Renovation for Sustainability

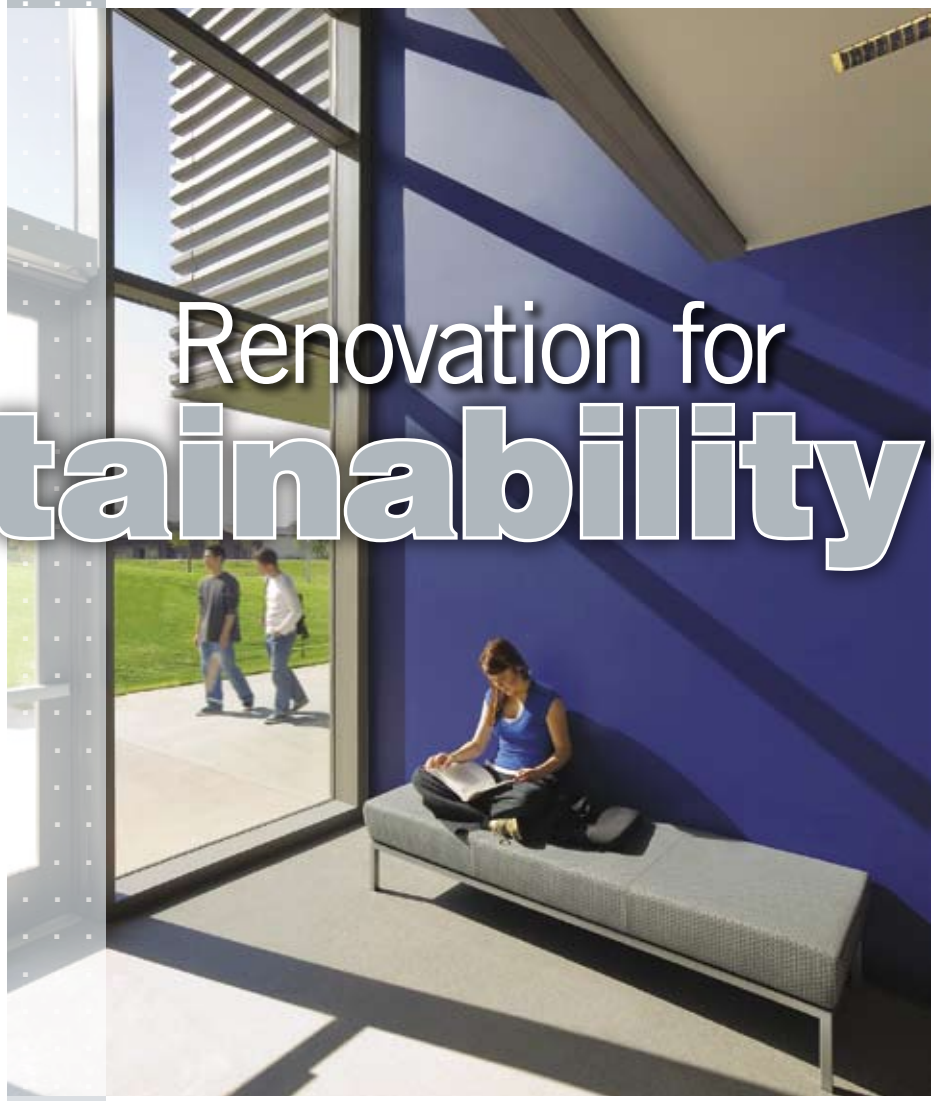

PHOTO: COSTEA PHOTOGRAPHY, COURTESY LPA INC.

Irvine Valley College's Business Sciences and Technology Innovation Center, Irvine, Calif., designed by LPA, features optimized building orientation, shading overhangs, recycled and recyclable materials, and a free-standing wall adjacent to the building to reduce solar heat gain.

