshop would also address the issue of developing core courses that can be easily transferred from one institution to another.
- *Curricular Transformations for Sustainability*: What would real transformation of architecture curriculum in schools of architecture look like? What future changes to the National Architectural Accrediting Board's requirements might support this transformation?
- *The Marketplace and Education for Sustainability*: The marketplace is a player in education today. The marketplace, concerned with "what sells," has a proclivity to limit the definition of sustainability, but could be reversed if sustainable education created new marketplaces for professionals.
- *Beyond Buildings*: Sustainable design requires an understanding of biology, hydrology, ecology, land-use decision-making, infrastructure engineering, chemistry, and material science—a host of subjects that go well beyond the elements of buildings. How can university curriculum teach awareness about scale, connection (as in Charles and Ray

Eames's *Powers of Ten*[3] concept), and innovative design processes necessary for this ecological interdependency?

- *Architecture for Generations*: Previous generations of architects designed for centuries, today's projects are often designed for decades. Sustainable design requires a commitment to longevity through "cherishable" quality, design for adaptation, and design for deconstruction and reuse. Educational innovation must embrace postoccupancy evaluation.
- *The Collaborative Design Process*: Given these challenges—design beyond buildings and design for generations—sustainability education will need to develop new collaborative design processes. These processes will be multidisciplinary, participatory, iterative, just-in-time, and responsive to ongoing changes in cultures and in the science of sustainability.
- *An Architecture of Place*: Knowledge of climatic, geographical and cultural diversity, and expertise in the region of practice is critical to sustainability. The identification of courses that champion regions and cultures, and the development of curriculum that embraces the liabilities of climates and the natural conditioning assets will be key to curricular innovation.
- *Sustainable Benchmarking Tools and the Classroom*: What is the role of rating systems, simulation tools, and physical testing tools in the architecture education process? A study of how these quantitative tools are being used in the classroom and their effectiveness and their meaning in continuing education is an important aspect of architecture for sustainability.
- *International Curriculum and Benchmarking Tools for Sustainability*: How are emerging standards and measures of sustainability changing education and practice in Europe and Asia and how does this relate to U.S. education and global architecture practice?

Using the AIA COTE Top Ten Measures of Sustainable Design as a Curriculum Tool

The AIA COTE Top Ten Measures are the basis of a definition of sustainable design that is broad and deep. The measures use an approach that holistically and creatively addresses land use, site ecology, community design and connections, water use, energy performance, energy security, materials and construction, light and air, bioclimatic design, and issues of long life and loose fit. The narrative measures and their associated metrics, initially developed and still used for the AIA COTE Top Ten Green Projects Awards, are a well-developed framework that could adapt easily into a curricular framework for different types of courses or an entire program. The CED would identify a team of educators and practitioners to work together to create teaching modules based on these measures and their evolution.

Trading the Mentor Model for an Ecological One

Many educators, ecological thinkers, and practicing architects believe that how ecological literacy is taught is as important (or even more so) as the content of what is being taught. At many architecture schools, the mentor model is still firmly in place; students are "filled up" by the knowledge of a professor. Some educators, however, have begun to teach using an ecological model—multidisciplinary, participatory, iterative, designing for place, designing across time. Students are becoming more involved in framing the questions, shaping courses, and interacting with practitioners and in the community. A workshop with leading education experts (including

[3] Charles Eames said, "Eventually, everything connects." This statement is perhaps the briefest way to summarize what is missing from contemporary design dialogue. The Eames's seminal film, *Powers of Ten*, is an exploration of connectedness and relative scale.

several from university centers for teaching excellence), ecological thinkers, and architecture educators would be an opportunity to explore some leading models and their outcomes based on comparisons and analysis of classroom results.

Relating Method to Content

The CED could embark on a study about how ecological and sustainable foundations and creativity are being taught and how method and content relate. One segment of the work could be to identify a few key programs that are trying innovative ideas to track over time. Another segment of this work might address how systems theory is rendering the linear model less effective for some knowledge bases. There is ongoing research on the impact of electronic communications on human brains and capacities for learning. There are also benefits when students are being taught to do research and engage information in cumulative and collaborative ways. Information and learning methods and aptitudes are changing shape. How is this affecting the methods and the content in the architecture classroom?

Mapping the Strengths and Gaps in Teaching Methodologies

The CED would expand on this report through additional, ongoing research to identify the means and methods through which schools are embracing ecology. An annual survey similar to the Design Intelligence survey of architecture schools would rank programs according to criteria based on ecological literacy.

Possible partners/consultants: Association of Collegiate Schools of Architecture, National Architectural Accrediting Board, various universities, Design Intelligence

Analyzing Software Tools in the Classroom and Office

Much software is being used in architecture classrooms across the country. A panel of experts, including such people as Harvey Bryan at Arizona State University, Susan Ubbelohde at the University of California-Berkeley, and Mark DeKay at the University of Tennessee, could be tapped to discuss what should be learned and shared from the classroom. Representatives from firms could participate to see where crossover lies and discuss what next steps should be.

Possible partners/consultants: AIA Technology in Architectural Practice Knowledge Community and various university research centers

Hosting Workshops

The CED would design and facilitate multiple-day educational workshops with the best ecological thinkers and practitioners to reveal the breadth and depth of courses, curriculum, tools, and process innovation for sustainability. A series of workshops for teachers who are (or want to be) teaching ecological literacy in their architecture courses could be established with an assembly of outstanding course modules from universities nationwide. These modules would address the spectrum of disciplinary knowledge areas needed for design professionals and the spectrum of curricular vehicles, including studio, lecture course, seminar, lab, design-build, campuswide project course, and community design project.

Possible partners/consultants: The Cloud Institute, Second Nature, Society of Building Science Educators, and U.S. Green Building Council

Offering Continuing Education for Professionals

Some university courses focused on sustainability currently offer AIA Continuing Education credits for professional participation (such as Bruce Haglund's graduate sequence at the University of Idaho, Arch 510-556). The CED could create a set of model characteristics and propose the model for architecture schools.

Possible partners/consultants: National Council of Architectural Registration Boards and U.S. Green Building Council

Identifying Games Designers Play

The CED could identify services and tools that have been effective in facilitating sustainability-framed design charrettes that demonstrate the process and significance of integrated design and interdisciplinary collaboration. These services and tools could be introduced into schools of architecture and continuing education programs.

Publishing

The AIA COTE Center for Ecological Design would undertake a range of professional literacy endeavors:

The Eco Design Reader. A *Utne Reader*-style collection of articles and papers, as well as commissioned articles about ecological literacy education in architecture education and ecological design.

Possible partners/consultants: The Cloud Institute and Society of Building Science Educators

Journal of Ecological Literacy in Architecture Education. A peer-reviewed journal focused on teaching ecological literacy, ecological design, environmental systems, and other related courses in architecture education. The Society of Building Science Educators has long discussed the possibility of such a journal and there are several interesting models that could be considered.

Possible partners/consultants: Society of Building Science Educators and Association of Collegiate Schools of Architecture

Books. Working with AIA publishing partners and other publishers, the CED would publish books about teaching ecological design and related subjects. In addition, the CED would develop an illustrated textbook to reveal the interdisciplinary and inspiring design depth behind critical elements of sustainability.

Possible partners/consultants: John Wiley & Sons Inc., Taunton Press, and Ecotone

Seeking the Sustainability Story

The theme for Global Possibilities' 1999 annual symposium for a solar future was Rethinking Design Curriculum: Integrating Solar Energy for a Sustainable Future. The 40 participants—mostly educators and deans—were divided into groups to tackle questions, including "What story would you create, or have you created or heard, that describes the importance of design in a sustainable society?" The response sought was for a story that replaces the description of design in industrial society. The group responding to this question included Gary Coates, a professor at Kansas State University, Hilary Brown, an adjunct professor at Columbia University, Ed Dorsa, an associate professor at Virginia Tech, and John Reynolds, a professor at the University of Oregon. Their response was summarized this way:

> We found that there are not yet commonly shared meta-stories. We might begin to envision a meta-industrial society, not as an alternative to, or as a contradiction of, but as the logical, necessary and desirable transformation of industrial civilization. This more sustainable, humane society would actually realize the purposes, dreams, and ideals that have moved generations by means of the Industrial Revolution. We should build this new story around the idea of interdependency and make that a motivating framework.

That lack is still with us and filling it should be a priority. A compelling narrative about the sustainability imperative story is critical to gaining public awareness about the real aims and taking things beyond "eco" and "green" labels. This is not a story about "green features" or new technologies, though both things have a role. This is a story that involves history, evolution,

science, and morality. It is about methods, research, and what it means to be human and to make things in the world. Told properly, the story will sound like a new language and will be a potent virus. Creating the story would be a collaborative exercise with a group of writers, interviewers, architects, and educators (likely including some of the "champions" mentioned in this report and other pioneers), and a draft could be created through a series of calls and Web-based communications. A workshop on the topic (at one of the biannual conferences) would bring the document to a sharable state.

Possible partners/consultants: The Cloud Institute and Second Nature

Seeking Other Documentation

There are other aspects of documentation that are important to this effort. The CED should author a timeline of architecture education framed by sustainability and an illustrated timeline of environmentally driven architectural practice over centuries. Understanding where we have been and where we are going is important here. Learning about Vitruvius as one of the first systems thinkers in the Classical world, as Orr has suggested (see Chapter 2), can be part of a powerful reframing of history. This document would be shared electronically and input welcomed via an electronic bulletin board.

Possible partners/consultants: Environmental Building News

Creating a New Curriculum Beyond the University

The CED could lead an effort to create a new model for architecture education outside the confines of the traditional university setting. Knowing what we know about the strength and limitations of university paths, as well as the strengths and weaknesses about other models (Taliesin, Ecosa Institute, Yestermorrow, and others), a group of educators and practitioners would re-imagine the process in a facilitated workshop setting. What kind of organizational structure would create a set of assumptions and explorations that would allow students to understand architecture as a part of ecological design? The right team would generate a strong vision and a plan with significant level of detail to make implementation possible.

Sponsoring a Competition

The CED would run a Top Ten Green Projects student competition, which would be integrated with the AIA COTE Top Ten Green Projects award program. Submissions would be judged according to the Top Ten Measures (but not Metrics). Interdisciplinary collaboration would be encouraged in the hope of spurring more interdepartmental activity in the universities. The resulting collection would become a traveling exhibit available to local COTEs and schools of universities, as well as any other interested organizations.

Possible partners/consultants: American Institute of Architecture Students

Offering Grants to Educators and Firms Collaborating with Schools

Because architecture is both an art and a science, it sometimes seems that getting grants on either "side" of that balance is a challenge. The CED would address this issue by setting aside funds for distribution each year following proposals from educators who would be invited to apply for grants to support guest lectures, ecological literacy-based studios, interdisciplinary team teaching or other interdisciplinary activities, green symposia, research tools, training workshops (for students, teaching assistants, teachers, and professionals), research activities (see Promoting Research below), collaborations with professionals, and other activities.

Providing Resources for Educators and Professionals

The CED would create a list of sustainability references, DVDs, and software for different levels of expertise, and arrange to have these available through Amazon and the AIA Store with discounts.

> *Possible partners/consultants: Association of Collegiate Schools of Architecture, Society of Building Science Educators, American Institute of Architecture Students*

Promoting Research

"Energy is a design topic, not a technology topic," says Don Watson, FAIA, of EarthRise. "There are a few of us who have always believed this." Watson taught at Yale University and Renssalaer Polytechnic Institute, where he was also dean, and was involved with the AIA's Energy Committee and COTE from the late 1970s. Watson has called the period from 1976 to 1986 a "golden moment" in architectural research in the United States, from which schools of architecture and the profession benefited enormously. "At that moment, we knew more about designing energy efficient buildings than anyone in the world." The CED would seek to express and embody the AIA's appreciation for research as something valuable for practitioners and universities.

Vivian Loftness, FAIA, 2005 AIA COTE chair and professor of architecture at Carnegie Mellon University, has identified that

> The combined budgets for building research across the federal government is less than two percent of federally funded R&D, in no way commensurate with the importance of the built environment to our economy and quality of life. Given this paucity of research support, there are only a handful of university Ph.D. programs focused on energy efficiency and environmental quality in the built environment, compared to many dozens of universities with federally funded research related to nano-technology and information security for example. Given that the building sector is 20 percent of the U.S. economy, over 35 percent of U.S. energy use and associated environmental quality, and significantly linked to the health and competitiveness of our nation, the federal sector must move beyond today's marginal funding of research in the built environment.[4]

The CED would urge congressional leaders to clearly state in allocations for the National Institutes of Health and National Science Foundation that a dedicated research funding stream of 5 percent be established to fund research in a sustainable built environment, including multidisciplinary centers of excellence, in order to fully understand the potential of design to reduce health and environmental costs in the United States. These are fundamental and applied research questions that have insignificant funding, public or private, despite the major role buildings play in our economy, health, quality of life, and environment.

Identifying Research Partnerships

These partnerships would be among universities, professionals, and industry (some of these are already finding one another through the EPIC Project and the AIA's Educator/Practitioner Network). Many people are already doing important work, and the CED would extend, build on, transfer, publicize, and support that work, as well as link it to the profession in ways that may not already be in play.

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[4] "The Impact of Federal Energy Efficiency and Renewable Energy R&D Programs," presented to the Energy Subcommittee of the House Science Committee, May 19, 2004.

Possible partners/consultants: Architectural Research Centers Consortium, Society of Building Science Educators, Second Nature, Gund Institute, and several university research centers

Developing Daylighting and Systems Laboratories

Daylight is a significant driver of ecological design and measurement is key to understanding. Every school of architecture and its community should have daylighting and/or integrated systems labs of the highest caliber. While the National Science Foundation fully supports the development of chemistry, materials, physics, and other science and engineering labs, they explicitly disallow applications for building science labs, arguing that they do not support budgets for buildings and that architecture is an applied, not fundamental, science. In addition, the building industry has only modest investments in university research or demonstration, despite the power of learning enabled by hands-on laboratories. The CED would work with the entire design community to challenge these decisions. Recent research is revealing that environmental education enhances learning, especially environmental education that engages the students with the facility itself.[5]

Linking Human Health and Buildings

The link to human health is still one of the most important and potentially transformative aspects of sustainability. This is also a subject that provides ample opportunity to links with such other disciplines as interior design, medicine, and industrial design. As one means of highlighting the importance of health, the CED could sponsor such initiatives as awards programs or competitions recognizing projects that successfully bring ecological design into complex buildings and buildings with heightened occupancy needs.

Possible partners/consultants: AIA Academy of Architecture for Health and National Institutes of Health

Using the Case Study Approach

Steven Moore of the University of Texas-Austin wrote about his coursework (in his submission to the ELAE grant program): "Architectural practice requires knowledge that is scientifically, ecologically, and culturally responsible. The best way to engage graduate students in the production of such knowledge is through the case study method."

Sponsored by the Large Firm Roundtable and the Educator/Practitioner Network, the AIA Case Studies Initiative was launched in September 2001 to produce an online database of case studies that analyze and document projects in the context of professional practice. From the start of the effort as an extension of the Large Firm Roundtable discussions between deans and practitioners (1998–2000), it has been conceived that case studies could originate in either venue with the hope that bridges would be built between them. In a series of open meetings, further consideration was given to the case study as a tool for scholarship, research, and academic advancement. It is intended that a broad collection of case studies will begin to alter the understanding we have of practice while assisting the most recent graduate to gain insight.

There is broad support for the case study approach within the AIA, and knowledge communities are encouraged to provide case studies for the growing database. But the format lacks sustainable design information. Seven case studies are online now, with more in review. The CED would review the case studies and then work with the Case Study Work Group to see how sustainability

[5] See Julie A. Athman and Martha C. Monroe, *www.rbff.org/educational/BPE3.pdf*.

issues might be made a part of the framework and work to augment the framework to better capture such issues.

Possible partners/consultants: AIA Case Study Work Group and Society of Building Science Educators

Conducting Postoccupancy Evaluations

This subject has been creatively pursued in the academy through Vital Signs and then Agents of Change, and through several postoccupancy evaluation courses and methodologies in architecture schools. Several educators have illustrated the power of these methods and the long-term value of their results. For the profession, this area is emerging as a new service and important area of monitoring and interpretation that has long been undervalued. Stewart Brand's *How Buildings Learn* raised design consciousness about the performance and sustainability over time. It is time to use case studies to inform iterative design improvements, design for flexibility and adaptation, and design for diverse occupancy needs.

Possible partners/consultants: Society of Building Science Educators and other educators

Engaging Local COTE Chapters and the COTE Regional Team

There are 44 local and state COTE chapters and five regional team leaders. Several local and state COTEs are already actively engaged with architecture schools in their areas. The AIA Honolulu COTE collaborated with a University of Hawaii effort directed by Stephen Meder. AIA Cincinnati COTE participated in a Ball State University studio led by Robert Koester. AIA Minnesota COTE has collaborated with the University of Minnesota College of Architecture and Design (and the U.S. Green Building Council). Other local chapters have used different models of engagement. To encourage architects to incorporate ecology in the design process, the CED would sponsor programs with local COTEs to identify and document regional ecosystems, climate, locally available materials, and other factors. The results would be clearly and consistently formatted primers available to any architect.

Possible partners/consultants: local COTEs, U.S. Green Building Council, Forest Stewardship Council, and industry representatives

Promoting Sustainability Demonstration Projects

Many communities have built or are planning sustainability demonstration projects, and there could be several ways that these could be linked to architecture curriculum. A review of several case studies could compare such methods and propose a model for that integration. This focus for the new CED could promote a fully funded Solar Decathlon effort for schools of architecture across the country, partnerships with community design centers for revitalizing neighborhoods, as well as climatically specific research centers at universities for students and professionals alike.

Possible partners/consultants: AIA Center for Communities by Design

Ranking Architecture Schools by Levels of Ecology Literacy

The World Resources Institute has published the only ranking of business schools that includes an assessment of environmental and social impact management. Inspired by this ranking, the AIA COTE has discussed how a similar ranking system of architecture schools might be structured. For each school of architecture (offering bachelor of architecture and masters of architecture degrees), the study would assess number of required and elective courses, dedication to ecological literacy and other sustainability issues, level of interdisciplinary teaching and learning, faculty qualifications, level of green campus effort, and several other factors, each defined as a quantifiable metric (outlined in Chapter 2). This kind of ranking system could be an invaluable tool for prospective students, young educators, and others interested in this field, as well as an important benchmarking reference for institutions and departments themselves. While there are some limitations and some challenges regarding how certain indicators are calculated and (self)

reported, those could be mitigated in various ways, depending on the groups behind the ranging, with an eye toward creating an objective and fair ranking system.

Possible partners/consultants: World Resources Institute

Supporting Communication Between Professionals and Academy

In 1996, among other goals, *The Boyer Report* urged changes to create "a unified profession," noting that "The priorities for sustained action between the academy and the profession should include strengthening the educational experience of students during school, creating a more satisfying system of internship after graduation, and extending learning throughout professional life. . . . We propose that [practicing architects] be made an even greater part of classroom and studio life, and in discussions about the priorities of the curriculum itself. . . .[W]e recommend that firms regularly invite faculty and administrators to spend time in offices to exchange ideas and to help educators and practitioners keep abreast of the realities of practice and academic life."

The Educator/Practitioner Network and the EPIC Project, as well as the Case Study Initiative, are examples of AIA efforts to foster communications between professionals and the academy. The CED would make connections with these existing frameworks and identify ways to effectively contribute.

Enriching Peace Corps Activities and Ecological Design

The CED would also be a major advocate for enriching Peace Corps activities to bring climatically and culturally sustainable design solutions to emerging nations. The race to mimic the nonsustainable lifestyles and architecture of industrialized nations not only diminishes the future of those nations, it does not challenge industrialized nations to advance place-specific designs to secure their own ecological futures. There is a tremendous transformative opportunity here.

Developing Potential Partnerships

As mentioned earlier, partnerships with existing groups and initiatives will be an important part of the CED's work. The list below, which includes several organizations the AIA COTE has previously worked with, is not comprehensive; many other organizations may be deemed appropriate partners. Not all organizations mentioned here have been contacted about this report and early plans for the CED.

- American Council for an Energy Efficient Economy, *www.aceee.org/*
- American Institute of Architecture Students, *www.aias.org/*
- American Planning Association, *www.apa.org*
- American Society of Landscape Architects, *www.asla.org*
- American Solar Energy Society, *www.ases.org*
- Architectural Research Centers Consortium, *www.asu.edu/caed/arcc/*
- The Architecture Research Institute, *www.architect.org/*
- ArchVoices, *www.archvoices.org*
- Association of Collegiate Schools of Architecture, *www.acsa-arch.org/*
- Association for Community Design, *www.communitydesign.org*
- Building Owners and Managers Association International, *www.boma.org*
- Centre for Education in the Built Environment, *www.cebe.heacademy.ac.uk/*
- Civil Engineering Research Foundation, *www.cerf.org/*
- The Cloud Institute for Sustainability Education, *www.sustainabilityed.org/*
- Environmental Building News, *www.buildinggreen.com*
- The Enterprise Foundation, *www.enterprisefoundation.org*

- Federal Resources for Educational Excellence
- The Kresge Foundation, *www.kresge.org*
- International Institute for Ecological Agriculture, *www.permaculture.com/*
- International Interior Design Association, *www.iida.org*
- Mayor's Institute on City Design, *www.archfoundation.org/micd/*
- National Architectural Accrediting Board, *www.naab.org/*
- The National Building Museum, *www.nbm.org*
- National Council of Architectural Registration Boards, *www.ncarb.org*
- National Renewable Energy Laboratory, *www.nrel.gov*
- The Natural Learning Initiative, *www.naturalearning.org*
- The Natural Step, *www.naturalstep.org*
- North American Association for Environmental Education, *naaee.org/pages/index.html*
- The Permaculture Research Institute, *www.permaculture.org.au/*
- Rocky Mountain Institute, *www.rmi.org*
- Second Nature, *www.secondnature.org/*
- Smart Communities Network/DOE, *www.sustainable.doe.gov*
- Smart Growth Network, *www.smartgrowth.org*
- Smart Growth Program/EPA, *www.epa.gov/smartgrowth*
- Society of Building Science Educators, *www.sbse.org*
- Society for Campus and University Planning, *www.scup.org*
- Sustainable Building Industry Council, *www.sbicouncil.org*
- Sustainable Communities Network, *www.sustainable.org*
- Union of Concerned Scientists, *www.ucsusa.org*
- University Leaders for a Sustainable Future, *www.ulsf.org*
- Urban Land Institute, *www.uli.org*
- U.S. Department of Energy, *www.energy.gov/engine/content.do*
- U.S. Environmental Protection Agency, *www.epa.gov*
- U.S. Geological Survey, *www.usgs.gov*
- U.S. Green Building Council, *www.usgbc.org*

Partners Within the AIA

- Academy of Architecture for Health, *www.aia.org/aah*
- Center for Building Science and Performance, *www.aia.org/cbsp*
- Center for Communities by Design, *www.aia.org/liv*
- Committee on Architecture for Education, *www.aia.org/cae*
- Committee on Design, *www.aia.org/cod*
- Corporate Architects and Facility Management Committee, *www.aia.org/cafm*
- Design-Build Knowledge Community, *www.aia.org/db*
- Education/Practice/Industry Connection (EPIC) Project, *www.epiconnection.org*
- Educator/Practitioner Network, *www.aia.org/ed_epn*
- Housing Committee, *www.aia.org/housing*
- Practice Management Knowledge Community, *www.aia.org/pm*
- Public Architects Committee, *www.aia.org/pa*
- Regional and Urban Design Committee, *www.aia.org/rudc*
- Technology in Architectural Practice Knowledge Community, *www.aia.org/tap*

Appendix

[S]ustainable design is not limited to simply trying to be more efficient. A new approach offers a clear alternative: an ecologically intelligent framework in which the safe, regenerative productivity of nature provides models for wholly positive human designs . . . we can begin to redesign the very foundations of architecture and industry, creating systems that purify air, land, and water; use current solar income and generate no toxic waste; and use only safe, healthful, regenerative materials. The benefits would enhance all life.

— William A. McDonough, FAIA, Architect, 2004

REFERENCE SOURCES AND OTHER RELEVANT WORKS

These lists include some of the many resources on which the authors of this report drew. Some were cited throughout the chapters, many more behind some of the ideas that inspired this project.

