Chapter 4



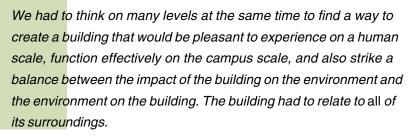
Teaching and Learning

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



 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 teamtaught, 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. Crossdiscipline 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 fiveyear 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."