Learning Objectives

After reading this article, you should be able to:

- ✔ Describe the importance of green building on university campuses.
- ✔ Explain cost-effective green renovation approaches.
- ✔ List sustainability considerations for college building enclosures, interiors and MEP systems.
- ✔ Discuss ways to reduce energy loads and use renewables in higher education facilities.

By C.C. Sullivan and Barbara Horwitz-Bennett

With higher education institutions among those leading the charge of the sustainable design movement, green building dominates the renovation agenda at many universities and colleges. Numerous projects, programs, and initiatives focused on sustainability continue to spring up on campuses nationwide.

In 2008 alone, according to the Lexington, Ky.-based Association for the Advancement of Sustainability in Higher Education (www.aashe.org), in North America more than 130 campus green buildings were planned, started, opened, or awarded LEED certification. On top of that, more than 50 sustainability-focused community engagement initiatives were announced, and at least 66 sustainability-focused academic programs were created. Of equal significance, 13 sustainability-themed research centers opened, with 33 more in the works.

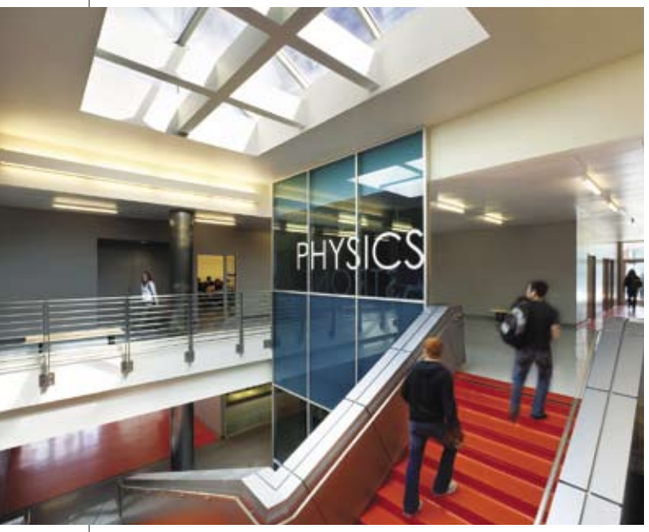

PHOTO: COSTEA PHOTOGRAPHY, COURTESY LPA INC.

A successful adaptive reuse project, the newly renovated Lewis Center for Applied Science at Orange Coast College in Costa Mesa, Calif., designed by LPA, preserves the structure's original brick shell and concrete core.

Student preferences have emerged as a major force in the green higher-ed movement. A 2008 survey of more than 1,700 students at the College of William and Mary, Williamsburg, Va., revealed that 13.5% of student respondents said "sustainability concerns" were among their reasons for choosing a college. Another 85% of students said they would be willing to pay an additional $20 per month just for the benefit of living in a sustainable residence. (Survey results at: http://jtrobe.people.wm.edu/press%20release%20campus%20greening.pdf.)

"The current generation of students is looking for their colleges and universities to take a leadership role in green construction, development, and operations, and how green an institution is has become one of the selection criteria students use in choosing colleges and universities," says Andrew Wolfram, AIA, LEED AP, a senior associate in the San Francisco office of Perkins+Will (www.perkinswill.com). Greening strategies commonly being adopted by schools include encouraging carpooling and bicycle ridership, reducing lighting energy consumption, installing more efficient mechanical systems, reducing water usage, and reducing waste in dining operations, says Wolfram.

Elliot Felix, associate director in the New York City office of consulting firm DEGW (www.degw.com), sees three main areas that universities often use as a starting point when launching a sustainability program:

• **Right-sizing spaces** so that space and energy are used efficiently.

• **Ensuring occupant comfort**, access to daylight, and good indoor air quality (IAQ).

• **Using space to express institutional values** that foster greener behavior and operations.

Felix adds, however, that "the biggest green building priorities in higher education actually have to do with a growing awareness about a different kind of green: costs." He says institutions of higher learning are being forced to take a more holistic, life cycle-based approach to design, a path that is not always so easy to take, given that funding and management for up-front capital projects and ongoing maintenance operations are often separate in most university budget schemes.