Books

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Brown, Marilyn A., Southworth, Frank, and Stovall, Therese K. "Towards a Climate-Friendly Built Environment." Pew Center on Global Climate Change, June 2005, www.pewclimate.org/docUploads/Buildings%5FFINAL%2Epdf

"Building Community: A New Future for Architecture Education and Practice" (an excerpt), http://academics.triton.edu/faculty/fheitzman/boyer.html

Cloud Institute for Sustainability Education Higher Education Resource List, The, www.sustainabilityed.org/what/education_for_sustainability/resources_and_links_full_list.html

Clugston, Richard M., and Calder, Wynn. 1999. "Critical Dimensions of Sustainability in Higher Education," *Sustainability and University Life*, edited by Walter Leal Filho and Peter Lang, www.ulsf.org/pdf/Critical_dimensions_SHE.pdf

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CHAMPIONS OF ECOLOGICAL LITERACY IN ARCHITECTURE EDUCATION

In his book, *Ecological Literacy*, David Orr notes that the study of humankind and the study of nature are separated in most institutions of higher learning. "Ecology has been isolated within biology departments as though it had little or nothing to do with the social sciences, the humanities, or the professions. The result is a pervasive anthropocentrism that magnifies the role of humans and their ideas, art, institutions, and technology relative to soil, water, climate, wildlife, resources, geography, energy, disease, and ecosystem stability."[1] He condemns the errors of econocentric thinking that might have been corrected "with a dose of ecological literacy, a nodding acquaintance with thermodynamics, a brief study of history, and a modicum of ethical sensitivity and common sense." Many other disciplines could benefit, he writes, from "a cross-fertilization with ecology" and cites the work of scholars in 11 fields who have engaged in that effort. In architecture, Orr mentions Ian McHarg, Malcolm Wells, Bruce Anderson, and Gary Coates.[2]

Orr's list made us curious to find out who today's architects and educators would cite as their own "champions" of ecological literacy who influenced them in school and helped shaped their approach and the paths of their careers. We asked this question, via e-mail, of the more than 7,000 members of the AIA COTE, as well as the educators who submitted coursework to the project's call for submissions and other sustainable design practitioners and educators we have contacted during the course of this study. This survey was random and intentionally unscientific, and the results reflect that. The list is temporally idiosyncratic, may contain some conflations, and most certainly should not be considered comprehensive; many important thinkers and teachers are not mentioned here. But even though the results are uneven and somewhat random, there are kernels of wisdom about the educators and practicing architects who inspired people around them.

We sought nominations for champions who were or are educators in schools of architecture and other schools. The first group fits this category, though many of them practiced, too. Some affected lives early on in design school while others remain a constant voice promoting the benefit of being literate in the simple notion of "being aware." Their contributions show the significant potential that a single individual can have on the ability to effect change. Most of these educators are listed with the university at which the nominators encountered them. Nominators and their comments are listed below the champion names, which appear in alphabetical order.

Fernando Abruna, FAIA, University of Puerto Rico

- Luis G. Huertas: "Showed me the dedication and passion that one must have in order to be successful. Fernando had been practicing sustainable architecture for 25 years before I met him and now his ideas are coming of age."

Arne Aho, North Carolina State University

- Jim Smith, AIA: "…teaching daylighting, passive solar design, efficient use of materials, etc., way before the current green building movement."

[1] Orr, David. 1992. *Ecological Literacy*. Albany: State University of New York-Albany, p. 135.
[2] Ibid, p. 136.

Zane Anderson, AIA, Roger Williams University

- Robert Guarcello Mencarini, AIA: "He was a great professor and instilled in me a great foundation and understanding of how to design for human needs while minimizing the impact on the world."

Roy Banwell, AIA, Dartmouth University

- Keith Moskow, AIA: "He explained the concepts of passive solar design, then challenged us as students to design a ski house that would be warm when you showed up mid-winter via passive solar means."

Raj Barr-Kumar, Catholic University

- David Hammond, Assoc. AIA: "… able to ignite a passion for responsible design, and reinforce the idea that green architecture isn't just another style of design, rather it is a foundation which all styles can and should be built upon."

James Blackburn, Rice University

- Dru Meadows, AIA: "While studying architecture, I took an elective course on environmental law. The dean of the School of Architecture actually called me into his office to question my judgment in allocating precious academic time on such a topic. Despite the dean's criticism (or perhaps because of, I was, after all a college student and defying authority may have simply reinforced my commitment), I continued in the course. There were no textbooks appropriate to the topic, just reprints of articles and case law, excellent lectures extrapolating trends ... and a memorable canoe trip down the Houston bayous which brought students face-to-face with an opaque, multicolored soup—the direct result of the way we design, construct, and operate buildings (and sites). This, as the professor knew, was a powerful and tangible image. It certainly stayed with me. I remain most grateful for his inspirational teaching ... and that I did not fall into that bayou. I cannot think of a person more deserving of recognition as a champion of ecological literacy in architecture education."
- Jim Wasley: "Jim was my patron saint through graduate school, 'hiring' me to write white papers on environmental ethics and other topics that we shared a common interest in and keeping me solvent in the process."

Mary Blade, Cooper Union

- Edward R. Acker, AIA: "Mary would begin to describe the travels of a rain drop—its effect on the plants, the ground, eventually winding its way into the Ringwood River, finding its way to the reservoir, and thence into the drinking taps of the downstream urban population. An hour later, by the time she was finished, the students would be listening in rapt attention."

G. Z. Brown, University of Oregon

- Margot McDonald, AIA: "He has inspired several generations of architecture faculty who teach the same subject at universities throughout the world as well as practicing architects. He continues to contribute to the field and to mentor his former students, many of whom are full professors themselves. I am deeply indebted to him for providing me with career direction and shared their passion for design with environment."
- Daniel Strening, Assoc. AIA: "Author of *Sun, Wind & Light* (a staple of environmental design) and he runs the Energy Studies in Buildings Lab the University of Oregon. I can't begin to describe how much I learned while working in the ESBL. He has developed an energy analysis software program, for use in the preliminary design stages, Energy

Scheming. He is a tremendous and accessible resource for all students at the university. The lab does sustainability consulting work for a constant stream of projects from around the country."
- Jan Fillinger, AIA: "He has created two important building research labs (one in Eugene and another in Portland) focused on providing architects and developers with the sustainable design information they need for their green buildings. He is involved in a large proportion of the sustainable projects of significance up and down the West Coast. He is on numerous boards and gives presentations about green design on a regular basis. He is having a great impact on both education of new professional and development of sustainable projects."
- Jim Wasley: "A true pioneer in architectural education."
- Rudy Berg, Assoc. AIA
- Karin Link, Assoc. AIA

Hans E. Butler, University of Oklahoma
- Eric Werner, Assoc. AIA: "Hans did, in refreshingly undogmatic fashion, encourage exploration of not only ecological design but also of the underlying moral framework and social implication of ecological ideas. He is a passionate and brilliant educator and most certainly deserving of recognition for his contributions to ecological design education."

Raymond Cole, University of British Columbia
- D. William Saul, AIA: "He was a true guiding light to a new legion of eco-directed architects, many of whom have fashioned a career based upon sustainable building practices both in the United States and Canada. His lectures were tempests of impassioned and learned evaluations of the science of ecological strategies and the poetics of their possible expression. I was fortunate to catch him as a visiting lecturer in San Francisco last year and that passion hasn't waned a bit."

Jeff Cook, Arizona State University; Murray Miln, University of California-Los Angeles; Charles (Cris) Benton, University of California-Berkeley
- Jim Wasley: "All three of these 'old guard' members of the Society of Building Science Educators have at one time or another been especially kind, encouraging, and inspirational to me as I considered returning to graduate school in order to teach, later sought a teaching position, and finally struggled to learn how to teach."

Buford Duke, AIA, University of Texas
- Doug Nissen, Assoc. AIA

Daria Fisk, University of Texas
- Tom Eisele, AIA: "Quite a broad thinker, appropriate technology proponent, social activist."

James Marston Fitch, Hon. AIA, Columbia University
- Sheldon Licht, AIA
- Sandra Baptie, AIA

Rebecca Foss, University of Minnesota
- Theresa M. Olsen, AIA: "As a specifications writer, she understood the technical information and the details that make the difference in an environmentally friendly

building and a healthy environment. As a landscape architect, her love of the environment was displayed in her work."

Harrison Fraker, FAIA, Princeton University
- Paul Macht, AIA

Carol Franklin and Leslie Sauer, University of Pennsylvania
- Jestena Boughton, Assoc. AIA: "They gave life and beauty to the finishing layer of landscape architecture: plants. Plants come alive as relating to each other and having habits that you can recognize like you can old friends from a distance."

Michael Garrison, University of Texas
- Tom Eisele, AIA: "Stressed appropriate technology and design within context. We were doing 'passive solar chicken coops' and 'Integral Urban House' kinds of projects."
- Doug Nissen, Assoc. AIA

Baruch Givoni, University of California-Los Angeles
- Helen J. Kessler, AIA

Dan Goldrich, University of Oregon
- Jim Wasley: "I've taken many courses outside of architecture that have fuelled my passion for the environment, but this course still stands out in my mind as providing a turning point in my UG education. I can no longer say why, but it gave structure to my more rebellious leanings."

Herb Greene, University of Kentucky
- Robert J. Koester, AIA

Mary Guzowski, University of Minnesota
- Gregory J. Maxam, AIA: "I have worked with her through AIA Minnesota COTE since the early 1990s, joining professionals and students in working toward sustainability. Mary started the Daylighting Lab at the college, a resource for both professionals and students, and has tirelessly promoted ecological coursework, such as the current Architecture and Ecology class. She is currently organizing a master of science degree track in sustainable design."

Bob Hanna, University of Pennsylvania
- Jestena Boughton, Assoc. AIA: "He taught the importance of team work and lots of design development from a strong concept."

Julie Herdt, University of Colorado
- Virginia DuBrucq, AIA: "I have been made aware of her long history teaching sustainable design and of the creative projects in which she has involved her students."

Patrick Horbrugh, FAIA, University of Notre Dame
- Donald E. Sporleder, FAIA: "….he directed the ecological forward looking graduate program in Environic Design…."

Narendra Juneda, University of Pennsylvania

- Jestena Boughton, Assoc. AIA: "He got us to understand the relationships of all the layers of mapping and their implications and possibilities."

William Katavolos, FAIA, Pratt Institute

- Fernando Abruna, FAIA

Douglas Kelbaugh, FAIA, University of Michigan

- Paul Macht, AIA

Ralph Knowles, University of Southern California

- Stephen Dent, AIA: "Ralph Knowles was the studio instructor for my third year at the USC in 1965–1966. His approach to design was abstract but rigorous. For example, a major assignment was the design of a form that collected heat in winter and shaded itself in summer—no function or scale was given. It was later determined to be a city in scale, but the critical issue was developing a design process that fully responded to the movement of the sun over time. The intensity of the effort to solve an original problem without starting from preconceptions has had lasting and significant impact on all who had this experience. Ralph went on to win the first AIA Gold Medal for Research and an ACSA teaching award among many other honors. Thom Mayne, this years' Pritzker Prize recipient, was also a student in the studio and has always given Ralph Knowles credit for this powerful and eye-opening educational experience. The development of architectural form in response to ecological forces was truly unique at that time in architectural education and proved to be extraordinarily prescient."
- Charles F. Davis III, AIA: "He began a series of design studios that focused on architectural form as responses to environmental forces. Students' designs were to meet programmatic requirements but focus on how a building form was shaped by an environmental force such as wind, sunlight, etc. Designs were tested in wind tunnels, heliodomes, etc. Each student focused on one force, and the clarity of responses became evident. It has led to a lifetime awareness of environmental forces on architectural design."

Wally Kronner, Rensselaer Polytechnic Institute

- Bill Worthen: "The first professor at Rensselaer (back in 1989) to talk to us about thermal comfort. *Thermal Delight* was required reading for his class. At the time, we thought Wally was a bit wacky, talking about individual control of your environment and having personal air supply controls at every workstation in an office and the benefits clean air and daylight would have on worker productivity. Wally was out there in 1989 but here in 2005, as an architect and green building consultant, his ideas are no longer that strange—they are central to good practice. *Thermal Delight* [by Lisa Heschong] is a great read that still holds true. I never would have thought it at the time, but Wally was a champion and not afraid to teach us to think differently about the way we inhabit our designs and improve the quality of the built environment."
- Jean Stark, AIA: "He has been a tireless champion of sustainable ideas his entire career. Active in architectural research and always looking for new ways to improve the built environment for the benefit of occupants, he was teaching sustainability before the word was ever used in relation to architecture. Many of his former students have told me that of all the professors that they had, he is the one who taught them the most about what was possible and worthwhile in the real world of architecture."

Nate Krug, AIA, University of Nebraska -Lincoln

- Jenni Felton, Assoc. AIA: "He opened my eyes to the possibilities of achieving great designs by embracing environmental sensitivities/green design principles. He was an energetic guide not only in the possibilities of sustainable architectural strategies, but also how to carry these through into technical building details that are typically lacking in architectural education."

Peter Land, Assoc. AIA, Illinois Institute of Technology

- Robert Vagnieres Jr., AIA: "He has done some wonderful work with his students, on sustainable housing, and more recently on sustainable high-rises."

Richard Levine, AIA, University of Kentucky

- Robert J. Koester, AIA: "'Ecological literacy' did not function as an explicit theme in studio education, but its tenants were embedded in his mentoring."

Vivian Loftness, FAIA, Carnegie Mellon University

- Rebecca Leet, AIA: "I attended Carnegie Mellon University's School of Architecture from 1993 to 1998. Loftness, the department head for much of that time, was an inspiration to us all in her efforts to educate not only us, the students, but also the administration of the university on the importance of green practices in building design.

Taisto Makela, Assoc. AIA, University of Colorado

- Merlin Maley, Assoc. AIA: "He teaches The Poetic Detail: Wood. His focus was not on sustainability per se, but on the disappearing art of craft and materiality. Details and materials make the difference in architecture. They make buildings, cities, and cultures. Details are becoming a lost art or at least an afterthought in architectural design."

William McCoskey, Larry Patrick, Robert Kobet, AIA, Slippery Rock University

- William Paul McKinney, Assoc. AIA: "The design of the built environment is specific to worldly magnitude, growth, and development after centuries; and continues to grow exponentially in a relatively abbreviated (time) order with technology. The message is clear. Architecture as a profession must oblige practice with accountability; and embrace sustainable principles with the vigor and energy embodied in this fundamental academic concept. Survival."

Ian McHarg, Hon. AIA, University of Pennsylvania

- Michael Holtz, FAIA: "His 1969 book, *Design with Nature,* was very important in the history of development of ecological literacy in design education."
- G. Mackenzie Gordon, AIA: "One of my mentors in school, the first one I know to have connected ecology with architecture and landscape architecture. His book, *Design with Nature*, is still the classic in the field."
- Jestena Boughton, Assoc. AIA
- Stuart Berger, AIA: "…distilled the essence of ecologically responsible design into easily followed principles."

Hayden McKay, AIA, University of Maryland

- Stanley J. Sersen

Steven Meder, University of Hawaii
- Kelly Carlson: "Thanks to his involvement, my classmates and I have graduated with an appreciation for our own role in the environmental movement and a sense of responsibility to utilize the knowledge we've acquired."
- Dean Johnston, AIA: "His support and indefatigable mentorship continue to inspire me."
- Debra Kohn

Larry Medlin, University of Arizona
- Helen J. Kessler, AIA: "He helped set the course of my career, which has been in the areas of solar energy, energy efficiency, and sustainability. Larry has continued to be a leader in ecological design ever since."

Armando Navarro, Bruce Hammond, Pete Gang, Sonoma State University
- Katherine Austin, AIA: "I had been very much tuned into the green building movement for several years before this program [Green Housing Certificate Program], which put it all in a good perspective with an overview of all the issues. This has given me tools and inspiration to be a bit of a 'green missionary' to preach to the wider audience of architects."

Eliyahu Ne'eman, Bartlett School at University College London
- Helen J. Kessler, AIA

Victor Olgyay, Princeton
- Michael Holtz, FAIA

Laurie Olin, Hon. AIA, University of Pennsylvania
- Jestena Boughton, Assoc. AIA: "…wise and strong enough to influence the greatest architects of our time."

Ed Orlowski, AIA, Lawrence Technological University
- Jason Schultz, AIA: "Professor Orlowski helped us research different ways of greening normal buildings. He introduced us to sustainability. From that, he has sparked a love in me. I have since studied extensively the greening of architecture, and am in the process of preparing for both my Architectural Registration Examination and the LEED registration. Once those are obtained, I plan to help create a new division within my firm, spreading green architecture where ever I can."

David Orr, Oberlin College
- Kevin Burke, AIA
- Robert J. Koester, AIA

Victor Papanek, University of Kansas
- David Whitney, AIA: "Introduced to me through his books by Ray Lloyd at the College of the Sequoias (COS) and was an inspiration to me as a student in the 1980s and today. A founder to the notion of responsible design, which promotes responsibility deeper than a basic interest in green materials replacing standard products, Victor inspired me to become an architect—and to design with regard to social and ecological responsibilities beyond the basic scope of an architectural program. As a student activist, I was fortunate to bring Victor as a keynote speaker to COS for Earth Day in 1985. He died in 1998."

Don Peting, University of Oregon
- Karin Link, Assoc. AIA: "…the studio I took with him showed a particular sensitivity to site and environment."

Brent Porter, AIA, Pratt Institute
- Michael McHugh, AIA: "I always laugh thinking about how he encouraged my goofy model of a 'solar temple' made out of an old air diffuser."

Corkey Poster, University of Arizona
- Marlene Siska, AIA: "He taught sustainability in second year of design. It wasn't a fad to him, it was his philosophy in good design. He was very influential, I'm sure, to hundreds of students."

Donald Prowler, FAIA, University of Pennsylvania, Princeton (and others)
- Keith Moskow, AIA: "His book, *Modest Mansions,* is great."

John Reynolds, FAIA, University of Oregon
- Jim Wasley: "…incredibly supportive mentor throughout my undergraduate education and have remained so ever since…is a true pioneer in architectural education…"
- Margot McDonald, AIA: "…has inspired several generations of architecture faculty who teach the same subject at universities throughout the world as well as practicing architects. He continues to contribute to the field and to mentor his former students, many of whom are full professors themselves. I am deeply indebted to him for providing me with career direction and shared their passion for design with environment."
- Rudy Berg, Assoc. AIA
- Karin Link, Assoc. AIA

Gene Ruskin, Columbia University
- Sheldon Licht

Harris Sobin, AIA, University of Arizona
- Helen J. Kessler, AIA: "He always brought a contextual sensitivity to his classes, based in part on the work of Le Corbusier."

Bernard Spring, FAIA, Cooper Union
- Edward R. Acker, AIA: "Bernie impressed upon us an awareness of the broader context of the buildings we were designing, and their effects on the environment as to consumption, distribution, and disposal issues related to air, water, sewage, and power."

Lance Tatum, AIA, University of Texas
- Doug Nissen, Assoc. AIA

Michael Utsinger, University of Wisconsin-Milwaukee
- Michael Doll, AIA: "His focus in teaching is sustainability and I believe his focus in life is improving the quality of life for all human beings. In essence, helping people understand the long-term benefits of working in concert with terrestrial cycles as a matter of survival for the human race."

Andy Vanags, University of Washington-Seattle

- Kathleen Flynn, AIA: "…the one and only… materials and methods professor—he was ahead of his time."

Sim van der Ryn, University of California-Berkeley

- David Arkin, AIA: "Sim's unlimited ability to see and stay focused on the big picture has been the hallmark of his career … Many colleagues practicing what is now known as 'green' building in the Bay Area studied under Sim while at UC Berkeley. Perhaps his greatest contribution to us all was simply letting us do what we knew to be the 'right' way to design in the first place: in tune with nature and mindful of its systems."
- Jonathan Reich, AIA: "His work was enormously influential for the expanded understanding of design that it offered and for the activist role that it proposed for architects."
- Tom Eisele, AIA: "Appropriate technology guru and prophet from California. Got me excited about passive solar, composting toilets, and low tech for high design in architecture and planning."
- Doug Nissen, Assoc. AIA

Donald Watson, FAIA, Rensselaer Polytechnic Institute and Yale University

- Phillippe Campus: "I learned from Don's teaching by examples and from his firm commitment in (the early days of) the solar movement."

Troy West, New Jersey Institute of Technology

- John Beyer Fitzgerald, Assoc. AIA: "Took us to see a 'Living Machine' in Providence, R.I., which is a complex system of plants etc. that consume raw sewage and clean stormwater runoff. It's one of many things he did or said that changed my thought process."

Hofu Wu, FAIA, California Polytechnic State University-Pomona

- Jaime Olmos: "He teaches all the concepts of environmental design, including passive and active methods and solar geometry. He brings a contagious passion to the material and teaches it in a way that has instilled the concepts in my mind and ingrained them into my design philosophy."

John Yellot, Arizona State

- Michael Holtz, FAIA: "A leading researcher on solar energy and climate adaptive design. Excellent teacher and researcher."
- Helen J. Kessler, AIA

Other Champions

Inspiration and support happens not only in school. Many of those who submitted nominations named authors, clients, architects, and other professionals as important influences on their careers and commitment to sustainable design. Some of these people have also taught from time to time.

Bruce Anderson, author of *Solar Energy and Shelter Design*

- Wm. Terry Osborn

Bob Berkebile, FAIA, BNIM

- Robert J. Koester, AIA

James Carter and Walter Mondale, president and vice president, respectively
- Stuart Berger, AIA: "The long-term energy policies set forth at the end of their administration demonstrated leadership and foresight. Their policies would have, if followed by the next president, provided by now, the benefits of several alternative energy sources, including large-scale wind and solar energy power and weaned us off of the Mideast oil."

Richard Crowther, FAIA, author
- Michael Holtz, FAIA: "A leading practitioner and prolific author on climate adaptive design, sustainable, healthy design. Still alive and active."

Randy Croxton, FAIA, Croxton Collaborative
- Robert J. Koester, AIA

Roger Ferri
- Tom Eisele, AIA: "He had some very interesting and forward thinking ideas, particularly about integrating the skyscraper with nature and creating pedestrian cities."

Pliny Fisk and Gail Vittori, codirectors, Center for Maximum Potential Building Systems
- Herman Thun, AIA: "They have been committed to the philosophy of sustainable architecture for 30-plus years. I am associated with the center in a number of ventures and count my time spent in his presence a continuing enormous learning experience. I am forever indebted to him and her for his contagious environmental fervor and his ability to share his extensive knowledge with others."
- Wm. Terry Osborn: "I encountered Pliny in 1971 at Ball State University; he had just come from Penn and Ian McHarg's graduate studio… he taught how to actually integrate ecological reality into our planning and design."

Buckminster Fuller, architect and thinker
- Tom Eisele, AIA
- Fernando Abruna, FAIA
- Wm. Terry Osborn: "I encountered him as a visiting teacher at Ball State University in 1970. His concepts of 'design science' and 'The World Game' still inspire my work."

Bill Godfrey, AIA, architect, president, Environic Foundation International
- Donald E. Sporleder, FAIA

Harry Gordon, FAIA, architect, Burt Hill Kosar Rittelmann Associates
- Jean Stark, AIA: "Harry's devotion to sustainability and his gift for inspiring young architects to stretch beyond their self-perceived limits have greatly affected my professional life."

Rich Haag, ASLA, landscape architect
- Jestena Boughton, Assoc. AIA: "Rich believed and lived the know-your-site and natural-elements-can-heal-it mantras."

E. Fay Jones, FAIA, architect
- W. Frank Little Jr., AIA

Grant Jones, FASLA, landscape architect, and Johnpaul Jones, FAIA, architect, both of Jones & Jones

- Jestena Boughton, Assoc. AIA

Amory Lovins, Rocky Mountain Institute CEO, physicist, energy thinker

- Tom Eisele, AIA: "Anyone who can out-argue the petroleum industry before Congress using their own data and presentation materials is impressive in my book."

John Lyle, landscape architect, author of *Regenerative Design for Sustainable Development*

- Marilyn Farmer, AIA

Ed Mazria, architect

- Wm. Terry Osborn
- Bob Bourguignon, AIA

William McDonough, FAIA, architect, William McDonough + Partners, McDonough Braungart Design Chemistry

- Robert J. Koester, AIA

Glen Murcutt, Hon. FAIA

- Paul C. Palmer, AIA: "Living architecture is interactive, responsive, dynamic, and synergetic to the wind, the sun, and the land. He showed that most architecture of our modern lives has not embraced these elements into the very fabric of a buildings design, and thereby leads us down a path to architecture that is 'dead' and unconnected from the environment it is located in."

Peter Pfeiffer, FAIA

- Doug Nissen, Assoc. AIA

Paolo Soleri, architect, Arcosanti

- Doug Nissen, Assoc. AIA

Richard G. Stein, FAIA, author

- G. Mackenzie Gordon, AIA: "A former employer of mine and the author of *Architecture and Energy* back in the 1970s when such ideas were novel. His buildings all displayed great economy of means and conscience, no fat and nothing just for looks."