Jon Niemuth, AIA, NCARB, LEED AP, a principal with the Kansas City office of AECOM Ellerbe Becket (www.ellerbebecket.com), describes another shift in the campus green building movement: that, as recently as a year or so ago, institutions were focused primarily on greening academic buildings, whereas more recently activity has spread to all types of campus buildings, including athletic facilities.

"Several years ago, there were a few institutions providing select green strategies," says Steven Flanagan, AIA, LEED AP, a principal with LPA Inc. (www.lpainc.com), Irvine, Calif. "Then, more campuses began to come on board. Before we knew it, everyone was doing it, and doing it with passion. In today's market, it's no longer about the next green priority. It's about adding to the already large, environmentally friendly snowball."

EVOLVING GREEN GUIDELINES

Just a few years ago, it was common practice for universities to register their projects for certification with the U.S. Green Building Council's LEED program, but were actually willing to complete the process all the way through to LEED certification. More recently, according to Gina Bocra, AIA, LEED AP, ID+C, a senior associate and director of sustainable design in the New York City office of Burt Hill (www.burthill.com), LEED has become more or less a requirement for academic building owners, especially for public institutions. This change was driven by a number of factors, notably state governments adopting LEED for public projects, but even many private-sector higher education institutions have been setting the bar at LEED Silver as a requirement for new construction.

LEED's evolution—namely the development of various categories of systems—has also "enabled greater clarity for green design, construction, and operations, as well as a better measurement of environmental performance," says Felix.

And now, with the release of LEED's third version, LEED 2009, the system has become even more viable for campuses, according to Greg Mella, AIA, LEED AP, sustainable design co-leader for SmithGroup (www.smithgroup.com), based in Washington, D.C. He points to LEED 2009's sharper focus on energy and water conservation and its prioritization of regional environmental issues.

For example, says AECOM Ellerbe Becket's Niemuth, LEED points can now be earned for simple things like turning off lights, whether via lighting controls or even a simple timer; introducing an IAQ management program where HVAC intakes, fans, and filters are periodically inspected and cleaned; installing C02 sensors; monitoring water use; and conducting building commissioning.

Perkins + Will's Wolfram sees greater emphasis on sustainable site planning and development as an important recent development. While optimized building orientation, solar shading, and natural ventilation strategies are already standard practice on many campuses, he sees stormwater management and landscaping treatment coming into play more frequently than in the past. "There is also a strong desire to reduce water usage by installing more water-efficient irrigation systems and drought-tolerant landscaping," he says.

Another initiative that has captured the attention of many in the higher education community is the American College & University Presidents' Climate Commitment (ACUPCC). With 662 signatories and counting, these schools have essentially committed themselves to reduce their total campus greenhouse gas emissions by 80% by 2050. The program's required plan of action entails: 1) a current emissions inventory, 2) setting interim milestones for becoming climate neutral, 3) taking immediate steps to reduce emissions, 4) integrating sustainability into the curriculum, and 5) publishing an action plan that can include such factors as renewable energy investments, recycling programs, purchase of products made from recycled materials, energy and environment-related research and development, and educational outreach (see the ACUPCC's website, www.presidentscli-

PHOTO: COURTESY PERKINS+WILL

The new 57,000-sf student center at Clarkson University in Potsdam, N.Y., will feature a cork floor designed by Perkins+Will.

The Evolving Classroom

While the traditional college campus setting has generally placed academics and student life within separate programs and buildings, this whole mindset is largely changing.

"There is now growing recognition in higher education that learning does not happen in 50-minute increments on an individual basis, but rather that learning is a social process which, when properly supported, can take place at all hours in a variety of settings—some more formal like classrooms and laboratories and some informal like cafes, corridors, lounges, and libraries," says Elliot Felix, associate director, DEGW, New York. What has evolved is a concept of learning/living environments, or what DEGW calls "learning landscapes," which merge these two traditionally separate kinds of spaces.