John Todd, biologist, inventor of Living Machines

- Michael McHugh, AIA: "…changed the way I thought about the integration of the natural and built environment."

Jorn Utzon, Hon. FAIA

- G. Mackenzie Gordon, AIA: "In my opinion he is the world's outstanding living architect. His buildings, all quite different from each other, always embrace ecological ideas but from a poetic rather than the 'get-LEED-brownie-points' point of view. While best known for the Sydney Opera House, his more mundane buildings such as his housing projects in Denmark show a remarkable concern for the environment."

- John Weidt, AIA, The Weidt Group
- Craig Norsted, AIA: "I often wish I still worked with such a single-minded and dedicated group of people (if it just weren't so cold there). John is truly one of the best and deserves our recognition."

Malcolm Wells, architect, activist, author

- G. Mackenzie Gordon: "The foremost proponent of earth sheltered architecture. It is sad that American architects and especially the architectural press have largely ignored this outstanding architect and his approach to design in favor or fashionable, cosmetic heroes."
- Douglas Steele: "The statement, 'if you want to change the world, change your life,' certainly applies to him."
- Tim McCorry, AIA: "His books, lectures, critiques, and correspondence encourage me to keep fighting for environmentally responsible design."
- Mark Spitzer, AIA: "He has contributed articles to a variety of publications on earth sheltering, water conservation, sensible development strategies and living lightly on the earth. He's published a book of examples of ways in which earth sheltering could be applied to a wide variety of building and infrastructure situations. He's one of the true believers on whose shoulders we now stand…."
- Doug Nissen, Assoc. AIA

LaVerne A. Williams, AIA, architect

- Dan Barnum, AIA: "Before any of us here ever even really thought about being "green" [LaVerne] set out on his path, and he has stuck with it, gently teaching, researching and explaining for all who would listen."

Paul Winslow, FAIA, Orcutt/Winslow Partnership

- Luis G. Huertas, AIA: "Showed me the actual practice of sustainable design in the everyday as an intern."

Thomas Wyche, environmentalist, builder, lawyer, photographer, writer

- Earle Hungerford, AIA: "For 35 years, he has devoted a significant portion of his personal and professional time to the conservation of approximately 100,000 acres of wilderness forests in the Blue Ridge Mountains of North and South Carolina. Without the leadership of his conservation efforts, much of this land would today doubtless be gated communities, golf courses and shopping centers. Instead, these lands are home to pristine rivers, lakes and waterfalls, undisturbed hiking trails, and campsites in a lush environment that supports an ecosystem of great richness and diversity."

READING FOR LEARNING: SAMPLE READING LISTS FROM SUBMITTED COURSEWORK

Providing reading lists with course descriptions was not a requirement of the Ecological Literacy in Architecture Education call for coursework submittals (though perhaps it should have been), but many educators provided them as part of their supporting material. We cross-referenced the 21 reading lists from a mix of class types. The lists included books, articles, and Web sites. AIA COTE volunteer Elizabeth Vandermark, AIA, collated the lists in a matrix (which shows which books were required or suggested and which courses were required or elective); this appears in the Appendix.

Two books showed up in eight lists each: *Sun, Wind and Light* and *Cradle to Cradle*. Three David Orr books made appearances in the lists: *Ecological Literacy* (SUNY Press, 1992) showed up in three lists, *The Nature of Design* (Oxford University Press, 2002) turned up in three, and *Earth in Mind* (Island Press, 1994/2004) made one list. Outlined here are the books that appeared on several lists accompanied by quotes from published reviews or book jackets.

Sun, Wind and Light
G. Z. Brown and Mark DeKay: John Wiley & Sons, 2000, 2nd edition

- Centre for Education in the Built Environment: "This book concentrates on one important design skill, which is the ability to make buildings respond to the sun, wind, and light. Its premise is that the more designers exercise this skill, the less energy their buildings will use, so the less carbon dioxide they will emit, and the greater will be their contribution to a sustainable future. . . . The authors are interested in the close relationship between architectural form and the flow of energy in buildings, and have provided designers with a working tool for exploiting that relationship. It is not just about saving energy. The authors hope that revealing this relationship to a building's occupants will be beneficial to their health and well-being. They make an eloquent argument for passive living. … [T]his is quite probably the best practical companion to bioclimatic design available. No architect should neglect to follow the advice that it gives."

Cradle to Cradle: Remaking the Way We Make Things
William McDonough and Michael Braungart: Rebound by Sagebrush, 2002

- Publishers Weekly: "[A] clear, accessible manifesto ... the authors' original concepts are an inspiring reminder that humans are capable to much more elegant environmental solutions than the ones we've settled for in the last half-century."
- Kirkus Reviews: "A readable, provocative treatise that 'gets outside the box' in a huge way. Timely and inspiring."
- Hazel Henderson, author of *Building a Win-Win World* and *Beyond Globalization*: Shaping a Sustainable Global Economy*:* "Achieving the great economic transition to more equitable, ecologically sustainable societies requires nothing less than a design revolution—beyond today's fossilized industrialism. This enlightened and enlightening book shows us how—and indeed, that 'God is in the details.' A must for every library and every concerned citizen."

Mechanical and Electrical Equipment for Buildings
Benjamin Stein and John S. Reynolds: John Wiley & Son, 1999, 9th edition (2005, 10th edition)

Intelligent Glass Facades
Andrea Compagno: Birkhauser, 1999

The Technology of Ecological Building
Klaus Daniels: Birkhauser, 1997

A Green Vitruvius: Principles and Practice of Sustainable Architectural Design
The European Commission: Earthscan Publications, 1999

Daylighting for Sustainable Design
Mary Guzowski: McGraw-Hill, 2000

Energy Efficient Buildings: Architecture, Engineering, and Environment
Dean Hawkes and Wayne Forster: W.W. Norton, 2002

Thermal Delight in Architecture
Lisa Heschong: MIT Press, 1979

The LEED Rating System and Reference Manual
U.S. Green Building Council, www.usgbc.org

Design with Nature
Ian McHarg: John Wiley & Sons, 1967

The Philosophy of Sustainable Design
Jason McLennan: Ecotone,[3] 2004

The HOK Guidebook to Sustainable Design
Sandra Mendler and William Odell: John Wiley & Sons, 2000 (2005, 2nd edition)

Ecological Literacy
David Orr: SUNY Press, 1992

The Nature of Design
David Orr: Oxford University Press, 2002

Eco-Tech: Sustainable Architecture and High Technology
Catherine Slessor: Thames and Hudson Ltd., 1997

Photovoltaics and Architecture
Randall Thomas and Max Fordam: Spon Press/Routledge, 2001

Sustainable Landscape Construction: A Guide to Green Building Outdoors
J. William Thompson and Kim Sorvig: Island Press, 2000

Ecological Design
Sim Van der Ryn and Stuart Cowan: Island Press, 1996

[3] Ecotone, founded by Jason McLennan in 2004, has started the Green Architecture Curriculum project, a three-year program to develop and introduce textbooks, coursework, and study guides. It is seeking volunteer collaborators; participating educators are asked to use *The Philosophy of Sustainable Design* and an associated study guide for their coursework.

The Ecology of Architecture: A Complete Guide to Creating the Environmentally Conscious Building
Laura C. Zeiher: Whitney Library of Design, 1996

Online Resource: *Environmental Building News* in Architecture Schools

Environmental Building News (EBN) has long been among the most respected publications on sustainable design and building. BuildingGreen, the publisher of *EBN* and the *GreenSpec Directory*, has found a receptive audience for its integrated, online resource, the BuildingGreen Suite. The subscription-based tool provides online access to the current issue of *EBN*, an archives of *EBN* back to the newsletter's launch in 1992, and the online GreenSpec products database.

James Wasley, associate professor of architecture at the University of Wisconsin-Milwaukee, has been using BuildingGreen resources as required reading in his courses for years. Wasley used to make photocopies of *EBN* articles and distribute them in his green building seminar. Copying and distributing these articles, though, became difficult to manage, and when BuildingGreen migrated its resources to the Internet in late 2003, using these articles in his seminar became much easier. Now he simply assigns the BuildingGreen Suite as required reading. "It's the text for my green building seminar. I swear by it," he says.

Although many architecture schools use the BuildingGreen Suite in this fashion—requiring students to subscribe individually (taking advantage of a special student discount that BuildingGreen offers)—more schools are subscribing to this resource campus-wide, which eliminates the need for students or faculty to log in individually when they are accessing the BuildingGreen Suite from within the university network or using a university IP address.

About a dozen architecture schools currently have campus-wide subscriptions to the BuildingGreen Suite, according to Jim Newman of BuildingGreen. Mary Guzowski in the Department of Architecture of the University of Minnesota (a school with campus-wide access) includes the BuildingGreen Suite as a resource for her students and points them to particular articles. She says she can trust the content the students will find, which is especially important as students look more and more to the Internet for their research. "It's accurate, comprehensive information that is well-researched," she says. "And not only do the students get a sense of the history of relevant topics, since BuildingGreen editors have been researching and writing on these issues since 1992, but I can count on them reading about cutting-edge issues before they appear in mainstream publications." The current campus-wide subscription cost is just under $1,000 per year.

Coursework Reading List

Sort by Author

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Addington, Michelle and Schodek, Daniel	*Materials and Technologies in Architecture*	Architectural Press-Elsevier, Burlington, MA 2004	U Minnesota		Weeks	ARCH 8565 Materials Performance	**E**
Addleson, Lyell	*Building Failures: a guide to diagnosis, remedy and prevention, 2nd ed*	Butterworth, London 1989	U Minnesota		Weeks	ARCH 8565 Materials Performance	**E**
Alexander, Christopher	*A Pattern Language*		U Tenn		DeKay/Shelton	Arch 572	**R**
Allard, Francis.	*Natural Ventilation in Buildings*	James and James, London, 1997.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	**E**
Allen, Edward and Iano, Joseph	*The Architect's StudioCompanion: Rules of Thumb for Preliminary Design 3rd Ed.*	John Wiley & Sons Inc. New York, 2002	Hampton U	**S**	Ilozor	ARC 307 Environmental Systems	**R**
American Instituite of Architects	*Environmental Resource Guide*	1735 New York Ave., NW, Washington DC 20006, 1996.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
American Institute of Architects	*Environmental Resource Guide*	Wiley, NY 2004	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	**E**
Ander, Greg D. AIA	*Daylighting Performance and Design*	Van Nostrand Reinhold, New York, 1995.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	**E**
Anderson, Larz T.	*Planning the Built Environment*	Planners Press, American Planning Association, Chicago 2000	Texas A & M		Abrams	ARCH 310 Site Planning and Design	**E**
Anink, David; Boonstra, Chiel; Mak, John.	*Handbook of Sustainable Building: An Environmental Preference Method for Selection of Materials for Use in Construction and Refurbishment*	James and James (Science Publishers) Ltd, 1996.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	**E**
Anthony, Diana	*Creative Sustainable Gardening*	CAT Publications, London, 2000	U Virginia		Quale	ecoMOD: Low Income House Design/Build	**E**
Appadurai, Arjun.	*"Part 1: Global Flows,"*	Modernity at Large: Cultural Dimensions of Globalization, 1996.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Appenzeller and Dimick	*Global Warming: Bulletins from a Warmer World*	National Geographic, September 2004	Savannah CAD		Moore		
ArchLeague	*"Ten Shades of Green: An Exhibition on design Excellence and Environmental Responsibilty"*	http://www.archleague.org/tenshadesofgreen/10shades.html	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Arieff, Alison and Burkhart, Bryan	*Prefab*	Gibbs Smith, Layton, Utah, 2002	U Virginia		Quale	ecoMOD: Low Income House Design/Build	**E**

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Bahamon, Alejandro	*Prefab: Adaptable, Modular, Dismountable, Light, Mobile Architecture*	HBI, New York, London, 2002	U Virginia		Quale	ecoMOD: Low Income House Design/Build	**E**
Baker, Nick and Steemers, Koen	*Daylight Design of Buildings.*	James & James, London, 2002.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Baker, Nick and Steemers, Koen	*Energy and Environment in Architecture*	E & FN Spon, London, 2000.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Baker, Nick and Steemers, Koen	*Daylight Design of Buildings*	James & James, London, 2002.	U Tenn		DeKay/Shelton	Arch 509	**R**
Balcomb, Douglas (Ed.)	*Passive Solar Buildings*	MIT Press, Cambridge, MA, 1992.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	**E**
Banham, Reyner	*"Bricologues à la lanterne,"*	New Society 37, no.717 (1 July 1976), 25-26.	Portland State U		Sukhwant	Design and Society	**E**
Banham, Reyner	*"The Great Gizmo,"*	Industrial Design 12 (September 1965): 48-59.	Portland State U		Sukhwant	Design and Society	**E**
Banham, Reyner	*The Architecture of the Well-Tempered Environment*		U Tenn		DeKay/Shelton	Arch 509	**R**
Bates, Robin and Mark, Robert.	*The Mystery of the Master Builders*	Coronet Film & Video (WGBH, Boston), Northbrook IL 1988.	Portland State U		Sukhwant	Design and Society	**E**
Battle-McCarthy	*Wind Towers*	Academy Editions, London, 1999.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Baxandall, Michael	*Painting and Experience in Fifteenth Century Italy*	Oxford UP, New York/Oxford 1988 (1972).	Portland State U		Sukhwant	Design and Society	**E**
Beck, Ulrich	*"The Cosmopolitan State: Towards a Realistic Utopia,"*	Eurozine, 2001.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Behling, Sophia and Stefan	*Solar Power: the Evolution of Sustainable Architecture*	Prestel-Verlag, Munich and New York, 1996	U Virginia		Quale	ecoMOD: Low Income House Design/Build	**E**
Behling, Sophia and Stefan.	*Glass: Structure and Technology in Architecture*	Prestel, Lakewood, NJ, 2000.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	**E**
Behling, Sophia and Stefan.	*Solar Power: the Evolution of Sustainable Architecture*	Prestel, Lakewood, NJ, 1999.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	**E**
Bell, Bryan	*Good Deeds, Good Design: Community Service Through Architecture*	Princeton Architectural Press, New York, 2004	U Virginia		Quale	ecoMOD: Low Income House Design/Build	**E**
Benyus, Janine M.	*Biomimicry: Inovation Inspired by Nature*	William Marrow & Co. Inc. New York, 1997	Savannah CAD		Montgomery	Architectural Design Studio II	**R**
Benyus, Janine M.	*Biomimicry: Inovation Inspired by Nature*	William Marrow & Co. Inc. New York, 1997	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	**E**
Berge, Bjorn	*Ecology of Building Materials*	Architectural Press-Elsevier, Burlington, MA 2000	U Minnesota		Weeks	ARCH 8565 Materials Performance	**E**
Berge, Bjorn	*Ecology of Building Materials*	Architectural Press-Elsevier, Burlington, MA 2000	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	**E**

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Blanc, Alan and McEvoy, Michael (Ed.).	*Architecture and Construction in Steel.*	Spon Press & Routledge, New York, 1993.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	**E**
Bolton, Richard.	*"Architecture and Cognac."*	Design After Modernism, 1988.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Bower, John	*Healthy House Building for the New Millennium*	The Healthy House Institute, Bloomington, IN, 2000	U Virginia		Quale	ecoMOD: Low Income House Design/Build	**E**
Bower, John	*Understanding Ventilation: How to Design, Select, and Install Residential Ventilation Systems*	The Healthy House Institute, Bloomington, IN, 1995	U Virginia		Quale	ecoMOD: Low Income House Design/Build	**E**
Bower, John	*Understanding Ventilation: How to Design, Select, and Install Residential Ventilation Systems*	The Healthy House Institute, Bloomington, IN, 1995.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	**E**
Bradshaw, Vaughn.	*Building Control Systems, 2nd ed.*	John Wiley and Sons, New York, NY 1993.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Bradshaw, Vaughn.	*Building Control Systems, 2nd ed.*	John Wiley and Sons, New York, NY 1985.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	**E**
Brand, Steward.	*"Built for Change," How Buildings Learn: What Happens After They're Built."*	1994	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Brand, Stewart	*How Buildings Learn: What happens after they're built*	Viking, NY 1994	U Minnesota		Weeks	ARCH 8565 Materials Performance	**E**
Brand, Stewart	*How Buildings Learn: What happens after they're built*	Viking, NY 1994	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	**E**
Brookes, Alan.	*Cladding of Buildings.*	James and James, London, 1998.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	**E**
Brown, David E. (Ed)	*Sustainable Architecture White Papers*	Earth Pledge Foundation	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Brown, G.Z. and Dekay, Mark.	*Sun, Wind & Light: Architectural Design Strategies*	Wiley & Sons, New York, 2001.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	**E**
Brown, G.Z. and Dekay, Mark.	*Sun, Wind & Light: Architectural Design Strategies*	Wiley & Sons, New York, 2001.	Kansas State U	**R**	Coates	Arch 413 Environmental Systems	
Brown, G.Z. and Dekay, Mark.	*Sun, Wind & Light: Architectural Design Strategies*	Wiley & Sons, New York, 2001.	Kansas State U	**S**	Coates		
Brown, G.Z. and Dekay, Mark.	*Sun, Wind & Light: Architectural Design Strategies*	Wiley & Sons, New York, 2001.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Brown, G.Z. and Dekay, Mark.	*Sun, Wind & Light: Architectural Design Strategies*	Wiley & Sons, New York, 2001.	Savannah CAD		Montgomery	Architectural Design Studio II	**R**
Brown, G.Z. and Dekay, Mark.	*Sun, Wind & Light: Architectural Design Strategies*	Wiley & Sons, New York, 2001.	U Virginia	**S**	Quale	ecoMOD: Low Income House Design/Build	**R**
Brown, G.Z. and Dekay, Mark.	*Sun, Wind & Light: Architectural Design Strategies*	Wiley & Sons, New York, 2001.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Brown, G.Z. and Dekay, Mark.	*Sun, Wind & Light: Architectural Design Strategies*	Wiley & Sons, New York, 2001.	U Tenn		DeKay/Shelton	Arch 572 (Studio), Arch 509	

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Brown, Lester R.	*Eco-Economy: Building an Economy for the Earth*	W. W. Norton & Company, New York 2001.	Kansas State U	**R**	Coates		
Brown, Lester R. (Ed)	*State of the World*	W.W. Norton & Company, 2005	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Brown, Lester R. Hal Kane and Ed Ayres (Eds)	*Vital Signs 2004*	W.W. Norton & Company, 2005	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Calthorpe, Peter	*The Next American Metropolis*	Princeton Architectural Press, Princeton 1993	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Caplan, Ralph	*By Design: Why There Are No Locks on the Bathroom Doors in the Hotel Louis XIV and Other Object Lessons [1982]*	Fairchild, New York 2005.	Portland State U		Sukhwant	Design and Society	
Capra, Fritjof	*"Ch. 3: Systems Theory; Ch. 4: The Logic of the Mind."*	The Web of Life, 1990s.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Cardwell, Diane.	*"Queens Concrete Supplier Is Charged in Pollution of Creek,"*	New York Times, 2005.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Carmody, J.S. Selkowitz, E.S. Lee, D. Arasteh and T. Willmert	*Window Systems for High Performance Buildings*	W.W. Norton & Co., New York, 2004	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
Carmody, John	*Residential Windows: A Guide to New Technology and Energy Performance*	Norton, New York, 1996	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Catton, William R. Jr.	*Overshoot: The Ecological Basis of Revolutionary Change*	University of Illinois Press, Urbana 1982	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Cerver, Francisco Asensio.	*The Architecture of Glass: Shaping Light*	Hearts Books International: New York, 1997.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Chandler, T.J.	*The Air Around Us*	The Natural History Press/Doubleday and Co., Garden City, NY., 1969.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Chappell, Steve (Ed.)	*Alternative Building Sourcebook: Traditional, Natural and Sustainable Building Products and Services*	Fox Maple Press, Brownfield ME 1998	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Ching,	*Design Drawing*		Ball State U		Woodfin	CAP 101 (First Design Course)	
Chiras, D.	*The Natural House*	Chelsea Green, Vermont, 2000	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Chiras, Daniel D	*The New Ecological Home: The Complete Guide To Green Building Options*	Chelsea Green Publishing Co., White River Junction, VT	U Virginia	**S**	Quale	ecoMOD: Low Income House Design/Build	**R**
Clark, W.G.	*"Replacement"*		U Tenn		DeKay/Shelton	Arch 509	
Clarke, Paul Walter.	*"The Economic Currency of Architectural Aesthetics,"*	Threshold, 1998.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Cline, Ann.	*"The Hut in the Backyard" from A Hut of One's Own: Life Outside the Circle of Architecture.*	MIT: USA, 1997. p.27-37.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Cofaign, Eoin O.,Olley, John A., Lewis, J. Owen	*Climatic Dwelling: An introduction to climatic-responsive architecture*	James & James, London 1996	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Commission of the European Communities.	*Daylighting in Architecture: A European Reference Book*	James and James (Science Publishers) Ltd, 1993.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Compagno, Andrea.	*Intelligent Glass Facades: Material Practice Design*	Birkhauser, Boston, 1999.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Compagno, Andrea.	*Intelligent Glass Facades: Material Practice Design*	Birkhauser, Boston, 1999.	U Penn		Veikos	Design Studio III Arch 601-206	
Compagno, Andrea.	*Intelligent Glass Facades: Material Practice Design*	Birkhauser, Boston, 1999.	U Tenn		DeKay/Shelton	Arch 509	
Compagno, Andrea.	*Intelligent Glass Facades: Material Practice Design*	Birkhauser, Boston, 1999.	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
Corner, James (ed.)	*Recovering Landscapes: Essays in Contemporary Landscape Architecture*	Princeton Architectural Press, New York 1999.	U Minnesota		Carmody	ARCH 8567 Intergrated Site and Building Design	
Correa, Charles.	*"Chandigarh is 50 and Young!."*	The Tribune, 2003.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Correa, Charles.	*The New Landscape: Urbanization in the Third World.*	1990's	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Cottom-Winslow, Margaret	*Environmental Design: Architectural and Technology*	PBC International, Glen Cove, NY 1995	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Crowther, Rich	*Ecological Architecture*	1992	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Curwell, S.R. and March, C.G. (eds)	*Hazardous Building Materials: a guide to the selection of alternatives*	E & FN Spon, London 1986	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Daay, Christopher	*Places of the Soul*	Glasgow, 1990	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Daniels, Klaus	*"Rainfall and Surface Water"*		U Tenn		DeKay/Shelton	Arch 509	
Daniels, Klaus	*Advanced Building Systems: A Technical Guide For Architects And Engineers*	Birkhauser, Basel, Boston, 2003	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Daniels, Klaus	*Low Tech Light Tech Building in the Information Age*	Birkhauser, 1998.	U Penn		Veikos	Design Studio III Arch 601-206	
Daniels, Klaus	*The Technology of Ecological Building: Basic Principles, Examples and Ideas*	Birkhauser, Berlin, 1997	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Daniels, Klaus	*The Technology of Ecological Building: Basic Principles, Examples and Ideas*	Birkhauser, Boston, 1997.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	

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Daniels, Klaus	*The Technology of Ecological Building: Basic Principles, Examples and Ideas*	Birkhauser, Boston, 1997.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Daniels, Klaus	*The Technology of Ecological Building: Basic Principles, Examples and Ideas*	Birkhauser, Boston, 1997.	U Penn		Veikos	Design Studio III Arch 601-206	
Davies, Mike	*"A Wall for All Seasons"*		U Tenn		DeKay/Shelton	Arch 509	
De Chiara, Joseph and Callender, John.	*Time Saver Standards for Building Types.*		Kansas State U	**S**	Coates, Gabbard, Ornelas Sachs, Watts & Wolf	Architectural Design Studio III	**R**
Dean, A.	*Green by Design*	Gibbs Smith, Salt Lake City, UT, 2003.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Denkin, Joseph (ed with AIA)	*Environmental Resource Guide*	Wiley, NY 1996	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Diamond, Jared.	*"The World as a Polder: What Does It All Mean to Us Today,"*	Collapse: How societies Choose to Fail or Succeed, 2005.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Domin, Christopher and King, Joseph.	*Paul Rudolph: The Florida Houses.*		Kansas State U	**S**	Coates, Gabbard, Ornelas Sachs, Watts & Wolf	Architectural Design Studio III	**R**
Duggal, S.K.	*Building Materials*	Bakkems, Netherlands, 1998	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Dunnett, Nigel	*Planting Green Roofs And Living Walls*	Timber Press, Portland, OR, 2004	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Dürer, Albrecht	*The Painter's Manual [1525]*	ed. Walter Strauss, New York, 1977.	Portland State U		Sukhwant	Design and Society	
Eason, David	*The Rammed Earth House. White River Junction*	Chelsea Green Publishing Co., VT 1996	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Edward Mazria, Edward.	*The Passive Solar Energy Book*	Rodale Press, Emmaus, Pa, 1979.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Edwards, Brian	*Green Buildings Pay*	E & FN Spon, London, 1998	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Edwards, Brian	*Towards a Sustainable Architecture*	Butterworth, London 1996	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Edwards, Brian and Hyett, Paul	*Rough Guide to Sustainability*		Savannah CAD		Montgomery	Architectural Design Studio II	**R**
Elgin, Duane	*Voluntary Simplicity: Toward a way of life that is outwardly simple, inwardly rich*	William Marrow & Co. Inc. New York, 1993	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Elizabeth, Lynne and Cassandra Adams (eds)	*Alternative Construction: Contemporary Natural Building Materials*	Wiley, NY 1999	U Minnesota		Weeks	ARCH 8565 Materials Performance	