"Programs that can be traditionally housed separately, such as classrooms, teaching labs, libraries, and administrative services are now being planned under one roof as a single multidisciplinary building," says Eddie Garcia, AIA, LEED AP, higher education studio leader in SmithGroup's Phoenix office. "This emerging building type provides the students and faculty with a venue that fosters better access and visibility between various departments and resources. In addition, with today's tough economy and scarce funding sources, institutions are realizing that multidisciplinary buildings can be an affordable solution, getting more for their buck."

For example, informal seating areas to encourage interaction, such as small alcoves along busy corridors or outdoor plazas, have become very common, according to Jeffrey Funovits, RLA, LEED AP, a principal at A/E firm Burt Hill. DEGW's Felix adds that campuses are also featuring "more versatile spaces that users can adapt with movable furniture and technology, as well as the spaces, technologies, and staff to support more collaborative and project-based learning."

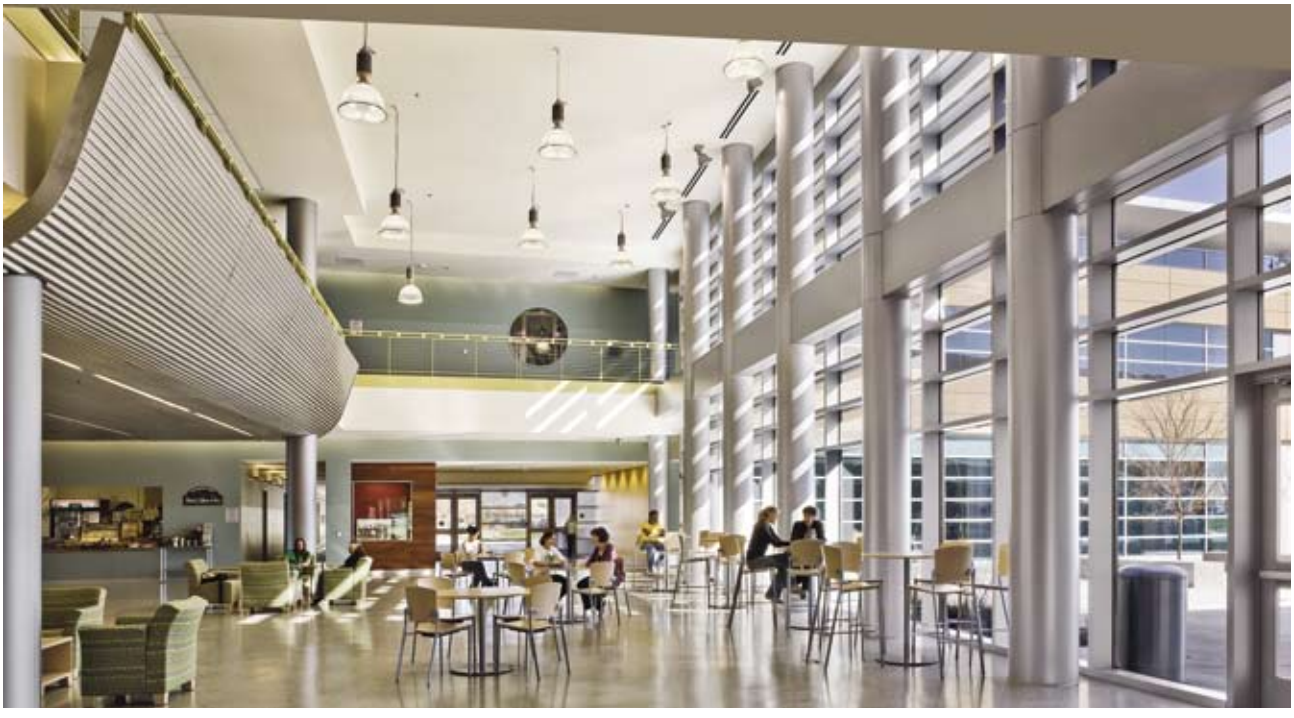

PHOTO: COURTESY ROBERT CANFIELD

The main lobby of Ohlone College's Newark Center for Health Sciences and Technology, Newark, Calif., designed by Perkins+Will, features informal seating and lots of natural light.

matecommitment.org).

But Hill's Bocra notes that many institutions are embracing the initiative. She says some schools are taking a cautious approach to this, looking at so-called Scope 1 emissions—those emissions that result from energy production on the campus—and Scope 2 emissions—those emissions derived from purchased energy. What's more surprising, she says, is that "many campuses are going beyond Scope 1 and Scope 2 emissions and are evaluating Scope 3 emissions that result from activities beyond their energy consumption."

Scope 3 emissions include things like transportation, production and use of purchased materials, and waste disposal. "Obviously, these emissions take a great deal of work to measure, but some schools have set goals to do this," says Bocra.

Furthermore, says Mella, "Even schools that have not yet signed the ACUPCC are still calculating their carbon footprint and thinking about emission reduction strategies. Schools are also enacting policies to ensure new construction projects are consistent with their climate action plans—policies that go beyond requiring LEED ratings—by establishing carbon reduction targets. Renovation, retrofitting, and commissioning of their existing building stock is becoming an increased priority as well."

Yet another industry-specific program worth noting is AASHE's Sustainability Tracking, Assessment & Rating System (STARS), released last year with 42 charter members. "The STARS approach focuses on a broad range of campus sustainability issues from administration, to curriculum, to operations," says Mella.

Referring to the STARS system, Johanna Brickman, AIA, LEED AP, an associate partner with ZGF Architects (www.zgf.com), Portland, says, "This campus sustainability standard is the culmination of years of work identifying the best metrics of institutional environmental commitment and performance."

Even in the case of institutions of higher learning that are not actively pursing sustainability planning, they are still being measured by advocacy groups and other industry research groups, says Amy Leitch, LEED AP, a sustainability consultant in the New York City office of Arup (www.arup.com). For example, the Sustainable Endowments Institute's annual "College Sustainability Report Card" and the Princeton Review's annual Green Rating Index publish indices of green performance.

GREEN RENOVATIONS THAT WORK

To get started, Leitch, whose recent clients include Harvard, Princeton, and Syracuse Universities, recommends choosing low-cost, rapid-payback projects, such as draft stripping, weatherizing, insulation, scheduling, lighting design changes, and building recommissioning.