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Elizabeth, Lynne and Cassandra Adams (eds)	*Alternative Construction: Contemporary Natural Building Methods*	John Wiley & Sons, NY 2000	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Engel, Heino	*The Japanese House: A Tradition for Contemporary Architecture*	Tuttle Publishing, Rutland, VT, 1964	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
European Commission	*A Green Vitruvius: Principles and Practice of Sustainable Architectural Design*	James and James (Science Publishers) Ltd., 1999.	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
European Commission	*A Green Vitruvius: Principles and Practice of Sustainable Architectural Design*	James and James (Science Publishers) Ltd., 1999.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
European Commission	*A Green Vitruvius: Principles and Practice of Sustainable Architectural Design*	James and James (Science Publishers) Ltd., 1999.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
European Commission	*The Climatic Dwelling: An introduction to climate-responsive residential architecture*	1996	Savannah CAD		Montgomery	Architectural Design Studio II	**R**
Evans, Benjamin H. AIA	*Daylight In Architecture*	McGraw Hill, New York, 1981.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Farmer, John	*Green Shift: towards a green sensibility in architecture*	Butterworth, London 1996	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Felcher, Marla	*"Children's Products and Risks,"*	Atlantic Monthly	Portland State U		Sukhwant	Design and Society	
Fetters, Thomas T.	*Lustron Homes: The History of a Postwar Prefabricated Housing Experiment*	McFarland & Co., Jefferson, North Carolina, 2001	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Filler, Martin.	*"Baron Haussmann, Urban Designer Par Excellence."*	1991	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Fitch, James Marston	*American Building: the Environmental Forces that Shape It*		U Tenn		DeKay/Shelton	Arch 509	
Flagge, Ingeborg	*Thomas Herzog: Architecture + Technology*	Prestel, Munich, 2001	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Fletcher, Alan	*The Art of Looking Sideways*	Phaidon, London, 2001	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Florida, Richard	*"Cities and the Creative Class,"*	City and Community 2.1 (2003): 3-19.	Portland State U		Sukhwant	Design and Society	
Florida, Richard	*The Rise of the Creative Class and How its Transforming Work, Leisure, Community, and Everyday Life*	Basic Books, New York 2002.	Portland State U		Sukhwant	Design and Society	
Fontoynont, Marc	*Daylight Performace of Buildings*	James & James, London, 1999	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Forman, R.T.T. and M. Godron	*Landscape Ecology*	John Wiley and Sons, New York, 1986	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Fox, Avril and Murrell, Robin	*Green Design: guide to the environmental impact of building materials*	Arch Des and Tech Press, London 1989	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Frampton, Kenneth	*Studies in Techtonic Culture*		U Tenn		DeKay/Shelton	Arch 509	
Freire, Paolo	*"The Banking Concept of Education,"*	Pedagogy of the Oppressed, 1976.	Portland State U		Sukhwant	Design and Society	
Friedman, Donald	*Historic Building Construction: Design, Materials and Technology*	Norton, NY 1995	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Fuller, S.K. and Peterson, S.R.	*Life-Cycle Costing Manual for the Federal Energy Management Program (FEMP)*	US Department of Energy, NIST Handbook 135; Washington, DC, 1996.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Gandy, Matthew.	*"Introduction,"*	Waterworks (by Stanley Greenberg).	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Gardner, Jean.	*"Fuel Cells Instead of Terrorists Cells: What the World Trade Center Bombing Indicates about The Role of Architecture and Urban Design in Globalization".*	Metropolis, 2002 "http://www.metropolismag.com/html/wtc/wtc_gardner_03072002.html"	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Gauzin-Muller, Dominique	*Sustainable Architecture and Urbanism*	Birkhauser, Basel, Switzerland, 2002	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Gaventa, Sarah.	*Concrete Design*	Mitchell Beazley, 2001.	Kansas State U	**S**	Coates		
Geiger, R.	*The Climate Near the Ground*	Harvard University Press, Cambridge, 1965.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Gimpel, Jean	*The Medieval Machine. The Industrial Revolution of the Middle Ages [1976].*	Penguin, 1977.	Portland State U		Sukhwant	Design and Society	
Gissen, D. (Ed.)	*Big & Green, towards sustainable architecture in the 21st century.*	Princeton Architectural Press, New York, NY, 2002.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Givoni, Baruch	*Climate Considerations in Building and Urban Design*	Van Nostrand Reinhold, New York, 1998	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Glancey, Johnathan	*"What can we do?' Rebuilding has begun on the south Asian shores. The world's architects are desperate to help."*	Guardian: Monday January 10, 2005	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Gordon, Harry.	*"Sustainable Design Goes Mainstream." In Sustainable Architecture White Papers.*	Earth Pledge: NYC, 2000. p. 34-38.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Graham, Peter	*Building Ecology: First Principles for a Sustainable Built Environment*	Blackwell Science, Oxford, 2003	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Gratz and Minz	*Cities Back from the Edge: New Life for Downtown*	John Wiley and Sons, New York 1998	Savannah CAD		Moore		
Guzowski, Mary	*Daylighting for Sustainable Design*	McGraw Hill, New York 2000	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	

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Guzowski, Mary	*Daylighting for Sustainable Design*	McGraw Hill, New York, 2000	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Guzowski, Mary	*Daylighting for Sustainable Design*	McGraw Hill, New York, 2000	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Habermas, Jurgen.	*"The Structural Transformation of the Public Sphere"*	1962	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Hagan, Susannah	*Taking Shape: A New Contract between Architecture and Nature*	Architectural Press, Oxford, 2001	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Hakim, Besim S.	*"Arabic-Islamic Cities: Building and Planning Principles".*		Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Hanson, Chris Scott and Kelly	*The CoHousing Handbook: Building a Place for Community*		MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Hart, Ivor B.	*"Leonardo the Engineer and Master of Gadgetry," The World of Leonardo da Vinci, Man of Science, Engineer, and Dreamer of Flight*	Viking, New York 1961, 204-53.	Portland State U		Sukhwant	Design and Society	
Hawken, Paul.	*Natural Capitalism: Creating the Next Industrial Revolution*	Little Brown and Company, Boston, 1999.	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Hawken, Paul.	*Natural Capitalism: Creating The Next Industrial Revolution.*	Little Brown and Company, Boston, 1999.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Hawken, Paul.	*The Ecology of Commerce: A Declaration of Sustainability.*	Harper Collins Publishers, New York, 1993.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Hawken, Paul.	*The Ecology of Commerce: A Declaration of Sustainability.*	Harper Collins Publishers, New York, 1993.	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Hawkes, Dean and Forster, Wayne	*Energy Efficient Buildings: Architecture, Engineering, And Environment*	W.W. Norton & Co., New York, 2002	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Hawkes, Dean and Forster, Wayne	*Energy Efficient Buildings: Architecture, Engineering, And Environment*	W.W. Norton & Co., New York, 2002	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
Hawkes, Dean; McDonald, Jane and Steemers, Koen	*The Selective Environment*	Spon Press, London, 2002	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Heinberg, Richard.	*The Party's Over: Oil, War and the Fate of Industrial Societies*	New Society Publishers, 2003.	Kansas State U	**R**	Coates	Arch 413 Environmental Systems	
Heinberg, Richard.	*The Party's Over: Oil, War and the Fate of Industrial Societies*	New Society Publishers, 2003.	Kansas State U	**R**	Coates		
Herbers, Jill	*Prefab Modern*	Harper Design International, New York, 2004	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Herzog, Peter	*Energy-Efficient Operation of Commercial Buildings*	McGraw-Hill, 1996	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
Herzog, Thomas	*Solar Energy In Architecture And Urban Planning*	Prestel, Munich, New York, 1996	U Virginia		Quale	ecoMOD: Low Income House Design/Build	

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Herzog, Thomas	*Solar Energy In Architecture And Urban Planning*	Prestel, Munich, New York, 1996	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
Herzog, Thomas (Ed.)	*Solar Energy In Architecture And Urban Planning*	Prestel, Lakewood, NJ, 2000.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Heschong, Lisa	*Thermal Delight in Architecture*	The MIT Press, Cambridge, Massachusetts, 1979	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Heschong, Lisa	*Thermal Delight in Architecture*	The MIT Press, Cambridge, Massachusetts, 1979	U Idaho		Wymelenberg	(3 grad courses), Int Design Lab/Outreach Ctr	
Heschong, Lisa	*Thermal Delight in Architecture*		U Tenn		DeKay/Shelton	Arch 509	
Holdren, John	*"Energy in Transition" : Scientific American*	September 1990	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
Holleman, T.R.	*Air Flow through Conventional Window Openings, Research Report No.33-Texas Engineering Experiment Station*	Texas A&M, College Station, 1951.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Hough, Michael	*Cities and Natural Process*	Routledge, London 1995	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
http://aia.org/aiaarchitect/thisweek02/tw0419/0419tw1cote.htm	*AIA Top Ten Sustainable Projects*		MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
http://bioenergy.ornl.gov			MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
http://geothermal.marin.org/pwrheat.html			MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
http://www.csbr.umn.edu/B3	*Minnesota Sustainable Building Guidelines*	2004	U Minnesota		Carmody	ARCH 8567 Intergrated Site and Building Design	
http://www.csbr.umn.edu/B3	*Minnesota Sustainable Building Guidelines*	2004	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
http://www.dirtstudio.com/	*Dirt Studio*		Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
http://www.eren.doe.gov			MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
http://www.iclei.org/efacts/hydroele.htm			MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
http://www.undp.org/energy/docs/WEAOU_full.pdf	*World Energy Assessment: Energy and the Challenge of Sustainability*	United Nations Dev. Programme 2004	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
http://www.undp.org/seed/eap /activities/wea/	*World Energy Assessment: Energy and the Challenge of Sustainability*	United Nations Dev. Programme 2000	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
http://www.usgbc.org	*LEED Rating System and Reference Manual*	US Green Building Council	U Minnesota		Carmody	ARCH 8567 Intergrated Site and Building Design	
http://www.usgbc.org	*LEED Rating System and Reference Manual*	US Green Building Council	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
http://www.usgbc.org	*LEED Rating System and Reference Manual*	US Green Building Council	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
http://www.wpm.co.nz			MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Hyde, Richard	*Climate Responsive Design: A Study Of Buildings In Moderate And Hot Humid Climates*	E&FN Spon, London, New York, 2000	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Hyde, Richard.	*Climate Responsive Design: A Study Of Buildings In Moderate And Hot Humid Climates*	E&FN Spon, London, New York, 2000	Mississippi State U	**S**	Berk	ARC 2713 Passive Building Systems	
International Code Council	*International Residential Code : for One- and Two-Family Dwellings*	2000	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Jackson, J.B.	*"American Public Space." In Classic Readings in Architecture edited by Kent F. Spreckelmeyer and Jay M. Stein*	WCB, Boston McGraw Hill, 1999.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Jackson, Wes	*Becoming Native to this Place*	University Press of Kentucky, Lexington 1994	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Jackson. John Brinckerhoff	*A Sense of Place, a sense of time*	Yale University Press, New Haven 1994	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Janis, Richard R. and Tao, William K. Y.	*Mechanical and Electrical Systems in Buildings 3rd Ed.*	Pearson Prentice Hall, New Jersey, 2005.	Hampton U	**S**	Ilozor	ARC 307 Environmental Systems	**R**
Johnson, Bart R. and Hill, Kristina (Eds.)	*Ecology and Design: Frameworks for Learning*	Island Press, Washington, DC, 2002	U Minnesota		Carmody	ARCH 8567 Intergrated Site and Building Design	
Jones, David Lloyd	*Architecture and the Environment: Bioclimatic Building Design*	Overlook Press, Woodstock and New York, 1998	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Jones, David Lloyd	*Architecture and the Environment: Bioclimatic Building Design*	Overlook Press, Woodstock and New York, 1998	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Jones, Tom	*Good Neighbors: Affordable Family Housing*	Images Publishing Group, Melbourne, Australia, 1997	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Kaltenbac, Frank	*Translucent Materials : Glass, Plastics, Metals*	Birkhauser, Basel, Boston, 2004	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Kant, Immanuel.	*"What is the Enlightenment?"*	1724	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Kataji, S., Schuurmans, A., Edwards, A.	*Life Cycle Assessment in Building and Construction, A State of the Art Report*	SETAC, NC, 2003	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Kelbaugh, Douglas S.	*Repairing the American Metropolis: Common Place Revisited*	University of Washington Press, Seattle WA, 2002.	Kansas State U	**R**	Coates		
Kelley,Tom with Littman, Jonathan	*The Art of Innovation. Lessons in Design from IDEO, America's Leading design Firm*	Currency Books, New York 2001.	Portland State U		Sukhwant	Design and Society	
Kennedy, Joseph F. (ed)	*The Art of Natural Building: Design, Construction and Technology*	New Society Publishers, CT 2001	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Khler, N., and Lleweyllyn, J. Edwards	*Assess Building Materials and Components*		U Minnesota		Weeks	ARCH 8565 Materials Performance	
Kieran, Stephen and Timberlake, James	*Refabricating Architecture: How Manufacturing Methodologies Are Poised to Transform Building Construction*	McGraw-Hill, New York, 2003	U Tenn		DeKay/Shelton	Arch 509	
Kieran, Stephen and Timberlake, James	*Refabricating Architecture: How Manufacturing Methodologies Are Poised to Transform Building Construction*	McGraw-Hill, New York, 2003	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
King, Bruce	*Buildings of Earth and Straw: Structural Design for Rammed Earth and Straw Bale Architecture*	Ecological Design Press, CA 1996	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
King, Ross	*Brunelleschi's Dome. How a Renaissance Genius Reinvented Architecture*	Random House, New York 2000.	Portland State U		Sukhwant	Design and Society	
Kirk, Stephen and Dell'Isola, Alphonse.	*Life cycle Costing for Design Professionals*	McGraw Hill, New York, 1995.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Kirk, Stephen and Dell'Isola, Alphonse.	*Life cycle Costing for Design Professionals*	McGraw Hill, New York, 1995.	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Knowles, Ralph L.	*Sun Rhythm Form*	MIT Press, Cambridge, Massachusetts, 1981.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Krampen, Martin and Schempp, Dieter.	*Glass Architects: Concepts, Buildings, Perspectives*	Birhauser, Boston, 1999.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Krapmeier, Helmut	*Cepheus: Living Comfort Without Heating*	Springer, Wien, New York, 2001	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Krewinkel, Heinz W.	*Glass building: Material Structure and Detail*	Birkhauser, Boston, 1998.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Lam, William M.C.	*Perception & Lighting As Formgivers For Architecture*	Van Nostrand Reinhold, New York, 1992.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Lam, William M.C.	*Sunlight as a Form-Giver for Architecture*	Van Nostrand Reinhold, New York, NY, 1986.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Lam, William M.C.	*Sunlight as a Form-Giver for Architecture*	Van Nostrand Reinhold, New York, 1986.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Lang, Fritz dir.	*Metropolis [1927].*	Kino International, 2003	Portland State U		Sukhwant	Design and Society	
Lasnier,F., GanAng, T., and Hilger, A.	*Photovoltaic Engineering Handbook*	IOP Publishing, Philadelphia, PA, 1990.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
LaVine, Lance	*Mechanics and Meaning in Architecture*		U Tenn		DeKay/Shelton	Arch 509	
Le Corbusier	*Towards a New Architecture [1925]*	trans. F. Etchells, Dover, New York 1986.	Portland State U		Sukhwant	Design and Society	
Leatherbarrow, David and Mostafavi, Mohsen.	*Surface Architecture*	MIT Press, 2002.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Leatherbarrow, David and Mostafavi, Mohsen.	*Surface Architecture*	MIT Press, 2002.	U Penn		Veikos	Design Studio III Arch 601-206	
Lechner, Norbert.	*Heating, Cooling, Lighting: Design Methods for Architects, 2nd Ed.*	Wiley & Sons, New York, 2001	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Lechner, Norbert.	*Heating, Cooling, Lighting: Design Methods for Architects, 2nd Ed.*	Wiley & Sons, New York, 2001	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Levy, Matthys and Salvadori, Mario	*Why Buildings Fall Down. How Structures Fail*	Norton, New York 1992.	Portland State U		Sukhwant	Design and Society	
Lippard, Lucy R.	*The Lure of the Local: Senses of Place in a multicultural society*	The New York Press, NY 1997	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Lippard, Lucy R.	*The Lure of the Local: Senses of Place in a multicultural society*	The New York Press, NY 1997	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Lloyd Jones, David.	*Architecture and the Environment: Bioclimatic Building Design.*	The Overlook Press, 1998.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Loriers, Marie Christine	*"Critical Ecology"*		U Tenn		DeKay/Shelton	Arch 509	
Lovelock, James	*Gaia: A New Look at Life on Earth*	Oxford University Press, Oxford 1979	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Lstiburek, Joseph W.	*Builder's Guide*	Building Science Corporation, MA 2000	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Lstiburek, Joseph W.	*Builder's Guide to Cold Climates*	Taunton Press, CT 2000	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Lstiburek, Joseph W.	*Builder's Guide To Mixed Climates: Details For Design And Construction*	Taunton Press, Newtown, CT, 2000	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Lstiburek, Joseph W.	*Moisture Control Handbook: Principles And Practices For Residential And Small Commercial Buildings*	John Wiley & Sons, New York, 1994	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Lupton, Ellen (Ed.)	*Skin: Surface, Substance + Design*	Princeton Architectural Press, 2002.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Lupton, Ellen (Ed.)	*Skin: Surface, Substance + Design*	Princeton Architectural Press, 2002.	U Penn		Veikos	Design Studio III Arch 601-206	

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Lyle, John Tillman	*Regenerative Design for Sustainable Development*	John Wiley & Sons, NY 1994	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Lyle, John Tillman	*Regenerative Design for Sustainable Development*		U Tenn		DeKay/Shelton	Arch 509	
Lyle, John Tillman	*Regenerative Design for Sustainable Development*	John Wiley & Sons, NY 1994	U Minnesota		Carmody	ARCH 8567 Intergrated Site and Building Design	
Lynch, Kevin	*Site Planning*	MIT Press, Cambridge MA 1984	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Lynch, Kevin.	*"Waste of Place." In Classic Readings in Architecture edited by Kent F. Spreckelmeyer and Jay M. Stein*	WCB, McGraw Hill, Boston 1999.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
MacKenzie, Dorothy	*Green Design: Design for the Environment*	Laurence King, London, 1997	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Mahfouz, Afaf and Serageldin, Ismail.	*"Women and Space in Muslim Societies,"*	Robert Powell, ed. Expression of Islam in Buildings. Singapore: Concept Media/The Aga Khan Award for Architecture, 1990.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Margalit, Avishai and Buruma, Ian	*"Occidentalism,"*	The New York Review of Books January 17, 2002 < HYPERLINK "http://www.nybooks.com/articles/15100" http://www.nybooks.com/articles/15100>	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Markus, Thomas.	*Buildings & Knowledge: Libraries, museums, panorama, exhibitions, lecture halls*	Buildings and Power: Freedom and Control in the Origin of Modern Building Types,1993.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Markus, Thomas.	*Buildings & People: schools, hospitals, prisons, workhouses, coffee houses, hotels*	Buildings and Power: Freedom and Control in the Origin of Modern Building Types,1993.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Markus, Thomas.	*Buildings & Things: Company Towns, Factories, Exchanges*	Buildings and Power: Freedom and Control in the Origin of Modern Building Types,1993.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Marsh, W.M.	*Landscape Planning: Environmental Applications. 3rd ed.*	Addition-Wesley Publishing Company, 1997	U Minnesota		Carmody	ARCH 8567 Intergrated Site and Building Design	
Mauren, Zara.	*Dream of the Sea Ranch.Film.*	Master Design Series, 1994.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Mazria, E.	*The Passive Solar Energy Book.*	Rodale Press, Emmaus, PA, 1979.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Mazria, Edward.	*"It's the Architecture, Stupid! Who really holds the key to the global thermostat? The answer might surprise you."*	May/June 2003.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
McCamant and Durrett	*CoHousing: A Contemporary Approach to Housing Ourselves*	Habitat Press, Berkeley 1988	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
McDonough, William	*Hanover Principles*	Internet	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
McDonough, William and Braungart, Michael.	*"Putting Eco-Effectiveness into Practice,"*	Cradle to Cradle, 2002 "http://www.ci.nyc.ny.us/html/dcp/html/fkl/ada/competition/2_2.html"	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
McDonough, William and Braungart, Michael.	*Cradle to Cradle: Remaking the Way We Make Things.*	North Point Press, 2002.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
McDonough, William and Braungart, Michael.	*Cradle to Cradle: Remaking the Way We Make Things.*	North Point Press, 2002.	Mississippi State U	**R**	Berk	ARC 2713 Passive Building Systems	
McDonough, William and Braungart, Michael.	*Cradle to Cradle: Remaking the Way We Make Things.*	North Point Press, 2002.	Savannah CAD		Montgomery	Architectural Design Studio II	**R**
McDonough, William and Braungart, Michael.	*Cradle to Cradle: Remaking the Way We Make Things.*	North Point Press, 2002.	Portland State U		Sukhwant	Design and Society	
McDonough, William and Braungart, Michael.	*Cradle to Cradle: Remaking the Way We Make Things.*	North Point Press, 2002.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
McDonough, William and Braungart, Michael.	*Cradle to Cradle: Remaking the Way We Make Things.*	North Point Press, 2002.	U Tenn		DeKay/Shelton	Arch 509	
McDonough, William and Braungart, Michael.	*Cradle to Cradle: Remaking the Way We Make Things.*	North Point Press, 2002.	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
McDonough, William and Braungart, Michael.	*Cradle to Cradle: Remaking the Way We Make Things.*	North Point Press, 2002.	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
McHarg, Ian L.	*"On Values." In Classic Readings in Architecture edited by Kent F. Spreckelmeyer and Jay M. Stein.*	Boston: WCB, McGraw Hill, 1999.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
McHarg, Ian L.	*Design with Nature*	John Wiley & Sons, New York, 1967	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
McHarg, Ian L.	*Design with Nature*	John Wiley & Sons, New York, 1967	U Minnesota		Carmody	ARCH 8567 Intergrated Site and Building Design	
McHarg, Ian L.	*Design with Nature*	John Wiley & Sons, New York, 1967	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
McLennan, Jason F.	*The Philosophy of Sustainable Design*	Ecotone Press, Kansas City, MO, 2004	Kansas State U	**R**	Coates		
McLennan, Jason F.	*The Philosophy of Sustainable Design*	Ecotone Press, Kansas City, MO, 2004	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
McLennan, Jason F.	*The Philosophy of Sustainable Design*	Ecotone Press, Kansas City, MO, 2004	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	

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McLuhan, Marshall	*"Introduction: Understanding Media"*	Extensions of Man, 1964.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
McLuhan, T.C.	*The Way of the Earth*	Simon & Scuster, NY 1994	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
McPhee, John	*Basin and Range*		MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Meadows, Donella H. et.al.	*Beyond the Limits: Confronting Global Collapse, Envisioning a Sustainable Future*	Chelsea Green Publishing, 1993.	Portland State U		Sukhwant	Design and Society	
Means, R.S.	*Green Building: Project Planning and Cost Estimating*		U Minnesota		Weeks	ARCH 8565 Materials Performance	
Meinig, D.W.. (Ed.)	*The Interpretation of Ordinary Landscapes: Geographical Essays*	Oxford University Press, 1979.	U Minnesota		Carmody	ARCH 8567 Intergrated Site and Building Design	
Mendler, Sandra F; Odell, William.	*The HOK Guidebook to Sustainable Design*	John Wiley & Sons, New York, 2000	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Mendler, Sandra F; Odell, William.	*The HOK Guidebook to Sustainable Design*	John Wiley and Sons, 2000.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Mendler, Sandra F; Odell, William.	*The HOK Guidebook to Sustainable Design*	John Wiley & Sons, New York, 2000	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Merleau-Ponty, Maurice	*"Cezanne's Doubt," The Merleau-Ponty Aesthetics Reader: Philosophy and Painting*	Galen A. Johnson ed., Northwestern U.P., Evanston 1993, 59-75.	Portland State U		Sukhwant	Design and Society	
Milgrom, Melissa.	*"Julie Bargmann,"*	Metropolis, May, 2003.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Millet, Marietta S.	*Light Revealing Architecture*	Van Nostrand Reinhold, New York, 1996.	U Tenn		DeKay/Shelton	Arch 509	
Millet, Marietta S.	*Light Revealing Architecture*	Van Nostrand Reinhold, New York, 1996.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Mollison, Bill	*Introduction to Permaculture*	Permaculture Services Intl Inc. Cedar Crest, NM 1992	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Monti, Michael J.	*"The Power of Competitions."*	ASCSNews. Dec. 2004. Vol. 34, No. 4.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Moore McGregor, Suzi and Burba Trulsson, Nora	*Living Homes: Sustainable Architecture and Design*	Chronicle Books, 2001.	Kansas State U	**S**	Coates		
Moore, Charles; Allen, Gerald and Lyndon, Donlyn.	*The Place of Houses.*		Kansas State U	**S**	Coates, Gabbard, Ornelas Sachs, Watts & Wolf	Architectural Design Studio III	**R**
Moore, Fuller	*Concepts and Practice of Architectural Daylighting*	Van Nostrand Reinhold, New York, 1991.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Moore, Fuller	*Concepts and Practice of Architectural Daylighting*	Van Nostrand Reinhold, New York, NY, 1985.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**

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Moore, Fuller	*Environmental Control Systems, Heating, Cooling, Lighting*	McGraw Hill, New York, NY, 1993.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Moore, Fuller	*Environmental Control Systems, Heating, Cooling, Lighting*	McGraw Hill, New York, NY, 1993.	Mississippi State U	**R**	Berk	ARC 2713 Passive Building Systems	
Morris, Errol dir.	*Fast, Cheap and Out of Control [1997]*	Columbia/Tri-Star, 2002.	Portland State U		Sukhwant	Design and Society	
Mostafavi, Mchsen and Corner, James.	*"Landscapes of Urbanism," and "Landscape Urbanism,"*	Landscape Urbanism: A Manual for the Machinic Landscape, 2003.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Muneer, T. (Tariq)	*Solar Radiation And Daylight Models*	Oxford, Burlington, MA, 2004	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Naess, Arne trans. David Rothenberg	*Ecology , Community and Lifestyle*	Cambridge University Press, MA 1989	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
National Institute of Building Sciences	*Life-Cycle costing (Whole building Design Guide)*	Washington, DC, 2000.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Nissen, Henrik	*Industrialized Building and Modular Design, Henrik Nissen, Shenval Press, London, 1972 TH860.N56*	Shenval Press, London, 1972	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Nochlin, Linda.	*"The Imaginary Orient,"*	The Politics of Vision: Essays on Nineteenth-Century Art and Society, pp. 33-59. 1989.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Noonan, Patty and Jon Vogel.	*"High Performance Building and Affordable Housing." In Sustainable Architecture White Papers.*	Earth Pledge: NYC, 2000. p. 129-135.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Norton, Richard J.	*"FERAL CITIES,"*	Navy War College Review, 2004.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
O'Brien, James.	*"Las Vegas Today -- Rome in a Day: Corporate Development Practices and the Role of Professional Designers,"*	Journal of Architectural Education, 2000.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Odum, Eugene Pleasants	*Ecology and our endangered life support systems*	Sinauer Associates, Sunderland MA 1989	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Oesterle, Eberhard; Lieb, Rolf-Dieter; Lutz, Martin and Heusler, Winfried.	*Double-Skin Facades: Integrated Planning*	Prestel, Lakewood, NJ, 2000.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Olgyay, V. and Olgyay, A.	*Solar Control and Shading Devices*	Princeton Press, Princeton, NJ, 1979.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Olgyay, Victor	*Design With Climate: Bioclimatic Approach To Architectural Regionalism*	Princeton University Press, Princeton, 1963	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Olgyay, Victor	*Design With Climate: Bioclimatic Approach To Architectural Regionalism*	Princeton University Press, Princeton, 1963	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Oppenheimer, Andrea and Timothy Hursley.	*Rural Studio: Samuel Mockbee and an Architecture of Decency.*	Princeton Architectural Press: China, 2002.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Orr, David W.	*Earth In Mind: Environment, and the Human Prospect*	Island Press, Washington, D.C., 1994.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Orr, David W.	*Ecological Literacy: Education and the Transition to a Post Modern World..*	State University of New York Press, Albany, 1992.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Orr, David W.	*Ecological Literacy: Education and the Transition to a Post Modern World..*	State University of New York Press, Albany, 1992.	Savannah CAD		Montgomery	Architectural Design Studio II	**R**
Orr, David W.	*Ecological Literacy: Education and the Transition to a Post Modern World..*	State University of New York Press, Albany, 1992.	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Orr, David W.	*The Nature of Design: Ecology, Culture, and Human Intention*	Oxford University Press, New York.	Kansas State U	**R**	Coates		
Orr, David W.	*The Nature of Design: Ecology, Culture, and Human Intention*	Oxford University Press, New York.	Portland State U		Sukhwant	Design and Society	
Orr, David W.	*The Nature of Design: Ecology, Culture, and Human Intention*	Oxford University Press, New York.	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Osmundson, Theodore.	*Roof Gardens: History, Design and Construction*	W.W. Norton and Company, Inc.. 1999.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Palasama	*The Eyes of the Skin*		U Idaho		Wymelenberg	(3 grad courses), Int Design Lab/Outreach Ctr	
Papanek, Victor	*The Green Imperative: Natural Design for the Real World*	Thames and Hudson, NY 1995	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Pasquale, Salvatore Di	*"Leonardo, Brunelleschi, and the Machinery of the Construction Site," Leonardo da Vinci, Engineer and Architect*	Paolo Galuzzi, ed., Museum of Fine Arts, Montreal 1987, 163-81.	Portland State U		Sukhwant	Design and Society	
Pawley, Martin	*Building for Tomorrow: Putting Waste to Work*	Serra, 1982	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Peirce, Charles	*"Charles Peirce on Pragmatism, Phenomenology and Semiotics"*	Introducing Semiotics, 3-7, 21- 35, 2001.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Phillips, D.	*Daylighting*	Architectural Press, London, 2004.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Phillips, Derek	*Daylighting: Natural Light In Architecture*	Architectural, Oxford, 2004	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Pilatowicz, Grazyna	*Eco-Interior; A Guide to Environmentally Concious Interior Design*	Wiley, NY 1994	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Pollio, Marcus Vitruvius	*"The Education of the Architect"*	Ten Books on Architecture, 1BC/1AD.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Postman, Neil	*"The Ideology of Machines" Technopoly: the Surrender of Culture to Technology*	Vintage, New York 1993.	Portland State U		Sukhwant	Design and Society	
Prager, Frank D. and Scaglia, Gustina	*Brunelleschi. Studies of His Technology and Inventions*	Harvard U.P., Cambridge MA 1970.	Portland State U		Sukhwant	Design and Society	
Prodanovic, Milan.	*"Urbicide and Chances for The Reconstruction of Balkan Cities,"*	Out of Ground Zero: Case Studies in Urban Reinvention, 2003.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Randall Eaton, Randall	*Modular Home Buyers Guide: Learn How to Save Thousands Before You Buy*	J & R Enterprises, Moses Lake, WA, 2004	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Rapoport, Amos.	*"the nature and definition of the field (ch. 1),"*	house form and culture, Foundations of Cultural Geography Series, 1969.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Rasmussen, Eiler Steen.	*Experiencing Architecture.*	The MIT Press: Cambridge, 1959.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Renfroe, O.S.	*Building Materials from Solid Waste*		U Minnesota		Weeks	ARCH 8565 Materials Performance	
Rice, Peter and Dutton, Hugh	*Structural Glass*	Routledge/Taylor & Francis, Florence, KY., 1998.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Rice, Peter and Dutton, Hugh.	*Structural Glass*	Spon Press & Routledge, New York, 1995	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Richardson, Barry A.	*Defects and Deterioration in Buildings*	E & FN Spon, London 1991	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Riley, Terence.	*The Un-Private House.*		Kansas State U	**S**	Coates, Gabbard, Ornelas Sachs, Watts & Wolf	Architectural Design Studio III	**R**
Roaf, Sue	*Ecohouse 2: A Design Guide*	Architectural Press, London, 2003	U Virginia	**S**	Quale	ecoMOD: Low Income House Design/Build	**R**
Roaf, Sue; Fuentes, Manuel; Thomas, Stephanie.	*Ecohouse: A Design Guide.*	Architectural Press, 2001.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Rogers, Richard	*Cities for a Small Planet*		U Tenn		DeKay/Shelton	Arch 509	
Rosenblum, Robert.	*"Aspects of Neoclassic Architecture,"*	Transformations in Late 18th Century Art, pp.107-145, 1967.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Rossbach, Sarah	*The Chinese Art of Placement*	E.P. Dutton, 1983	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Rowe, Colin; Slutzky, Robert; Hoesli, Bernhard.	*Transparency*	Birkhauser, Boston, 1997.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Russell, James S.	*"Where are We Now? Architecture's Place in an Era of Evolving values,"*	Architectural Record, 3.03.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Salvadori, Mario	*Why Buildings Stand Up*	Norton, New York 1990.	Portland State U		Sukhwant	Design and Society	
Sanda National Laboratories	*Design Handbook for Photovoltaic Power Systems*	Science Applications, Inc., McLean, VA, 1981.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Schaer, Roland.	*"Utopia: Space, Time History," and Lyman Tower Sargent. "Utopian Traditions: Themes and Variations,"*	Utopia: The Search for the Ideal Society in the Western World, 2001.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Schiler, M.	*Simulating Daylight with Architectural Models*	DNNA, Los Angeles, 1980.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Schittich, Christian	*Building Skins: Concepts, Layers, Materials*	Birkhauser Edition Detail, 2001.	U Penn		Veikos	Design Studio III Arch 601-206	
Schittich, Christian (Ed.).	*in Detail: Building Skins, Concepts Layers Materials*	Birkhauser, Boston, 2001.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Schittich, Staib, Balkow.	*Glass Construction Manual,*	Birkhauser, 1999.	U Penn		Veikos	Design Studio III Arch 601-206	
Schmitz-Gunther, Thomas ed.	*Living Spaces: Sustainable Building and Design*	Konemann, Cologne, 1999	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Schor, Juliet and Taylor, Betsy eds.	*Sustainable Planet: Solutions for the Twenty-First Century*	Beacon Press, 2003.	Portland State U		Sukhwant	Design and Society	
Schumacher, EF	*Small is Beautiful*	Harper & Row, NY 1973	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Scott, Andrew (ed)	*Dimensions of Sustainability*	E & FN Spon, London 1998	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Scully, Vincent	*Architecture: The Natural and the Manmade*	St. Martin's Press, NY 1991	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Scully, Vincent.	*"Architecture: The Natural and the Manmade,"*	Denatured Visions: Landscape and Culture in the 20th century, 1988.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Sick, Frederick and Erge, Thomas.	*Photovoltaics in Buildings*	James and James, London, 1998.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Slessor, Catherine.	*Eco-Tech: Sustainable Architecture and High Technology*	Thames and Hudson, Ltd., 1997.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Slessor, Catherine.	*Eco-Tech: Sustainable Architecture and High Technology*	Thames and Hudson, Ltd., 1997.	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Slessor, Catherine.	*Eco-Tech: Sustainable Architecture and High Technology*	Thames and Hudson, Ltd., 1997.	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Smil, Vaclav	*Energy at the Crossroads: Global Perspectives and Uncertainties*	MIT Press, 2003	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
Smith, Peter F.	*Eco-Refurbishing: A Guide to saving and producing Energy in the Home*	Architectural Press-Elsevier, Burlington, MA 2004	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Smith, Peter F.	*Sustainability at the Cutting Edge*	Architectural Press, Oxford, 2003	U Virginia		Quale	ecoMOD: Low Income House Design/Build	

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Smith, Peter F.	*Sustainability at the Cutting Edge*		Mississippi State U	**R**	Berk	ARC 2713 Passive Building Systems	
Sorkin, Michael.	*"Chandigarh after Corbusier,"*	Architectural Record, 1998.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Speigel, Ross	*Green Building Materials: A Guide to Product Selection*	Wiley, New York, 1999	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Spiegel, Ross and Meadows, Dru.	*Green Building Materials.*	Wiley & Sons, New York, 1999.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Spirn, Anne Whiston	*The Language of Landscape*		MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Stattmann, Nicola	*Ultra Light-Super Strong : A New Generation Of Design Materials*	Birkhauser, Basel, Boston, 2003	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Steele, James.	*Sustainable Architecture: Principles, Paradigms, and Case Studies*	McGraw-Hill Incorporated, 1997.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Steele, James.	*Sustainable Architecture: Principles, Paradigms, and Case Studies*	McGraw-Hill Incorporated, 1997.	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Steen, A.S.; Steen, Bill, et. al.	*The Straw Bale House Book*	Chelsea Green, 1994.	Kansas State U	**S**	Coates		
Stein, Benjamin and Reynolds, John.	*Mechanical And Electrical Equipment for Buildings 9th Ed.*	Wiley & Sons, New York, 1998.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Stein, Benjamin and Reynolds, John.	*Mechanical And Electrical Equipment for Buildings 9th Ed.*	Wiley & Sons, New York, 1998.	Kansas State U	**S**	Coates		
Stein, Benjamin and Reynolds, John.	*Mechanical And Electrical Equipment for Buildings 9th Ed.*	Wiley & Sons, New York, 1998.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Stein, Benjamin and Reynolds, John.	*Mechanical And Electrical Equipment for Buildings 9th Ed.*	John Wiley & Sons, New York, 2000.	Hampton U	**S**	Ilozor	ARC 307 Environmental Systems	**R**
Stitt, Fred A. ed.	*Ecological Design Handbook*	McGraw-Hill, New York, 1999	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Stitt, Fred A. ed.	*Ecological Design Handbook*	McGraw-Hill, New York, 1999	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Strong, Steven	*The Solar Electric House*	Sustainabilty Press	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Suzuki, David	*The Sacred Balance: Rediscovering our place in nature*	Greystone Books, Vancouver 1999	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Szokolay, Steven V.	*Introduction to Architectural Science: The Basis of Sustainable Design*	Architectural Press, London, 2004	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Szokolay, Steven V.	*Introduction to Architectural Science: The Basis of Sustainable Design*	Architectural Press, London, 2004	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Talarico, Wendy.	*"Taking the Elective out of Architectural Education" in Sustainable Architecture White Papers.*	Earth Pledge: NYC, 2000. p 201-206.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Tanizaki	*In Praise of Shadows*		U Idaho		Wymelenberg	(3 grad courses), Int Design Lab/Outreach Ctr	
Tanizaki	*In Praise of Shadows*		U Tenn		DeKay/Shelton	Arch 509	
Thayer, Robert	*Gray world, green heart: technology, nature, and the sustainable landscape*	John Wiley & Sons, NY 1994	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Thomas, Randall (Ed.), Fordham, Max and Partners UK.	*Photovoltaics and Architecture*	Spon Press & Routledge, New York, 2001.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Thomas, Randall (Ed.), Fordham, Max and Partners UK.	*Photovoltaics and Architecture*	Spon Press & Routledge, New York, 2001.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Thomas, Randall (Ed.), Fordham, Max and Partners UK.	*Photovoltaics and Architecture*	Spon Press & Routledge, New York, 2001.	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Thompson, J. William and Kim Sorvig	*Sustainable Landscape Construction: A Guide to Green Building Outdoors*	Island Press, Washington, DC, 2000	U Minnesota		Carmody	ARCH 8567 Intergrated Site and Building Design	
Thompson, J. William and Sorvig, Kim	*Sustainable Landscape Construction: A Guide to Green Building Outdoors*	Island Press, Washington DC, 2000	U Virginia	**S**	Quale	ecoMOD: Low Income House Design/Build	**R**
Thompson, J. William and Sorvig, Kim.	*Sustainable Landscape Construction: A Guide to Green Building Outdoors*	Island Press, Washington DC, 2000	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Thoreau, Henry David	*The Selected Works of Thoreau (Revised by Walter Harding*	Houghton Mifflin, Boston 1975	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Thoreau, Henry David	*Walden or, Life in the Woods (1854)*	Signet Classics, NY 1961	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Thrush, Glenn.	*"Oil, Water, & Politics,"*	Brooklyn Bridge, 1996.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Todd, Nancy Jack and John	*Bioshelters, Ocean Arks, City Farming: Ecology as a basis of design*	Sierra Club Books, San Francisco 1984	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Todd, Nancy Jack and John	*Tomorrow is our Permanent Address - The Search for an Ecological Science of Design as Embodies in the Bioshelter*	Harper & Row, New York 1980	MA College of Art	**R**	Seitz	Sustainable Design Issues in Architecture	
Todd, Nancy Jack and John	*Tomorrow is our Permanent Address - The Search for an Ecological Science of Design as Embodies in the Bioshelter*	Harper & Row, New York 1980	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Tomasky, Michael.	*"The World Trade Center: Before, During, & After,"*	The New York Review of Books, 2002.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Toy, Maggie (ed)	*The Architecture of Ecology*	Architectural Design Magazine Press, London 1997	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Trost, Frederick J. and Choudhury, Ifte	*Design of Mechanical and Eelctrical Systems in Buildings*	Merrill Prentice Hall, New Jersey, 2004	Hampton U	**R**	Ilozor	ARC 307 Environmental Systems	**R**

author	title	publisher, location, date	institution	required/ suggested reading	instructor	course name	required/ elective course
Trulove, James Grayson	*25 Houses Under 2,500 Square Feet*	Harper Design International, 2003	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Tuan, Yi-Fu	*Passing Strange and Wonderful: Aesthetics, Nature and Culture*	Island Press, Washington DC 1996	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Tuan, Yi-Fu	*Topophilia*	Columbia University Press, NY 1974	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Tuluca, Adrian	*Energy Efficient Design and Construction of Commercial Buildings*	McGraw-Hill, 1997	U Minnesota		Carmody	ARCH 8563 Energy and Indoor Environmental Quality Issues in Sustainable Design	
UC Berkeley	*"Vital Signs: Teaching Environmental Technology through Student Field Work"*	http://arch.ced.berkeley.edu/vitalsigns/	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Unwin, Simon.	*Analyzing Architecture.*	Routeledge: New York, 2003.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Vale, Brenda and Robert	*Green Architecture: Design for an energy concious future*	Little, Brown and Co., Boston 1991	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Vale, Brenda and Robert	*Green Architecture: Design for and energy conscious future*	Bullfinch Press-Little Brown, London 1991	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Vale, Robert and Brenda	*"Ground Rules for a Green City"*		U Tenn		DeKay/Shelton	Arch 509	
Van Alen Institute	*"Berlin,"*	Information Exchange: How Cities Renew, Rebuild, and Remember, 2003.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Van Alen Institute	*"Kolbe,"*	Information Exchange: How Cities Renew, Rebuild, and Remember. 2003.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Van der Ryn, Sim and Cowan, Stuart.	*Ecological Design*	Island Press, Washington D.C., 1996.	Kansas State U	**R**	Coates		
Van der Ryn, Sim and Cowan, Stuart.	*Ecological Design*	Island Press, Washington D.C., 1996.	Portland State U		Sukhwant	Design and Society	
Van der Ryn, Sim and Cowan, Stuart.	*Ecological Design*	Island Press, Washington D.C., 1996.	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Van der Ryn, Sim and Cowan, Stuart.	*Sustainable Communities: A New Design Synthesis For Cities, Suburbs, and Towns*	Sierra Club Books, San Francisco 1986	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Venolia, Carol	*Healing Environments*	Celestial Arts, Berkeley CA 1988	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Wackernagel, Mathis and Rees, William	*Our Ecological Footprint. Reducing Human Impact on Earth*	New Society Publishers, Gabriola Island BC 1996.	Portland State U		Sukhwant	Design and Society	
Wackernagel, Mathis and Rees, William	*Our Ecological Footprint. Reducing Human Impact on Earth*	New Society Publishers, Gabriola Island BC 1996.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**

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Webb, Michael.	*Modernism Reborn: Mid Century American Houses*		Kansas State U	**S**	Coates, Gabbard, Ornelas Sachs, Watts & Wolf	Architectural Design Studio III	**R**
Wheeler, Stephen M. and Beatley, Timothy (Eds.)	*The Sustainable Urban Development Reader*	Routledge Press, 2004	Texas A & M		Abrams	ARCH 310 Site Planning and Design	
White, Dana.	*"Frederick Law Olmsted,"*	Two Centuries American Planning (ed. by Daniel Schaffer), 1998.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Whiteley, Nigel	*Design for Society*	Reaktion Books, London 1993.	Portland State U		Sukhwant	Design and Society	
Whyte, William H.	*Social Life of Small Urban Spaces. Film.*	The Municipal Art Society of New York, 1988.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Wigginton, Michael	*Glass in Architecture*	Phaldon Press Limited: London, 1996.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
Wigginton, Michael	*Intelligent Skins*	Architectural Press, Oxford, 2002.	Oklahoma State U		Mansy	Sustainability Issue in Architecture	**E**
Wigley, Mark.	*"Insecurity by Design,"*	After the World Trade Center: Rethinking New York City, 2002.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Wilhide, Elizabeth.	*Eco: An essential Sourcebook for Environmentally*		Kansas State U	**R**	Coates	Arch 413 Environmental Systems	
Williams, Elizabeth and William	*Building with Salvaged Lumber*	TAB, PA, 1983	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Wines, James	*Green Architecture*	Taschen, Koln, 2000	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Winston, Morton and Edelbach, Ralph eds.	*Society, Ethics, and Technology*	Wadsworth, Belmont CA 2000.	Portland State U		Sukhwant	Design and Society	
Wood, H. Paul.	*Site Design.*	Kaplan Architecture: Chicago, 2004.	Hampton U	**R**	Chance	Architectural Ecology & Basic Arch and Env Design	**R**
Woolley, Tom	*Green Building Handbook, volumes 1 & 2*	E & FN Spon, London, 1997	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
World Commission on Environment and Dev	*Our Common Future*	Oxford University Press, NY 1987	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Wright, Frank Lloyd	*Frank Lloyd Wright Collected Writings (Ed Bruce Brooks Pfeiffer)*	Rizzoli, New York 1992	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Wright, Frank Lloyd	*The Natural House*	Horizon Press, New York 1954	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Wright, Frank Lloyd	*"In the Cause of Architecture," In the Cause of Architecture. Essays by Frank Lloyd Wright for Architectural Record, 1908-1952*	Frederick Gutheim, ed.,McGraw-Hill, New York 1975 [1908].	Portland State U		Sukhwant	Design and Society	

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Wright, Gwendolyn	*Building The Dream: A Social History of Housing in America*	The MIT Press, Cambridge, Massachusetts, 1981	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Yannas, Simos	*Solar Energy and Housing Design*	Architectural Association, London, 1994	U Virginia		Quale	ecoMOD: Low Income House Design/Build	
Yeang, Ken.	*"What is Ecological Design,"*	The Green Skyscraper, 1999.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Yeang, Ken.	*Designing with Nature: The Ecological Basis for Architectural Design.*	McGraw-Hill Incorporated, 1995.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Yeang, Ken.	*Designing with Nature: The Ecological Basis for Architectural Design.*	McGraw-Hill Incorporated, 1995.	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
Yegenoglu, Hüsnü.	*"The torn metropolis: Explorations in Beirut,"*	Archis, 2000.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
Zeiher, Laura C.	*The Ecology of Architecture: A Complete Guide to Creating the Environmentally Conscious Building.*	Whitney Library of Design, 1996.	Ball State U	**R**	Koester	Arch 501 Graduate Design Studio/Greening Campus	
Zeiher, Laura C.	*The Ecology of Architecture: A Complete Guide to Creating the Environmentally Conscious Building.*	Whitney Library of Design, 1996.	U Minnesota		Weeks	ARCH 8565 Materials Performance	
Zeiher, Laura C.	*The Ecology of Architecture: A Complete Guide to Creating the Environmentally Conscious Building.*	Whitney Library of Design, 1996.	U Minnesota	**R**	Guzowski	ARCH 8561 Sustainable Design Theory/Practice	
	"LEED: A Look at the Rating System That's Changing the Way America Builds,"	Environmental Building News, June, 2002.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
	"Environmental Group Initiates Lawsuits Against ExxonMobil....,"	2004	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
	"Sustainable Architecture of the Past."	The Climate Dwelling: An Introduction to Climate-Responsive Residential Architecture, 1996.	Parsons/New School	**R**	Gardner	Issues and Practices in Architecture and Urbanism	**E**
	OM Solar Handbooks, (three volumes in Japanese)		U Virginia		Quale	ecoMOD: Low Income House Design/Build	
	Renewable Energy, Sources for Fuels and Electricity	Island Press, Washington, DC, 1993.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	
	Solar Engineering of Thermal Process, 2nd Ed.	Wiley & Sons, New York, 1991.	U Texas		Garrison	Arc 696/560 SolarDecathalon Design/Build	

SUBMITTED COURSEWORK

Introduction to the Matrix

The Coursework Matrix that follows charts the 44 submissions and indicates the level (undergraduate or graduate) and some aspects of the courses such as format (studio or lecture) and whether the courses include field work (postoccupancy evaluation), laboratory work, a small project, a design-build project, or community outreach. There are also columns indicating whether the course or courses have a connection to a green campus effort, and whether that university has signed the Talloires Declaration (a commitment to working toward a sustainable campus that is maintained by the University Leaders for a Sustainable Future). Two columns deal with interdisciplinary links; one for students and one for teachers (a G instead of X indicates there were interdisciplinary guest lecturers). Another column is labeled Professional Practice and is checked when the course or courses include a link to professional practice in some way, such as having a real client and presentations, or having practicing architects as part of the instructional team or guest lectures or critiques. Another column, Collaboration, is checked if students are required to work in teams for any part of the course. The last pair of columns identifies whether courses are required or elective (submittals marked with both included more than one course). Where programs are minors or their own degrees, courses are marked as required, though those programs are "elective" add-ons to the basic architecture degree. The variety of documentation submitted should be taken into consideration. Some courses may include one or another element that was not mentioned in the submittal descriptions. Given that variety, this categorization should not be considered absolute.