Many seasoned AEC professionals emphasize that reuse

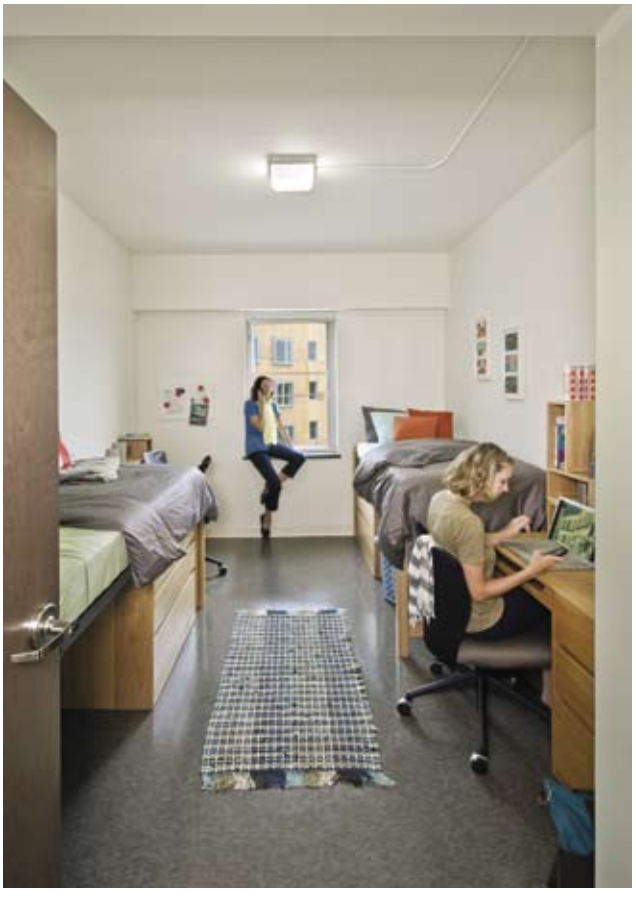

PHOTO: ANTON GRASSL/ESTO PHOTOGRAPHICS

The new North Campus Residence Hall at Roger Williams University in Bristol, R.I., designed by Perkins+Will, features reused beds and desks and high-end furnishings with a longer life expectancy for the common spaces.

and renovation can be the most sustainable approach to building design and construction. While demolition and replacement were once the norm, recent years have seen a shift to preservation and environment concerns, adds Wolfram. For Building Teams, this often means encouraging universities to work with their existing structures.

"Many campuses are finding that adaptive reuse and historic preservation are a great fit with their sustainability agenda," says Wolfram, who serves as a commissioner of the San Francisco Historic Preservation Commission. "The preservation and improvement of their existing building stock, the reuse of historic and older buildings, and the greening of existing facilities are the most economical and environmentally sustainable approach to addressing space and facility needs."

LPA's Flanagan, who has worked on dozens of higher education projects, says there are practical considerations, notably the scarcity of new construction dollars. "Many existing buildings have more character than some new building's budget can provide," he says. "By utilizing the existing building's bones, we can maintain the history of the past with all of the amenities of today's new technology."

Of course, a campus's historic buildings often shape a university's heritage and character, so such preservation efforts are generally well embraced. An Flanagan points to another benefit of renovation: "A byproduct of this is a campus environment with less construction traffic, reduced noise, and an overall reduced construction schedules, resulting in less need for interim space for staff, faculty, and students."

In practical terms, Wolfram advises that the first step should be to assess the existing building and evaluate whether the new program can be efficiently integrated into the existing building in a way that best utilizes the building's features.

"Many older buildings have operable windows, so can the program take advantage of that feature with natural ventilation and a nighttime purge system?" he asks. He notes, too, that many older buildings have thick, heavy exterior walls, so it should be determined whether the heating and cooling system can take advantage of the mass of these walls to store heat or keep a building cool.

Lastly, many older campus buildings have very high floor-to-floor heights that, when properly used, allow for greater stratification of air. Wolfram asks: How can the building's mechanical system efficiently utilize that feature for cost savings?

As for financing, Leitch says some campuses are appealing to students to help fund green building investment, renewable power purchases, and other sustainability initiatives with either mandatory or optional tuition fees. "Many are also pursuing creative funding options," she adds. One example: Harvard's Green Campus Initiative, which funds the university's energy-efficiency projects through the revolving Green Campus Loan Fund, using energy savings from one project to invest in others.

EMPLOYING LIFE CYCLE COST ANALYSIS

Another important factor in green design strategies is the key role that life cycle cost (LCC) analysis can play in the overall sustainability and efficient operation of campus buildings. "Because colleges and universities typically own and operate their buildings for long periods of time, life cycle assessments are critical to making prudent long-term economic decisions," says Wolfram.

LPA's Flanagan adds that "the key in any life cycle cost analysis is to build smart by selecting the most energy-efficient, long-lasting, and low-maintenance equipment, finishes, and systems that meet programmatic needs and are affordable within the given budget."