Profiles of the Additional Coursework Submitted

In addition to the three grant recipients and eight programs selected for special recognition, there were 33 other submitters to the Coursework Grant portion of this project.

University of Arizona, School of Architecture

ARC 301: Design Studio III: Land Ethic (undergraduate)
Submitted by Alvaro Malo

> This third-year architecture course involves the study of earth sciences (geology, hydrology, meteorology) through empirical observation and analysis. Experimental site analysis is used to encourage students to formulate an ethical response for a site design.

Ball State University, College of Architecture and Planning

CAP 101 Studio (undergraduate)
Submitted by C. Daniel Woodfin and Shaun R. Krenzke

> This is a first design studio shaped to teach about environmental design and sustainability principles. The course is team taught by architecture, landscape architecture, and planning professors. Students are asked to produce a model to study daylight, shading, natural ventilation, and climate and site issues.

California Polytechnic State University-San Luis Obispo, College of Architecture and Environmental Design

Solar Cal Poly: Solar Decathlon Competition (graduate and undergraduate)
Submitted by Sandy Stannard

> Interdisciplinary hands-on design-build project for the second Solar Decathlon that will result in a 626-square-foot solar-powered home. Design focuses on energy conservation

due to the small size of the home and accompanying solar array. Energy conservation is a critical issue in California, and this project helps raise awareness.

City College of New York at CUNY, School of Architecture, Urban Design and Landscape Architecture
ARCH 51372 New Directions in Green Planning and Design (undergraduate)
Submitted by Anthony Walmsley

Elective architecture course introduces sustainable design through specific designers, writers, or works. Students undertake research assignments that allow them to explore an area of interest such as the work of William McDonough, AIA, the use of green roofs, or the writings of Aldo Leopold. A broad range of topics covers introduction to ecology, vernacular design, energy efficiency, new urbanism, water management, social issues, and economics.

Clemson University, School of Architecture
Graduate Studies in Architecture and Health (graduate)
Submitted by Dina Battisto

Graduate program culminates in design of a green health clinic in Clemson, S.C, over five courses involving different aspects. The interdisciplinary public service project involves faculty from architecture, landscape architecture, nursing, and public health. The project raises awareness within the university and the Clemson community about sustainable design issues.

Florida A & M University, School of Architecture
Green Team and Coursework (undergraduate)
Submitted by Beth Dobson

Several faculty members are integrating sustainability into existing design and technology courses. Technology of Architecture course requires students to develop a connection with nature through observation. Field trips to LEED-certified buildings give students opportunities to learn successful design strategies for surrounding communities.

Hampton University, Department of Architecture
Beginning with Site in Architectural Education and Envisioning Portsmouth: Service Learning (undergraduate)
Submitted by Shannon Chance

Architectural ecology course focuses on technical understanding of site issues to facilitate later design studio courses. Theoretical writings are used to introduce ecological issues and develop interest among students. Projects involving research and analysis such as sun angle studies, site analysis, or sustainable techniques/ materials further students' technical understanding. Envisioning Portsmouth is a three-semester, five-course service project involving sustainability with urban renewal. Interdisciplinary in nature, the project introduces students to community design, landscape, housing, and historic preservation.

Hampton University, Department of Architecture
Environmental Systems/Mechanical Equipment I and II and Systems and Advanced Architectural Design Studio (undergraduate)
Submitted by Benedict Ilozor

Introductory mechanical course for third-year students teaches basic principles of HVAC design with emphasis on ecologically sustainable mechanical design. Environmental Systems course is integrated with Architectural Ecology course and Advanced Design course. Third-year mechanical course focuses on lighting, electrical, and building

acoustics. Daylighting principles introduced as part of building lighting design. Fourth-year architectural design course involves the complete design process for a moderately sized project within an urban setting. Concentration on contextual issues of site, orientation, and environmental relationships creates basis for environmentally sensitive designs.

University of Idaho, Department of Architecture
Daylight in Building, Modeling for Integrated Design, and Building Case Studies and Integrated Design Lab and Outreach Center (graduate and undergraduate)
Submitted by Bruce Haglund and Kevin Van Den Wymbelenberg

Two-semester capstone for graduate students that results in design of projects with sustainable emphasis. Students choose projects based on their own interests. The first semester is spent researching, programming, and developing schematic design. The second semester completes architectural design work. This completes curriculum with basis in sustainability, including Introduction to Ecological Design, Materials and Methods, Architectural Site Design, and Environmental Control Systems courses.

University of Kansas, School of Architecture and Urban Design
Proposed Course: Building with Intelligence and Introduction to Architecture (undergraduate)
Submitted by Shannon Criss

Introduction to Architecture integrates the relationship of ecology and the built environment into an established introductory course. Building with Intelligence is an interdisciplinary course focusing on sustainability in a larger context than architecture by emphasizing interconnecting systems. Case studies are used to expose students to sustainable design, specifically the areas emphasized by the U.S. Green Building Council's LEED program.

University of Kansas, School of Architecture and Urban Design
Studio 804 (graduate)
Submitted by Dan Rockhill and David Kelman

Final design studio course in three-year graduate program allows students to design and build projects for local community organizations. Students learn about materials and methods in a hands-on environment. The course also raises awareness of environmental issues within the communities where projects are completed.

Massachusetts College of Art, Department of Environmental Design
Architecture Program (undergraduate)
Submitted by Patricia Seitz

Preprofessional architecture major program emphasizes natural systems and environmental issues. Several courses concentrate on these issues specifically. Students are taken on field trips to learn about sustainable design of human environments and building systems. An urban design course emphasizes sustainable communities. Design Works course provides students with a multidisciplinary experience and real-world opportunity with a community partner.

Miami University, Department of Architecture and Interior Design, Center for Building Science Research

Interdisciplinary Energy and Sustainable Design Studio (undergraduate)
Submitted by Scott Johnston

The interdisciplinary studio attracts students from various fields related to the environment. Advanced computer and physical modeling is used to understand thermal performance of buildings designed by student teams. Natural ventilation and daylighting are also studied, using both physical and computer models.

University of Nebraska-Lincoln, College of Architecture

Principles of Sustainable Design (graduate)
Submitted by William Borner

Fifth- and sixth-year elective course focuses on the use of case study to evaluate a design project with emphasis on LEED criteria. Case studies are conducted in cooperation with local architecture firms.

University of New Mexico, School of Architecture & Planning

Six courses and Design and Planning Assistance Center (graduate and undergraduate)
Submitted by Stephen Dent

Several courses are offered that address environmental issues as they relate to architecture. Site and environmental controls classes that emphasize minimizing impact on the environment have been offered for more than 20 years. Recently courses covering sustainable design as well as studios that encourage "green" design have been integrated into the curriculum.

New York Institute of Technology, School of Architecture and Design

NYIT Solar Decathlon 2005: Green Machine/Blue Space (graduate and undergraduate)
Submitted by Michele Bertomen

Multidisciplinary design-build project for second Solar Decathlon competition in Washington, D.C., gives students hands-on experience in sustainable design. The design separates the living quarters (Blue Space) from the mechanical components (Green Machine) in order to conserve energy and maintain comfort. A transparent link connects the two components. The design of the Green Machine component is universal so that it can be used with varying Blue Spaces.

North Dakota State University, Department of Architecture and Landscape Architecture

Architectural Design IV: Earth System Science and Policy (undergraduate)
Submitted by Mohamed Elnahas

Third-year design studio involves complete design process with real-world client. Students work with a local architect to meet the client's goal of a sustainable design that minimizes environmental impact. Student teams produce schematic designs for the client. The architect actualizes the winning design.

Oklahoma State University, College of Engineering, Architecture, and Technology

Sustainability Issues in Architecture (undergraduate)
Submitted by Khaled Mansy

Elective course introduces sustainability as a set of principles relating to ecology and the environment rather than as an architectural style. Students learn how to design passive environmental control systems using engineering principles to quantify the effectiveness of the system.

University of Oregon, Department of Architecture
HOPES Conference 24-Hour Design Charrette (graduate and undergraduate)
Submitted by Christine Theodoropoulos

Run by the Ecological Design Center, a student organization, the charrette is an event that launches the annual three-day conference on ecological design. Interdisciplinary teams address a real-world problem. The program is in its 11th year.

University of Pennsylvania, Department of Architecture, School of Design
Design Studio III ARCH 601-206 (graduate)
Submitted by Cathrine A. Veikos

This second-year graduate studio investigates passive systems for ventilation and heating. Students are charged to develop a choreography of spatial qualities of lightness, darkness, reflectivity, and other characteristics over various times of day and at various times of the year. Students use 3D Studio Max and Lightscape programs to capture information. The aim is have students make interpretive translations of digital drawings and use simulations to test the results.

Philadelphia University, Architecture Program, Engineering and Design Institute
Design V for Architecture: Survive: The Ultimate Game of Architecture (undergraduate)
Submitted by Rob Fleming

This course was created after frustrating attempts at cross-disciplinary teaching and learning. Modeled loosely on the *Survivor* television show, teams of students face six challenges: one that regards awareness of surroundings, one that involves anthropological research and biodiversity, one that asks them to create a permaculture community, one that involves architecture history (in a game show format) that reinforces 6,000 years of architecture (rather than 100 of modernism), one that involves a debate about environmental literacy (based on the reading of *Ishmael: An Adventure of Mind and Spirit*), and the final one that requires each team to make and play a musical instrument.

Philadelphia University, School of Architecture and Design
A810 Design X Capstone Studio: Ecological Design and Technology (undergraduate)
Submitted by Susan Frosten

The studio focuses on exploration of environmentally sustainable technology in environmental and technical terms and also as the expression of culture relative to "an understanding of our place as human beings within the ecological framework." After extensive site analysis is followed, the conventional design process is inverted. Students are asked to employ research in four constructs that deal with earth, air, sun, and water.

Portland State University, University Studies Program

Design and Society (undergraduate)
Submitted by Sukhwant Jhaj

Interdisciplinary course focuses on the designer's impact on social and physical systems with attention to societal responsibilities (sustainable development, social justice).

University of Puerto Rico, School of Architecture
Puerto Rico Institute for Sustainable Architecture/House Restoration for Institute (undergraduate)
Submitted by Fernando Abruna

This is an introduction to sustainable architecture through a restoration project for third- and fourth-year undergraduates. The tropical house will become the headquarters of the Puerto Rico Institute for Sustainable Architecture. Students will be asked to develop a

program of yearly activities for the education of the professional and general public about the importance of sustainable buildings.

Ryerson University, Department of Architectural Science
ASF 905: Community Outreach Program (undergraduate)
Submitted by Margery Winkler

A community interaction course with the Toronto District School Board involved a charrette with the architecture students and middle school students to develop a multipurpose learning space designed with sustainable concepts and lifecycle analysis in mind. Eight models and master plans were produced with elevations and land management reports. The project is being executed.

Savannah College of Art and Design (SCAD), Department of Architecture
Architecture Design Studio II: A Discovery Center for Children to Learn about Ecology (undergraduate)
Submitted by LaRaine Montgomery

Third-year architecture students interface with local school children on a green design project. The design team studies the ecology of the salt mars and maritime forest habitats and conceptualizes a green building design that respects the fragile environment of the site. The center operates more than 40 programs for the county's school children, ranging from barnyard classes to tidal creek ecology sessions to astronomy classes.

Savannah College of Art and Design (SCAD), Department of Architecture
Arch 507/707: Urban Design Studio (undergraduate)
Submitted by Mike Moore

In Arch 507/707, fifth-year design studios, students respond to a hypothetical design competition sponsored by the city of Newport, Ore., or another challenge in the city of Ashland, Ore. Students are expected to develop an ability to create a meaningful solution to a very complex and large-scale architecture problem in an urban setting. Given problems might involve the design or redesign of a major urban area. Lectures and discussions center on theories regarding the development of cities.

SBSE Retreat 2005: Greener Foundations: Environmental Technology and the Beginning Design Student
Submitted by Christopher Theis, Louisiana State University; Leonard Bachman, University of Houston; Terri Meyer Boake, University of Waterloo

Request for grant funding to enable three beginning design instructors to attend the 2005 Annual Retreat of the Society of Building Science Educators (SBSE), held at the Savannah College of Art and Design in Savannah, Ga., June 9–12, 2005, and focused on the question: Should environmental technology be a component of beginning design courses and, if so, how?

University of Southern California, School of Architecture, Landscape Architecture Program
The Brown Lab (graduate)
Submitted by David Fletcher

Students from the landscape architecture, architecture, urban planning, and public art programs at the University of Southern California take this studio, which is designed to affect change in the community through charrettes and alternatives to conventional development practices. One part of the challenge to students is to create an elaborate field guide to the site that involves hydrology, infrastructure, site history, demographics, and phenomenology.

University of Texas, School of Architecture
Arc 696/560: Advanced Design/SolarDecathlon Design-Build Studio (graduate and undergraduate)
Submitted by Michael Garrison

> Students investigate the application of building systems that may be used to design and construct environmentally responsive architecture as part of the project to design and build the 2005 Texas SolarD House. The course links the theory and practice of sustainable design and planning to familiarize the student with the salient issues of green architecture. The goal is to reestablish the continuity and interrelationship between the process of conceiving, making, and using the building and landscape and to empower designers to refine environmentally responsive architecture.

University of Texas, School of Architecture, Center for Sustainable Development
ARC 384K: Environmental Control II (graduate)
Submitted by Steven A. Moore

> The required course is a quantitative and qualitative survey of heating, cooling, ventilating, electrical, plumbing, solar, vertical transportation, and fire safety technologies. The seminar/studio blend is intended to provide students with a chance to critically study systems (via case studies) within the assumption that architecture practice "requires knowledge that is scientifically, ecologically, and culturally responsible."

University of Texas, School of Architecture, Center for Sustainable Development
Design/Build Mexico (graduate and undergraduate)
Submitted by Sergio Palleroni

> This summer studio was conducted in collaboration with a consortium of public and private groups and was aimed at designing and building two prototype houses for single women and their children. In-depth climate and site research preceded design, and students returned to Sonora the following year to build the houses (to near completion). A follow-up visit by three students and one faculty assessed the completion process and results.

Texas A&M University, Department of Architecture
ARCH 310 Site Planning and Design (graduate and undergraduate)
Submitted by Robin Fran Abrams

> This is a one-semester interdisciplinary seminar team taught by a licensed architect, landscape architect, and urban planner (students of all three departments enroll). The course is taught with a "biophysical" perspective (beginning with Robert Thayer's bioregional quiz in *Grey World Green Heart*). In 2005, the course had three parts: poetry of site, gaining an ecological understanding, and issues in sustainable site development. Discussions are framed in terms of sustainability in three frames: environmental, economic, and equity.

Coursework Matrix

course name	submitted by	institution	graduate	undergaduate	studio	lecture / seminar	project	design-build	field work / measurements	lab work / testing	community outreach	green campus connection	Talloires Declaration	interdisciplinary teaching	interdisciplinary students	professional practice link	collaboration	required	elective	
grant winners									SOME KEY CHARACTERISTICS											
Sustainable Environment & Implementing Sustainable Principles	Jonathan Reich	University-San Luis Obispo, College of Architecture & Environmental Design		X		X	X				X		X	X	X		X	X		
Comprehensive Green Design	Jim Wasley	University of Wisconsin-Milwaukee School of Architecture and Urban Planning	X		X	X						X		G	X	X	X		X	
Seminar in Architectural Technology & Technological Traditions	Mark DeKay and Ted Shelton	University of Tennessee College of Architecture and Design	X		X	X												X		
special recognition																				
Animated Architecture	Keith Evan Green	Clemson University School of Architecture	X		X								X						X	
MS Sustainable Design Track (4 Core Courses)	Mary Guzowski	University of Minnesota Department of Architecture	X		X	X			X					X	X	X	X	X		
ecoMOD	John Quale	University of Virginia School of Architecture	X		X	X			X		X		X		X	X	X		X	
Graduate Design Studio & Green Campus	Robert Koester	Ball State University College of Architecture and Planning	X		X	X			X			X	X	G		X			X	
Issues and Practices in Modern Architecture and Urbanism	Jean Gardner	Parsons School of Design (at The New School University), Department of Architecture, Interior Design and Lighting	X			X			X									X		
Portable Classroom Project (Environmental Design and Mechanical Systems + Env Sys Lab)	Stephen Meder	University of Hawaii School of Architecture		X		X			X	X	X		X			X	X		X	
Architecture and Other Courses	Gary Coates	Kansas State University Department of Architecture		X		X	X											X		
Passive Building Systems / Ecological Design	Michael Berk	Mississippi State University College of Architecture		X		X	X								X		X	X		
other submissions																				
Design Studio III: Land Ethic	Alvaro Malo	University of Arizona School of Architecture		X	X					X			X						X	
CAP 101 (First Studio)	Dan Woofin and Shaun Krenzke	Ball State University College of Architecture and Planning		X	X								X						X	
Solar CalPoly: Solar Decathlon Competition	Sandy Stannard	University-San Luis Obispo, College of Architecture & Environmental Design	X	X	X	X		X	X		X		X	X	X	X	X		X	

course name	submitted by	institution	graduate	undergaduate	studio	lecture / seminar	project	design-build	field work / measurements	lab work / testing	community outreach	green campus connection	Talloires Declaration	interdisciplinary teaching	interdisciplinary students	professional practice link	collaboration	required	elective
New Directions in Green Planning and Design	Anthony Walmsley (LA)	City College of New York (CUNY) School of Architecture, Urban Design & Landscape Architecture		X		X													X
Graduate Studies in Architecture and Health (6 Courses)	Dina Battisto	Clemson University School of Architecture	X	X	X	X								G	X	X			X
Green Team + Coursework	Beth Dobson	Florida A&M University School of Architecture		X	X	X			X			X				X			X
Beginning with Site in Architecture & Envisioning Portsmouth Service Learning	Shannon Chance	Hampton University Department of Architecture		X	X	X					X						X		X
Foundations/Mechanical Equipment/Systems Courses and Advanced Design Studio	Benedict Ilozor	Hampton University Department of Architecture		X	X	X										X		X	X
Integrated Design Lab and Outreach Center	Kevin Van Den Wymbelenberg	University of Idaho Department of Architecture	X	X		X				X			X			X	X		X
Building with Intelligence	Shannon Criss	University of Kansas School of Architecture and Urban Design		X		X													X
Studio 804	David Kelman and Dan Rockhill	University of Kansas School of Architecture and Urban Design	X		X			X			X					X	X		X
Design Seminar, Design Works	Patricia Seitz	Department of Environmental Design & Architecture		X		X					X						X		X
Interdisciplinary Energy & Sustainable Design Studio	Scott Johnston	Miami University, Department of Architecture and Interior Design & Center for Building Science Research		X	X		X			X				X	X		X		X
Principles in Sustainable Design (and Other Courses)	William Borner	University of Nebraska-Lincoln College of Architecture	X			X										X			X
Design and Planning Assistance Center	Stephen Dent	University of New Mexico School of Architecture & Planning	X	X	X	X		X	X		X			X		X	X		X
Green Machine/Blue Space: Solar Decathlon 2005	Michele Bertomen	New York Institute of Technology School of Architecture and Design	X	X	X	X		X	X		X			X	X	X	X		X
Architectural Design IV: Earth Systems Science & Policy	Mohamed Elnahas	North Dakota State University Department of Architecture & Landscape Architecture		X	X						X			X		X	X		X
Sustainability Issues in Architecture	Khaled Mansy	Oklahoma State University College of Architecture, Engineering and Technology	X	X		X	X												X
HOPES Conference 24-hour Charrette and the Ecological Design Center	Christine Theodoropoulos	University of Oregon Department of Architecture	X	X			X				X			X	X	X	X		X

course name	submitted by	institution	graduate	undergraduate	studio	lecture / seminar	project	design-build	field work / measurements	lab work / testing	community outreach	green campus connection	Talloires Declaration	interdisciplinary teaching	interdisciplinary students	professional practice link	collaboration	required	elective	
Design Studio III	Cathrine Veikos	University of Pennsylvania School of Design, Department of Architecture	X		X														X	
Design V for Architecture (Survive: The Ultimate Game of Architecture)	Rob Fleming	Philadelphia University Architecture Program, Engineering Design Institute		X		X	X				X		X		X		X		X	
Design X Capstone Studio: Ecological Design and Technology	Susan Frosten	Philadelphia University Architecture Program, Engineering Design Institute		X	X								X						X	
Design and Society	Sukhwant Jhaj	Portland State University, University Studies Program		X		X	X							X	X				X	
Puerto Rico Institute for Sustainable Architecture & House Restoration	Fernando Abruna	University of Puerto Rico School of Architecture		X		X	X									X	X		X	
Community Outreach Program	Margery Winkler	Ryerson Polytechnic University Department of Architectural Science	X	X	X						X		X			X	X		X	
Urban Design Studio	Mike Moore	Savannah College of Art and Design Department of Architecture		X	X														X	
Architecture Design Studio II: Discovery Center	LaRaine Montgomery	Savannah College of Art and Design Department of Architecture		X	X									X					X	
Student Support / SBSE Retreat 2005	Christopher Theis	Society for Building Science Educators	X																	
Brown LAb	David Fletcher (LA)	University of Southern California Architecture Department	X	X	X						X			X	X		X		X	
Decathlon Design/Build Studio	Michael Garrison	Architecture Center for Sustainable Development	X	X	X	X		X	X		X			X	X	X	X		X	
Environmental Control II	Steven Moore	Architecture Center for Sustainable Development	X		X	X												X		
Design/Build Mexico	Sergio Palleroni	Architecture Center for Sustainable Development	X	X	X			X			X				X	X	X		X	
Site Planning & Design	Robin Fran Abrams	Texas A&M University Department of Architecture	X	X		X								X	X				X	

DEFINING SUSTAINABLE DESIGN

The AIA Committee on the Environment's

MEASURES OF SUSTAINABLE DESIGN AND PERFORMANCE METRICS

This set of 10 measures and supporting metrics is the foundation of the COTE Top Ten Green Projects, an annual awards program in its tenth year, and the basis of the COTE theory of sustainable design. COTE recognizes that great design includes environmental, technical, and aesthetic excellence. Stewardship, performance, and inspiration are essential and inseparable. Top Ten entrants are asked to provide narratives (maximum 200 words each) responding to specific categories and indicate an understanding of the connections between them, quantifying features when possible using the suggested metrics. While emphasis should be placed on measurable results whenever possible, the narrative format recognizes that qualitative goals are often subjective and therefore cannot always be evaluated quantitatively. The brief essays allow the entrants to describe in their own words how the project's goals were pursued and achieved. Narrative and metrics should refer only to the final built project without regard to design measures that were not implemented. Selection favors beautifully designed solutions that exhibit an integration of natural systems and appropriate technology, verified through building systems modeling, analysis, and best practices. (Entrants also provide a description, key environmental features, project economics, and details about the process and results.)

Top Ten Measure 1: Sustainable Design Intent and Innovation

Narrative: Sustainable design embraces the ecological, economic, and social circumstances of a project. How did these circumstances drive the project's design? How were they expressed? Describe the most important sustainable design ideas for your project as well as the specific circumstances or constraints that generated those ideas. (This should not be a list of sustainable design measures.) Describe any unique sustainable design innovations. How does the architectural expression demonstrate the sustainable design intent? How did the sustainable design effort lead to a better overall project design?

Top Ten Measure 2: Regional/Community Design and Connectivity

Narrative: Sustainable design recognizes the unique cultural and natural character of a given region. Describe how the design promotes regional and community identity and an appropriate sense of place. Describe how the project contributes to public space and community interaction. Does the project's selected location reduce automobile travel from home, work, shopping, or other frequent destinations? Does the project make use of any alternative local or regional transportation strategies as well as successful efforts to reduce locally mandated parking requirements?

Metrics: Indicate percentage of the building population traveling to the site by public transit (bus, subway, light-rail or train), carpool, bicycle or on foot. Please indicate in the narrative whether there are company transportation policies and incentives, and efforts made to provide a quality experience for those using transportation alternatives (enhancements to bikeway or pedestrian streets, etc.)

AND: Divide the total number of parking spaces available by the total building population (occupants and visitors). Parking spaces that are dedicated to the building use but not part of the building project must be counted. Please indicate in narrative if project is

successful in providing fewer parking spaces than zoning requirements through proactive measures.

Percent of building population using transit options other than the single occupancy vehicle: _____ %

Number of parking spaces per person: _____

Top Ten Measure 3: Land Use and Site Ecology

Narrative: Sustainable design reveals how ecosystems can thrive in the presence of human development. Describe how the development of the project's site responds to its ecological context. How does the site selection and design relate to ecosystems at different scales, from local to regional? How does the development of the immediate site and its buildings relate to a larger master plan and/or land use guidelines for the area?

Describe the landscape design and the creation, re-creation or preservation of open space, permeable groundscape, and/or on-site ecosystems. Briefly describe any strategies for habitat creation and regionally appropriate planting. (Water will be addressed elsewhere.)

Describe any density or land use assessments and objectives. Is the site rural, suburban or urban, brownfield or other previously developed land, infill or greenfield? (Or can its land use be best characterized in other terms?) How does the project address sustainable land use practices within its given context?

Top Ten Measure 4: Bioclimatic Design

Narrative: Sustainable design conserves natural resources and maximizes human comfort through an intimate connection with the natural flows and cycles of the surrounding bioclimatic region. Describe how the building responds to these conditions through passive design strategies. What are the most important issues to address for your climate and building type? Describe your site analysis and how the building footprint, section, orientation, and massing respond to this analysis and to regional and local climate conditions, the sun path, prevailing breezes, and seasonal and daily cycles. Discuss design strategies and energy conserving techniques that reduce or eliminate the need for active systems or mechanical solutions. Describe how passive ventilation and solar design strategies shaped the building.

Top Ten Measure 5: Light and Air

Narrative: Sustainable design creates and maintains a comfortable interior environment while providing abundant daylight and fresh air. Outline design strategies that create a healthful and productive indoor environment through daylighting, lighting design, ventilation, indoor air quality, view corridors, and personal control systems. Describe how the project's design enhances connections between indoors and outdoors. Provide drawings or diagrams to illustrate these strategies.

Metrics: Identify the percentage of the total building area that uses daylight as the dominant light source during daylight hours (with electric lights off or dimmed below 20%). This calculation should include all areas of the building, including stairways, restrooms, corridors, etc. Identify the percentage of the total building area that can be adequately served by

natural ventilation (with all HVAC systems shutdown) for all or part of the year.

Percent of total building area that is daylit: _____

Percent of building that can be ventilated or cooled with operable windows: _____

Top Ten Measure 6: Water Cycle

Narrative: Water is an essential resource for all life on earth. Describe how building and site design strategies conserve water supplies, manage site water and drainage, and capitalize on renewable sources (such as precipitation) on the immediate site. Outline water-conserving landscape and building design strategies, as well as any water-conserving fixtures, appliances, and HVAC equipment. List water reuse strategies for rainwater, graywater, and/or wastewater.

Metrics: What percentage of precipitation from a typical (regularly occurring in spring/summer/fall) storm event falling on the site is retained and infiltrated/recharged on-site? Naturally occurring storm water flows due to topography and soils inherent to the pre-development conditions on the site (unaffected by development) can be deducted from this calculation.

AND: This calculation must include all water use inside and outside of the building (e.g., plumbing fixtures, appliances, HVAC equipment, landscape irrigation, etc.). Potable water is defined as water that is extracted from municipal supply, wells or irrigation ditches. Reclaimed graywater and harvested rainwater should not be deducted for this calculation, but note the percentage of reclaimed water used and note the source in the narrative. Please describe water conserving strategies used and projected water savings in the narrative.

AND: If wastewater is re-used on site, rather than discharged to municipal treatment systems or conventional septic systems, identify the portion of wastewater that is reused on site.

Precipitation managed on site: _____ %

Total water used indoors: _____ gal/yr

Total water used outdoors: _____ gal/yr

Percent of total water from reclaimed sources. ___%

Percent wastewater reused on-site: _____ %

Top Ten Measure 7: Energy Flows and Energy Future

Narrative: Good design of building mechanical and electrical systems and integration of those systems with passive design strategies is essential for conserving natural resources and improving building performance. Describe how the design of building systems contributes to energy conservation, reduces pollution, and improves building performance and comfort. Describe techniques for integrating these systems with other aspects of building design. Describe effective use of controls and technologies, efficient lighting strategies, and any on-site renewable energy systems.

Sustainable design carefully considers the long-term impact of current decisions in order to protect quality of life in the future. Describe how your project responds to the on-going

reduction and possible loss of fossil fuels. Does the project employ or encourage alternative energy sources? Describe strategies to reduce peak electrical demand through design. programming, use patterns, equipment selection, HVAC / lighting controls, and on-site energy generation. Describe how the building or parts of the building could function in a blackout (operable windows and daylight / independent power for life-safety etc.).

Metrics: Use the Environmental Protection Agency's (EPA) Energy Star Target Finder tool and enter your score here. (Note that a limited number of building types are available for this analysis.) Use actual utility meter or billing data whenever possible. Go to:

www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder

EPA Performance Rating _____

For residential projects, if you used the HERS rating system, enter your score here. Go to:

www.energystar.gov/index.cfm?c=new_homes.hm_verification

HERS Performance Rating _____

Determine percentage of annual energy cost savings achieved with the design, as compared to a minimally code compliant base model. Use ASHRAE 90.1-2004, or the local code/standard, whichever is more stringent. Other, more stringent codes may be used as a baseline. However, the alternate code must be identified (including year of issue), and the calculation method (e.g., DOE-2 energy modeling, utility meter data, etc.) must be described. Also provide a PDF of the energy calculations (energy model summary, LEED energy sheet, Title 24 analysis, or other.) Use the Supplemental Narrative field below to provide details on your base case and energy model

Percent total energy savings: _____

Provide the requested detailed information to the extent possible. Note that total energy (consumption) includes all purchased and site generated energy, and refers to all related loads including HVAC, lighting, and plug loads. Square footage (sf) refers to gross square footage. Provide building "standard design" or "base case" from building energy model.

	Base Case	Actual	
Total annual energy:	_____	_____	Btu/sf/yr
Total annual energy by fuel:			
Electricity	_____	_____	Btu/sf/yr
Natural Gas	_____	_____	Btu/sf/yr
Other (Specify)	_____	_____	Btu/sf/yr
Heating:	_____	_____	Btu/sf/yr
Cooling (If Necessary):	_____	_____	Btu/sf/yr

Cooling capacity: _____ _____ sf/ton

Lighting Load Connected: _____ _____ W/sf

Lighting Load after Controls _____ _____ W/sf
(estimate used in energy model):

Plug Load (estimate used in energy model): _____ W/sf

AND: Identify peak electrical demand per net square footage of building area (subtract mechanical space and loading docks), and identify the extent to which you have reduced peak power demands through demand side management and renewable energy generation.

AND: What percentage of total annual energy usage for the facility is provided by on-site renewable energy sources? Identify the mix from the following list: PV, solar thermal, wind, micro-hydro, biomass (define) electricity, biomass thermal, geothermal, biogas (define), electricity, passive solar, others.

AND: What portion of the total annual energy usage for the facility is generated from grid supplied renewable sources that meet the Center for Resource Solutions (CRS) Green-E requirements? Please identify the sources used and the proportion from each source.

	Base Case	Design Case
Identify watt per net SF peak electricity demand		W/sf
Percent on-site renewable energy generation		
Percent grid-supplied renewable energy		

Top Ten Measure 8: Materials and Construction

Narrative: The careful selection of materials and products can conserve resources, reduce impacts of harvesting, production, and transportation, improve building performance, and enhance occupant health and comfort. Describe the most important selection criteria, considerations, and constraints (such as optimizing health, durability, maintenance, and energy use, and/or reducing the impacts of extraction, manufacturing, and transportation) for materials or building assemblies for your project? What were the most important considerations in developing the building envelope? What were the most important material or building assembly decisions or selections (no more than 3) and how did they meet the criteria? Include consideration given to impacts on the environment over the full life cycle and the results of life cycle assessment if available. Describe any materials that are part of a "green lease" program. Describe construction waste reduction and any strategies to promote recycling during occupancy. (<200 words)

Top Ten Measure 9: Long Life, Loose Fit

Narrative: Sustainable design seeks to maximize ecological, social, and economic value over time. Describe how the project's design creates enduring value through long-term

flexibility and adaptability. Why is this project likely to continue thriving far into the future? Identify the anticipated service life of the project, and describe any components designed for disassembly. Describe materials, systems, and design solutions developed to enhance versatility, durability, and adaptive reuse potential. Describe efforts to “right size” the project and to reduce unnecessary square footage.

Top Ten Measure 10: Collective Wisdom and Feedback Loops.

Narrative: Sustainable design recognizes that the most intelligent design strategies evolve over time through shared knowledge within a large community. Clearly and specifically describe how your design process enhanced the ultimate performance and success of the building. How did collaborative efforts between the design team, consultants, client, and community contribute to success?

What lessons were learned during the design, construction, and occupation of the building? If starting over today, how would your approach or emphasis change? Identify efforts to document and share these lessons with the larger community. Describe commissioning and any on-going monitoring of building performance and occupant satisfaction. How do (or will) these contribute to building performance, occupant satisfaction, or design of future projects? (<200 words)

AIA COTE TOP TEN GREEN PROJECT AWARD RECIPIENTS

The AIA COTE Top Ten Green Project Awards have honored many leading efforts in sustainable design. Submissions are juried based on a series of measures of sustainable design (land use, site ecology, community design and connections, water use, energy performance, energy security, materials and construction, light and air, bioclimatic design, and issues of long life and loose fit) and supporting metrics of performance.

1997
William McDonough + Partners
The ENSAR Group Inc.
Susan Maxman Architects
Burt Hill Kosar Rittelmann Associates
Design Harmony
Dougherty + Dougherty
Croxton Collaborative Architects
Donald Watson, FAIA
Thompson Ventulett Stainback & Associates
Innovative Design
1998
GreenVillage Co.
WLC Architects Inc.
Jones Studio Inc.
Osborn Sharp Architects
Thompson Ventulett Stainback & Associates
Miller/Hull Partnership
Pratt/Whitelaw Architects Inc.
Hellmuth, Obata + Kassabaum Inc.
Tanner Leddy Maytum Stacy Architects
BSE International
1999
Conservation Consultants and Breen Building Services
Denver Urban Renewal Authority and Affordable Housing Development Corporation
Herbert S. Newman & Partners PC
Stewart & Stewart, Rosser Babrap with Roger Preston + Partners
BNIM Architects
SHW Group Inc.
Hellmuth, Obata + Kassabaum Inc.
Gastinger Walker Harden Architects
Van der Ryn Architects
Mithun Partners Inc.
2000
Miller/Hull Partnership
Matsuzaki Wright Architects Inc.
Siegel & Strain Architects
LHB Architects and Engineers
Marc Rosenbaum PE

Overland Partners
Stein White Architects
L. Robert Kimball Associates
LHB Architects and Engineers
Hellmuth, Obata + Kassabaum Inc.
2001
Pei Cobb Freed & Partners Architects LLP
Leger Wanaselja Architecture
Marketplace Architects
Architects: SmithGroup
Mithun Architects + Designers + Planners
Leddy Maytum Stacy Architects
Hellmuth, Obata + Kassabaum Inc.
L. D. Astorino Companies
Jones & Jones Architects and Landscape Architects
National Park Service, Denver Service Center
2002
Sarah Nettleton Architects
Mithun Architects + Designers + Planners
SMWM
William McDonough + Partners
Hellmuth, Obata + Kassabaum Inc.
RDG Bussard Dikis
Hellmuth, Obata + Kassabaum Inc.
Siegel & Strain Architects
CTG Energetics
Tom Bender, Architect
2003
450 Architects
Farr Associates Architecture and Urban Design
Pugh Scarpa Kodama
Susan Maxman & Partners Ltd.
Miller|Hull Partnership LLP
Integrated Architecture
Arkin Tilt Architects
Hellmuth, Obata + Kassabaum Inc.
Randall Stout Architects
Siegel & Strain Architects
2004
Cesar Pelli & Associates
Busby + Associates Architects
Esherick Homsey Dodge & Davis
Behnisch, Behnisch & Partner
Maya Lin Studio and Cybul & Cybul Architects
Krueck & Sexton Architects
Fields Devereaux Architects & Engineers
Miller|Hull Partnership
Robert A. M. Stern Architects

William McDonough + Partners
2005
Arkin Tilt Architects
Bohlin Cywinski Jackson
Croxton Collaborative Architects and Gould Evans
David Gardner Gannon Pope and Bruce Lindsey
LZT Architects
Mahlum Architects
Mithun Architects + Designers + Planners
Polshek Partnership Architects
Rob Wellington Quigley

SBSE RETREAT PROBES THE INTEGRATION OF SUSTAINABLE DESIGN EDUCATION INTO BEGINNING DESIGN STUDIOS

Alex Wilson, executive editor of Environmental Building News*, was a special guest at the 2005 SBSE retreat and provided this report:*

The June 2005 retreat of the Society of Building Science Educators (SBSE) in Savannah, Ga., tackled the question of how first-year design studio courses at architecture schools can more effectively integrate teaching about environmental design topics. Participants in this annual retreat listened to—and participated in—dynamic presentations by some of the leading thinkers in sustainable design education, including Mary Guzowski of the University of Minnesota, Mark DeKay of the University of Tennessee, Gary Coates of Kansas State University, author Ed Allen of Cambridge, Mass., Virgina Cartwright and John Reynolds of the University of Oregon, and Bruce Haglund of the University of Idaho.

According to James Wasley, president of SBSE and associate professor of architecture at the University of Wisconsin-Milwaukee, the design studio is "the heart and soul" of an architecture student's educational experience. He argues that addressing ecological literacy early on for design students "means that it will be part of the core, not layered on in later years." This is not always the norm in architecture schools. Often, students aren't exposed to environmental technology until the middle years of the curriculum.

There seemed to be universal agreement among participants at the retreat that addressing environmental technology early on in the curriculum was critical. Strategies for doing that are widely varying, though, and much of the program illustrated those differences. Some professors described hands-on design exercises that capture students' excitement and spawn their creativity at the outset. David Lee Smith, from the University of Cincinnati, for example, uses an involved design exercise in which each student creates a musical instrument out of a discarded appliance, to inspire creative thinking about design solutions in a way that is both engaging and fun. The success stories that were described at the retreat demonstrated the tremendous creativity that can be found at some of the nation's leading architecture schools and left participants with a feeling of optimism that, at least at some architecture schools, we're on the right track.

WEB SURVEY REPORT

Part I: Prominent Themes

Each course or program described by an architecture program as pertaining to sustainable design or ecological issues is identified to focus on one of the following: Site/Land, Studio, Daylighting, Energy Systems, Integrated Design Process, LEED, Materials and Community Involvement.

Part II: Curriculum Information by Program

Each accredited architecture program in the United States is listed along with the following information: type of curriculum information available online, amount of curriculum information related to sustainable design, key courses related to ecological literacy, key programs related to ecological literacy, and key faculty members teaching ecological literacy. Further descriptions are included when necessary to explain a course or program.

Part III: Research Method

Description of the questions, tools, and processes employed to execute this project.

Part I: Prominent Themes

The following abbreviations will be used for each of the Prominent Themes in Part II:

- SITE/LAND (S/L)
- STUDIO (S)
- DAYLIGHTING (D)
- ENERGY SYSTEMS (E)
- INTEGRATED DESIGN PROCESS (I)
- LEED (L)
- MATERIALS (M)
- COMMUNITY INVOLVEMENT (CI)
- OTHER (O)

The majority of courses and programs identified in this study were found to be related to Energy Systems. In addition, evidence showed that many programs offer some form of the Site/Land or Community Involvement approaches. Conversely, the more specific topics of Daylighting, Integrated Design Process, LEED and Materials did not prove to be consistantly evident in the curriculum information collected.

Part II: Curriculum Information by Program

ANDREWS UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Sustainable Design Studio (S)
Environmental Technology II (E)

ARIZONA STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Building Systems I (E)
Building Environmental Science (E)
Daylighting Design (D)
Passive Heating and Cooling (E)
Building Energy Efficiency (E)

AUBURN UNIVERSITY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Low
Courses: Environmental Controls (E)
Programs: Rural Studio (CI)
Urban Studio (CI)

BALL STATE UNIVERSITY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Environmental Systems I (E)
Programs: Center for Energy Research/Education/Service (CI)
Clustered Academic Minors in Environmentally Sustainable Practices (O)

BOSTON ARCHITECTURAL CENTER
Information Available Online: school catalog
Amount of Sustainable Design Information: None
Courses: Technology and Management sequence

CALIFORNIA COLLEGE OF THE ARTS
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Building Technology: Environmental Control Systems (E)

CALIFORNIA POLYTECHNIC STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Environmental Control Systems I (E)
Environmental Control Systems II (E)
Climatic Determinants of Building Design (S/L)
Programs: Sustainable Environments Minor (O)
Renewable Energy Institute (E)
Faculty: M. McDonald, AIA

CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA
Information Available Online: course descriptions

Amount of Sustainable Design Information: Mid
Courses: Environmental Controls (E)
Energy Conservation (E)
Solar Design Application in Architecture (E)

CARNEGIE MELLON UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Materials & Assemblies (M)
Architecture Design Studio: Site (S)
Site Engineering, Foundations & Landscape (S/L)
Environment I: Climate & Energy in Buildings (E)
Environment II: Acoustics & Light (E)
Environment III: Mechanical Systems (E)
Architecture Design Studio: Systems Integration (S)
Advanced Building Systems (I)
Urban Design (S/L)
Architectural Design in the Urban Context (S)
Programs: Center for Building Performance Diagnostics (E)
Faculty: V. Hartkopf, R.A., PhD, S. Lee, AIA, V. Loftness, FAIA, D. Lewis, FAIA

THE CATHOLIC UNIVERSITY OF AMERICA
Information Available Online: required course listing
Amount of Sustainable Design Information: None
Courses: Environmental Design I & II

CITY COLLEGE OF CUNY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Construction Technology I (M)

CLEMSON UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Collaborative Studio III (S)
Architectural analysis and design problems focusing on understanding the context of architecture. Specific investigation of the relationship between buildings and the cityscape and landscape.
Energy In Architecture (E)

COLUMBIA UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Low
Courses: Enclosures & Environments I (E)

THE COOPER UNION
Information Available Online: curriculum listing
Amount of Sustainable Design Information: None
Courses: Environmental Technology I & II

CORNELL UNIVERSITY
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Mid
Courses: Environmental Controls II: Mechanical and Passive Solar Systems (E)

DREXEL UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Studio 4-1 (S)
Investigates the design relationship between the man-made and the natural environment in a study of large scale site design and building development in relation to natural forces.
Studio 4-3 (S)
Addresses architectural problems with specific environmental and site restraints and criteria. Issues of sustainable design will also be explored.
Energy and Architecture (E)

DRURY UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Low
Courses: Environmental Systems I (E)
Environmental Systems II (E)

FLORIDA AGRICULTURAL AND MECHANICAL UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Technology II (E)
Vital Signs (I)

FLORIDA ATLANTIC UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Site Planning & Engineering (S/L)

FLORIDA INTERNATIONAL UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Design Theory (S/L)
Graduate Design II (S)
Programs: Southeast Environmental Research Center (CI)

FRANK LLOYD WRIGHT SCHOOL OF ARCHITECTURE
Information Available Online: curriculum description
Amount of Sustainable Design Information: High
Courses: Site & Environmental Design Core Area (S/L)

GEORGIA INSTITUTE OF TECHNOLOGY
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Environmental Systems & Design Integration I (E)
Environmental Systems & Design Integration II (E)
Construction Technology & Design Integration II (S/L)

HAMPTON UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Architectural Ecology (S/L)

HARVARD UNIVERSITY

Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Technologies in Building: Climate & Thermal Behavior (E)
Energy, Technology & Building (E)
Faculty: M. Addington

HOWARD UNIVERSITY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Introduction to Environmental Systems I (E)
Principles of Site Design (S/L)

ILLINOIS INSTITUTE OF TECHNOLOGY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Energy Conscious Design I & II (E)

IOWA STATE UNIVERSITY
Information Available Online: cirriculum listing
Amount of Sustainable Design Information: None
Courses: Environmental Forces in Architecture

JUDSON COLLEGE
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Environmental Technology I (S/L)

KANSAS STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Systems in Architecture I (E)

KENT STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Technology I (E)
Environmental Technology III: The Secret Life of Builidngs (E)

LAWRENCE TECHNOLOGICAL UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Environmental Systems I (E)
Passive Solar Design Strategies (E)
Allied Design Studio: Sustainable Architecture (S)

LOUISIANA STATE UNIVERSITY
Information Available Online: curriculum listing
Amount of Sustainable Design Information: None
Courses: Environmental Control Systems

LOUISIANA TECH UNIVERSITY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid

Courses: Building Systems II (E)
Architectural Design II (S)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Building Technology Laboratory (E)
Fundamentals of Energy in Buildings (E)
Daylighting in Buildings (D)
Programs: Alliance for Global Sustainability (CI)
Faculty: L. Glicksman, M. Andersen

MIAMI UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Low
Courses: Environmental Systems (E)

MISSISSIPPI STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Site Planning for Architects (S/L)
Passive Building Systems (E)

MONTANA STATE UNIVERSITY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Issues in Sustainability (O)
Environmental Controls I (E)
Programs: Community Design Center (CI)

MORGAN STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Low
Courses: Architectural Technology III (E)

NEW JERSEY INSTITUTE OF TECHNOLOGY
Information Available Online: curriculum description
Amount of Sustainable Design Information: Mid
Courses: Landscape Architecture (S/L)

NEWSCHOOL OF ARCHITECTURE
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Energy Fundamentals (E)

NEW YORK INSTITUTE OF TECHNOLOGY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Site Planning (S/L)
Landscape Design (S/L)
Energy Conservation (E)
Programs: Energy Management concentration (E)

NORTH CAROLINA STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Ecological Design (O)
Natural Systems and Architecture (E)

NORTH DAKOTA STATE UNIVERSITY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Low
Courses: Environmental Control Systems I (E)

NORTHEASTERN UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Low
Courses: Environmental Systems (E)

NORWICH UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Introduction to Passive Environmental Systems (E)

THE OHIO STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Passive Solar Energy I & II (E)
Mechanical Systems in Architecture (E)

OKLAHOMA STATE UNIVERSITY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Environmental Control (E)
Sustainability Issues in Architecture (O)

PARSONS SCHOOL OF DESIGN (Candidate School)
Information Available Online: studio descriptions
Amount of Sustainable Design Information: Low
Courses: Architecture Design III: Land and Artifact (S)

THE PENNSYLVANIA STATE UNIVERSITY
Information Available Online: curriculum description
Amount of Sustainable Design Information: Low
Courses: Architectural Environmental Control Systems (E)

PHILADELPHIA UNIVERSITY
Information Available Online: undergraduate bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Building Technology II (M)
Environmental Controls II (E)

POLYTECHNIC UNIVERSITY OF PUERTO RICO
Information Available Online: course descriptions
Amount of Sustainable Design Information: (Mid)
Courses: Site Planning (S/L)

Advanced Design II (S)

PRAIRIE VIEW A&M UNIVERSITY
Information Available Online: select course descriptions
Amount of Sustainable Design Information: Low
Courses: Environmental Systems (E)
Programs: Community, Urban and Rural Enhancement Service (CI)

PRATT INSTITUTE
Information Available Online: curriculum description
Amount of Sustainable Design Information: Mid
Courses: Site Design (S/L)
Energy-Concious Architectural Design Applications (E)

PRINCETON UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Energy and Form (E)
Environmental Engineering of Buildings (E)
Faculty: H. Brown; D. Nall; M. Raman

RENSSELAER POLYTECHNIC INSTITUTE
Information Available Online: select course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Systems (E)
Advanced Environmental Systems (E)
Programs: The Lighting Research Center (D)
Faculty: S. Van Dessel, W. Kroner

RHODE ISLAND SCHOOL OF DESIGN
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Mechanical: HVAC & Plumbing (E)
Faculty: D. Tidwell

RICE UNIVERSITY
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Low
Courses: Building Climatology (E)

ROGER WILLIAMS UNIVERSITY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Site and Environment (S/L)
Sustainable Paradigms (O)

SAVANNAH COLLEGE OF ART AND DESIGN
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Sustainable Design (O)
Environmental Control I (E)
Landscape Design (S/L)

SOUTHERN CALIFORNIA INSTITUTE OF ARCHITECTURE
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Hardtech: Intro to Environment and Climate (S/L)
Hardtech: Smart, Sustainable, Emerging Technologies (I)

SOUTHERN POLYTECHNIC STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Low
Courses: Environmental Technology I (S/L)
Environmental Technology II (E)

SOUTHERN UNIVERSITY AND A&M COLLEGE
Information Available Online: course descriptions
Amount of Sustainable Design Information: Low
Courses: Environmental Control Systems (E)
Site Planning and Landscape Architecture (S/L)

SYRACUSE UNIVERSITY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Building Systems Design I (E)
Reading the Landscape (S/L)
Programs: Community Design Center (CI)

TEMPLE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Site Investigations (S/L)
Energy and Building Design (E)
Programs: Vital Signs (E)

TEXAS A&M M UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Energy Conservation in Residential Architecture (E)
Energy & Architecture Design (E)
Energy Optimization in Building Design (E)
Environmental Control Systems (E)
Programs: Energy Systems Laboratory (E)
Day lighting and Energy Laboratory (D)

TEXAS TECH UNIVERSITY
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Low
Courses: Architecture Site Planning (S/L)

TULANE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Natural Landscape and Built Form (S/L)
Structures/Technology III (E)
Structures/Technology IV (E)

Sustainability & Tectonics (M)
Faculty: J. Klingman

TUSKEGEE UNIVERSITY
Information Available Online: cirriculum description
Amount of Sustainable Design Information: Low
Programs: Solar Home

UNIVERSIDAD DE PUERTO RICO
Information Available Online: course descriptions (in Spanish)
Amount of Sustainable Design Information: Mid
Courses: Tecnologia I (E)
Tecnologia II (S/L)

UNIVERSITY AT BUFFALO
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Landscape/Environment sequence (E)

UNIVERSITY OF ARKANSAS
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Architectural Technology I, V & VI (E)

UNIVERSITY OF ARIZONA
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Building Technology II (I)
Building Technology III (E)
Design Studio III: A Land Ethic (S)
Programs: House Energy Doctor (CI)

UNIVERSITY OF CALIFORNIA, BERKELEY
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Design for Sustainability (I)
Natural Cooling and Sustainable Design (E)
Introduction to Energy and Environmental Management (E)
Diagnostics of Land Form, Settlement and Architecture (S/L)

UNIVERSITY OF CALIFORNIA, LOS ANGELES
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Mid
Courses: Building Climatology (E)

UNIVERSITY OF CINCINNATI
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Technology I (E)
Site Systems (S/L)

UNIVERSITY OF COLORADO
Information Available Online: course descriptions

Amount of Sustainable Design Information: High
Courses: Design Studio II (S)
Environmental Control Systems I (E)
Solar & Sustainable Design (E)

UNIVERSITY OF DETROIT MERCY
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Mid
Courses: Building and Energy (E)
Programs: Detroit Collaborative Design Center (CI)

UNIVERSITY OF FLORIDA
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Technology I (E)
Architecture, Energy & Ecology (E)

UNIVERSITY OF HARTFORD (Candidate School)
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Site Planning & Development (S/L)
Advanced Site Planning (S/L)

UNIVERSITY OF HAWAII AT MANOA
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Mid
Courses: Lighting, Power, Acoustical Systems (E)
HVAC & Mechanical Systems (E)
Programs: Asian-Pacific Center for Architecture (CI)
Environmental Control Systems Laboratory Projects (E)

UNIVERSITY OF HOUSTON
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Systems I & II (E)

UNIVERSITY OF IDAHO
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Architectural Site Design (S/L)
Environmental Control Systems (E)
Programs: Idaho Urban Research & Design Center (CI)

UNIVERSITY OF ILLINOIS AT CHICAGO
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Design and Environment (S/L)
Architectural Technology concentration (E)
Landscape Urbanism concentration (S/L)
Programs: City Design Center (CI)

UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN
Information Available Online: curriculum listing

Amount of Sustainable Design Information: High
Courses: Architecture Design and the Landscape (S/L)
Building Systems and Design Integration (I)
Programs: East St. Louis Action Research Project (CI)
Building Research Council (CI)
CIVITAS Community Design Center (CI)

UNIVERSITY OF KANSAS
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Mid
Courses: Landscape Design (S/L)

UNIVERSITY OF KENTUCKY
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Environmental Controls I (E)
Environmental Controls II (E)
Design Studio IV: Ecology and Context (S)
Programs: Building Technology Concentration (E)

UNIVERSITY OF LOUISIANA AT LAFAYETTE
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Natural Environmental Systems (E)

UNIVERSITY OF MARYLAND
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Technology I (I)
Solar Energy Applications for Buildings (E)
Design and Energy (E)
Programs: National Center for Smart Growth (CI)

UNIVERSITY OF MIAMI
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Architecture and the Environment (S/L)
Programs: Center for Urban and Community Design (CI)

UNIVERSITY OF MICHIGAN
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Technology I (E)
Intro to Urban and Environmental Planning (S/L)
Building Ecology (I)

UNIVERSITY OF MINNESOTA
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Mid
Courses: Environmental Technology I (E)
Environmental and Material Forces in Architecture (E)
Programs: Center for Sustainable Building Research (CI)

UNIVERSITY OF NEBRASKA - LINCOLN
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Mid
Courses: Arch Design: Ecological Context (S)
Day lighting and Energy (D)

UNIVERSITY OF NEVADA, LAS VEGAS
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Design With Climate (E)
Solar Energy Applications in Architecture (E)

UNIVERSITY OF NEW MEXICO
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Site/Environment (S/L)
Environmental Controls I (E)
Programs: Design and Planning Assistance Center (CI)

UNIVERSITY OF NORTH CAROLINA – CHARLOTTE
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Low
Courses: Environmental Control Systems (E)
Architectural Technology concentration (E)
Programs: Charlotte Community Design Studio (CI)

UNIVERSITY OF NOTRE DAME
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Environmental Systems (E)
Environmental Studies (I)
Programs: Downtown Design Center (CI)
Faculty: Crowe, DeFrees

UNIVERSITY OF OKLAHOMA
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Architecture and the Environment (S/L)
Environmental Controls I (E)
Architectural Design/Environmental Factors (I)
Theory of Sustainability (O)
Sustainable Technology (E)
Programs: Graduate program with focus on "Sustainability and Regional Response" (O)

UNIVERSITY OF OREGON
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Climate Analysis for Design (E)
Environmental Control Systems I (E)
Environmental Architecture (I)
Passive Cooling (E)
Solar Heating (E)

Daylighting (D)
Programs: Ecological Design Center (student group) (O)
Energy Studies in Buildings Laboratory (E)
Materials Resource Center (M)

UNIVERSITY OF PENNSYLVANIA
Information Available Online: course descriptions
Amount of Sustainable Design Information: Low
Courses: Environmental Systems I (E)

UNIVERSITY OF SOUTH FLORIDA
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Environmental Technology (E)
Programs: Florida Center for Community Design and Research (CI)

UNIVERSITY OF SOUTHERN CALIFORNIA
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Design for the Thermal and Atmospheric Environment (E)

THE UNIVERSITY OF TENNESSEE
Information Available Online: curriculum listing, elective course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Control Systems (E)
Green Design (O)
Building Energy Analysis (E)

UNIVERSITY OF TEXAS AT ARLINGTON
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Control Systems II (E)
Energy Use and Conservation in Architecture (E)

UNIVERSITY OF TEXAS AT AUSTIN
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Environmental Controls I (E)
Environmental Controls II (E)
Advanced Design: Climate, Site Design (S)
Programs: Center for Sustainable Development (CI)

UNIVERSITY OF TEXAS AT SAN ANTONIO
Information Available Online: curriculum listing
Amount of Sustainable Design Information: Low
Courses: Construction Materials and Sustainable Technology (M)
Environmental Systems I (E)

UNIVERSITY OF UTAH
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Environmental Controls I (E)
Environmental Contorls II (E)

Advanced Technology: Sustainable Design (I)

UNIVERSITY OF VIRGINIA
Information Available Online: select course descriptions
Amount of Sustainable Design Information: High
Courses: Building & Climate (E)
Buildings & Climate (E)
Environmental Control Systems & Lighting (E)
Programs: Institute for Environmental Negotiation (CI)
Faculty: W. Sherman

UNIVERSITY OF WASHINGTON
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Passive Environmental Control Systems (E)
Environmental Control Principles (E)

UNIVERSITY OF WISCONSIN - MILWAUKEE
Information Available Online: course descriptions
Amount of Sustainable Design Information: High
Courses: Architecture and Environmental Response (E)
Landscape Architecture (S/L)
Sustainable Architecture Studio (S)
Green Building Design (I)
Programs: Milwaukee Idea Home (CI)

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environment & Building Systems (I)
Building Environmental Systems (E)
Programs: Environmental Systems Laboratory & Research and Demonstration Facility (CI)

WASHINGTON STATE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Site and Landscape Design (S/L)

WASHINGTON UNIVERSITY in St. LOUIS
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Site Planning (S/L)
Programs: Metropolitan Research and Design Center (CI)

WENTWORTH INSTITUTE OF TECHNOLOGY
Information Available Online: course bulletin/catalog
Amount of Sustainable Design Information: Mid
Courses: Site Planning & Landscape (S/L)
Site Engineering & Planning (S/L)
Materials and Methods in Sustainable Design (M)

WOODBURY UNIVERSITY
Information Available Online: curriculum listing

Amount of Sustainable Design Information: Mid
Courses: Design Studio 2B: Site Orders (S)
Environmental Systems (E)
Programs: Hollywood Center for Community Research and Design (CI)

YALE UNIVERSITY
Information Available Online: course descriptions
Amount of Sustainable Design Information: Mid
Courses: Environmental Systems in Buildings (E)
Simulation and High Performance Green Design (E)
Programs: Yale Building Project (CI)

Part III: Research Method

Surveyed web sites of all 115 accredited (and candidate) architecture programs in the United States. This investigation was first executed by visiting the home page of each specific program directly. If more information was necessary after this initial query, the home page of the entire institution was used as a starting point to search for a course catalog or other administrative tool with useful curriculum information.

Compiled spreadsheet of all attainable information for each program including: type of curriculum information available online, key courses, key programs and key faculty members. In general, courses and programs were identified to some degree, while names of key faculty members were less commonly found online.

After the full survey was complete, executed analysis of the information collected. The objective of this analysis was to investigate the following questions:

- What level of information on sustainable design does the program offer online?
- What are the predominant themes across the curriculum information related to sustainable design?

Using both quantitative and qualitative curriculum information, rated the amount of sustainable design information provided by each program. To rate programs, the following guidelines were employed:

None No information about sustainable design is stated or can be inferred by the curriculum information provided.

Low Information about programs or courses may imply issues of sustainable design without stating these concepts directly.

Mid Information about one to three programs or courses state issues of sustainable design directly.

High Information about three or more programs or courses state issues of sustainable design directly.

Among the programs identified as providing a *Low*, *Mid* or *High* amount of sustainable design information within the curriculum, identified predominant themes across the information. The categories of Site/Land, Studio, Daylighting, Energy Systems, Integrated Design Process, LEED, Materials, and Community Involvement were identified and curriculum information was used to match each course to the appropriate grouping.

TEACHING DESIGN THAT GOES FROM CRADLE TO CRADLE

By William McDonough, FAIA

Editor's note: This article originally appeared in the July 23, 2004, issue of the Chronicle of Higher Education*. It is reprinted here with permission.*

Each year American colleges and universities hand out design degrees by the thousands. Credentials in hand, an army of young architects and urban planners, engineers, and product designers enter the job market and, with a little luck, begin to practice their professions. But what exactly is the "system" within which they are practicing? Have their college educations prepared them to be the designers of the 21st-century world?

These are not merely academic questions. Designers create the human environment. They make the objects we use, the places we live and work, our modes of communication and mobility. Simply put, design matters. And at a moment in our history when the scientific community has warned of some technologies' negative consequences—global warming, water pollution, the loss of biodiversity and natural resources—designers have a crucial role to play in the creation of a more just, healthful, and sustainable world.

Our colleges, by and large, are not preparing design students for that challenge. While design for sustainability is increasingly seen as an important element of both basic and specialized courses, we still have a long way to go. Consider, for example, the 2003 *Metropolis* magazine survey of more than 350 deans, department chairs, and professors on the relevance of sustainability to design education. Although 67 percent of the respondents strongly agreed that sustainability is relevant to their design curricula, only 14 percent said their institutions were developing programs to educate their instructors about sustainable design. When asked how many graduate courses their department offered that included considerations of sustainability, 28 percent said none and 45 percent said they didn't know.

That lack of focus on sustainability, of course, has a profound impact on professional practice. A separate *Metropolis* survey of practicing design professionals, conducted in 2002, found that 70 percent did not feel equipped to do a sustainable-design job.

The impact on our world is profound, as well. Instead of designs for buildings and products and manufacturing systems that effectively use energy and resources and generate a wealth of positive environmental, economic, and social effects, we get designs that reiterate the "take, make, and waste" sensibility of conventional industry. Instead of safe, healthful materials designed for many lifecycles, we get toxic materials designed for a one-way trip to the landfill or incinerator. In short, conventional design tends to diminish the long-term health of human culture and the natural world on which it depends.

We can do much better.

The first step is to define sustainability and good design more clearly. What is it that we intend to teach young architects when we teach them about sustainable design? Typically, sustainability is used as a descriptive term for a range of cultural responses to the environmental and social impacts of economic growth. It is often defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable design puts that sensibility into practice. Many approaches to "sustainable"

architecture, for example, focus primarily on outlining strategies for building systems that make efficient use of energy and materials. Sustainable land planning and site design emphasize an environmentally responsive use of vegetation, water, and other natural systems. Yet while those strategies represent a marked improvement over conventional practice, they most often rely on minimizing human impact on the environment, striving only to be “less bad.”

And “less bad” is not good enough for our young designers. A reductive approach to design may allow architects and manufacturers to use fewer resources, produce less waste, and minimize toxic emissions, but it does not change the fundamental design paradigm. As a result, many so-called “sustainable” technologies use energy and materials within a conventional, cradle-to-grave system. Although they dilute pollution and slow the loss of natural resources, they don't deal with the design flaws that create waste and toxic products in the first place.

Thankfully, sustainable design is not limited to simply trying to be more efficient. A new approach offers a clear alternative: an ecologically intelligent framework in which the safe, regenerative productivity of nature provides models for wholly positive human designs. Within that framework, every material is designed to provide a wide spectrum of renewable assets. After a useful life as a healthful product, such cradle-to-cradle materials (as opposed to materials designed for a one-way trip from cradle to grave) either replenish the earth with biodegradable matter or supply high-quality resources for the next generation of products. When materials and products are created specifically for use within these closed-loop cycles—the flow of biological materials through nature's cycles and the circulation of industrial materials from producer to customer to producer—businesses can realize both enormous short-term growth and enduring prosperity. As well, we can begin to redesign the very foundations of architecture and industry, creating systems that purify air, land, and water; use current solar income and generate no toxic waste; and use only safe, healthful, regenerative materials. The benefits would enhance all life.

Such a positive agenda can redefine design education. Rather than teach architecture students and designers how to reduce the impact of their work to meet today's environmental standards, we should inspire them with an altogether different assignment: Design industrial and architectural systems for the 21st century that

- introduce no hazardous materials into the air, water, and soil
- measure prosperity by how much we enhance the positive effects of the human footprint
- measure productivity by how many people are gainfully and meaningfully employed
- measure progress by how many buildings have no smokestacks or dangerous effluents
- do not require regulations whose purpose is to stop us from killing ourselves too quickly
- produce nothing that will require future generations to maintain constant vigilance
- generate more energy than they consume
- make every building a life-support system
- celebrate the abundance of biological and cultural diversity and renewable energy

Colleges need to support students who engage in this revolutionary design assignment in the classroom. In the 1970s, when green architecture began to emerge in response to the energy crisis, most design students interested in creating solar-powered buildings found themselves working with faculty members who didn't understand—and didn't want to understand—the principles of ecologically intelligent design. In fact, one of my professors at Yale University, an architect well known for his sophisticated Modernist designs, went as far as to say that “solar energy has nothing to do with architecture.”

Vitruvius would have disagreed. The Roman master's encyclopedic treatise on architecture,

hugely influential in ancient times and again in the Renaissance, contained whole chapters on the profound significance of the sun's movement in relation to the location of rooms, the size of apertures, thermal mass, and so on. A building insensitive to the movement of the sun would have left Vitruvius aghast.

But not the Modernists. Indeed, my professor's rebuttal suggests just how far the Modernist project had divorced architecture from place and from the past. Following Le Corbusier, the Modernist ideal was “one single building for all nations and climates.” The house was to be “a machine for living in.” No need to understand local energy flows in that paradigm; just add fossil fuels. Style, too, was fiercely ideological, defined by the Bauhaus maxim, “Less is more.” Energetically applied, the “less is more” lens had a clarifying effect on architectural theory and practice, but as it calcified into academic rhetoric, its effect in the classroom was ultimately chilling.

And so architecture students, their ideas dismissed by their teachers, often graduated and began to practice ecological design without a suitable aesthetic foundation. The results were less than handsome. Architects who designed solar-powered buildings typically delivered machines for living in with solar collectors on the roof. The devices were crude and utilitarian, and they did not really change the basic Modernist approach: same materials, same generally insensitive relationship to place and history, same ecological illiteracy.

The architecture critic Nikolaus Pevsner wrote that “a bicycle shed is a building” while a cathedral is “architecture.” The new solar buildings in the 1970s were seen as bicycle sheds, and, in fact, they were. That cast a shadow over ecological design for years, which meant our colleges were not blessed with a new generation of faculty members capable of helping students pursue aesthetically rich designs that also express ecological intelligence.

The situation has begun to change. It is worth noting that even though only 14 percent of the design educators responding to the *Metropolis* survey said their colleges were developing sustainable-design curricula for instructors, 67 percent saw the relevance of sustainability to design education. Even 10 years ago that number would have been considerably smaller.

Moreover, the work of prominent architects is now demonstrating that ecological design and aesthetic excellence create a wonderful synergy. Consider Norman Foster's designs for the Commerzbank Tower, in Frankfurt; the Reichstag, in Berlin; and London's new city hall, all of which combine a formally rich design sensibility with a keen sensitivity to the larger ecological context of architecture. As *The New York Times* has reported, for decades Foster has been "mining the expressive potential of low-energy construction" to create buildings "as elegant as any in the world."

In the Commerzbank Tower, Foster created a 60-story atrium at the center of the building and built multistory sky gardens, replacing air-conditioning with natural ventilation. The Reichstag's domed assembly hall is also naturally ventilated, and its three-story mirrored sun reflector sends light down into the Bundestag. The spherical shape of London's city hall reduces the buildup of solar heat, keeping the building cool with far less energy than most structures of its size would require. As described in the *Times,* it should put to rest any lingering notion that an ecologically intelligent building is destined to be a bicycle shed: "In the gorgeous Assembly Chamber, an oculus of unusually transparent water-white glass (regular glass has a slight greenish tint) opens the chamber northward through a diagonal fretwork of tubular-steel supports to a splendid vista of the Tower of London and London Bridge. The room is bathed in light as limpid and serene as a Vermeer painting. (This is also part of the low-energy scheme: the Assembly need switch on the

lights only for nighttime and televised events.)"

Now when students express interest in ecological design, not only is there no reasonable argument for dismissing their enthusiasm, but also there are inspiring examples that they can emulate.

But while that is a salutary change in the general atmosphere of design education, it is not enough to power a true transformation. The creativity unleashed by our new design assignment—which is really a lifetime design assignment—can be sustained in the classroom only when the classroom itself embodies the same values. As David W. Orr, professor and chair of the environmental-studies program at Oberlin College, has pointed out, architecture always serves a pedagogical function: The design of buildings teaches and reinforces how we use resources, how we relate to nature, and what our culture values. It is absurd, he believes, to teach young people about the world—especially young people interested in intelligently redesigning the world in buildings that devour fossil fuels, have no relationship to their surroundings, are generally uncomfortable and uninspiring, and express ignorance of how nature works.

To redress the shortcomings of the contemporary classroom, Orr worked with my architecture firm, William McDonough + Partners, to design the Adam Joseph Lewis Center for Environmental Studies at Oberlin, which teaches ecological intelligence rather than ecological illiteracy. Drawing the bulk of its power from solar energy, the Lewis Center already has exceedingly low energy demands, and with additional solar panels it may one day produce more energy than it needs to operate. Its other sustainable-design features include geothermal wells, for heating and cooling; daylight and fresh-air delivery throughout; an extended botanical garden that recovers nutrients from circulating water on-site; and a landscape that offers gathering spaces, instructional gardens and orchards, and a newly planted grove of native trees that has begun re-establishing the habitat of the building's location.

The building and its classrooms provide opportunities for learning how nature and human industry can work together, the foundation of ecological literacy. Perhaps the most moving lesson that the building imparts is that the human presence in the landscape can be regenerative. Not simply benign or less bad, but positive, vital, and good. That is not a rhetorical lesson. At Oberlin habits of mind grow out of daily interactions with wind, water, soil, and trees as well as the workings of experimental building and energy systems. Those habits become the skills and knowledge that inform intelligent design.

Learning like this can be integrated into the curricula of many disciplines. Chemists aware of the concerns of sustainability can master the skills necessary to assess the environmental health and safety of industrial and architectural materials. "Green" engineers, who are employed throughout the sustainable-design process, can garner the technical know-how to develop an array of sustainable systems, from solar-collection technology to chemical-recycling processes that allow the reuse of valuable materials. MBA students who understand the value of design for the “triple top line”—the creation of ecological, economic, and social value through cradle-to-cradle product development—will generate extraordinary value for shareholders of the companies they go on to lead.

Although it will take time for colleges to change the way they construct buildings, they can begin now to revamp curricula so that they reflect the interdisciplinary values of a sustainable world. When young professionals knowledgeable about good sustainable design begin to practice, they can change the nature of “the possible.” Ten years ago if a young architect walked into a firm and said, “I think we can build a green roof,” he would have met considerable resistance; there wasn't

a single green roof in North America. Now, however, thousands of architects have seen the multiple successful examples that have not only met budget and time restrictions but have also created a new way of thinking about the relationship between building and landscape. At Ford Motor Company's revitalized River Rouge Manufacturing Center, for example, the Dearborn Truck Plant has a 10.5-acre green habitat on its roof, which effectively filters storm-water runoff and saved millions of dollars in construction costs alone. When a young architect suggests a green roof today, his superiors know that some of the smartest firms are creating successful, cost-effective versions of the same thing.

The very purpose and nature of learning should evolve from what is largely a celebration of human intelligence toward a sensibility that seeks to replace dominion over nature with a more fulfilling relationship between humanity and the natural world. This movement away from simple stewardship and toward a sense of kinship with life—what the biologist E. O. Wilson calls biophilia—is a source of creativity and deep learning. We also find that human beings are profoundly affected for the better by the life-sustaining systems that this design agenda creates.

Our educational institutions, inasmuch as they support and nurture this new sensibility, can be home to the flowering of a 21st century that becomes known for prosperity, beauty, and growth. To achieve a sustaining world, the design assignment for our students in all disciplines could be the same: Seek a delightfully diverse, safe, healthy, and just world with clean air, water, soil, and energy that is economically, equitably, ecologically, and elegantly enjoyed.

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