The so-called "embodied energy" of materials also is becoming more of a consideration in green projects, says SmithGroup's Mella. On a recent project for St. Mary's Col-

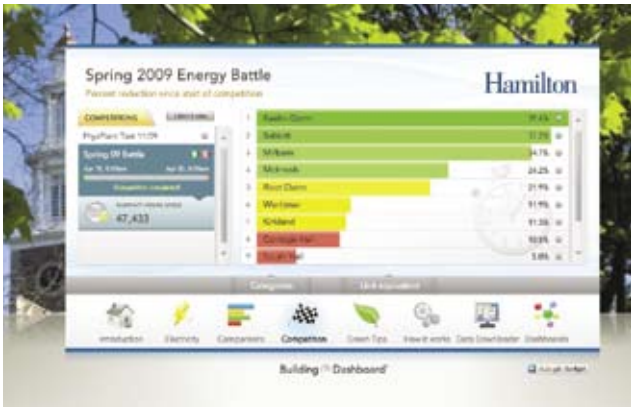

PHOTO: COURTESY LUCID DESIGN GROUP

This building dashboard, designed by Lucid Design Group for Hamilton College, Clinton, N.Y., is used as an educational tool to help the campus reduce resource use. Here, energy-use reductions for a recent dormitory competition are displayed, as well as the power production by the campus's 10 kW wind turbine.

lege of Maryland in Emmetsburg, Mella's team helped the college to see that renovating an existing facility would result in lower carbon emissions from the greater energy requirements embodied by new construction and materials. "In this example, a compromise was reached: building a new, state-of-the-art, energy-efficient building that uses a great deal of salvaged materials from the former hall, to reduce the new building's embodied energy," Mella recalls.

Citing the Miesian dictum that "less is more," LPA's Stephen Flanagan says he is a fan of what he calls "building less." By this, he does not mean building fewer buildings. "But

Editor's Note

Additional required reading online! To earn 1 AIA/CES continuing education unit, complete the required reading and take the CEU test posted at www.bdcnetwork.com/article/442807-January_2010_AIA_CE_exam_High_Performance_Workplaces.php.

UNIVERSITIES AND GREEN BUILDING EDUCATION MODULE

Pass this exam and earn 1 AIA/CES credit! You must go to www.bdcnetwork.com/article/442807-January_2010_AIA_CE_exam_High_Performance_Workplaces.php to take this exam!

1. The main concerns that colleges and universities usually first address when launching a sustainability program include:
   A. Right-sizing spaces so that space and energy are used efficiently.
   B. Ensuring occupant comfort, access to daylight, and good indoor air quality (IAQ).
   C. Using space to express institutional values that foster greener behavior and operations.
   D. All of the above.
2. LEED 2009 has been called a more viable rating system for campuses in part because points can be earned for things like installing systems for automatically turning off lights and encouraging building commissioning. These changes reflect LEED 2009's:
   A. Increased emphasis on life cycle analysis.
   B. Increased focus on energy conservation.
   C. Increased focus on credits for adaptive reuse projects.
   D. All of the above.
3. True or false: The American College & University Presidents' Climate Commitment requires schools that sign on to the ACUPCC initiative to reduce their total campus greenhouse gas emissions by 80% by the year 2050.
   A. True.
   B. False.
4. Which of the following statements is most accurate with respect to the Association for the Advancement of Sustainability in Higher Education's "Sustainability Tracking, Assessment & Rating System" (STARS):
   A. STARS recommends specific materials and products for use in the construction of academic buildings.
   B. STARS focuses primarily on lighting upgrades and water conservation.
   C. STARS addresses a broad range of issues, including administration, curriculum, and operations.
   D. None of the above.
5. Today's green renovation projects for universities often include low-cost, rapid-payback types of projects such as:
   A. Draft stripping, weatherizing, insulation, and lighting upgrades.
   B. Changes to building orientation, siting, and landscaping.
   C. Installation of renewable energy systems, such as photovoltaics and CHP.
   D. Adding double-glazed windows and new roof insulation.
6. True or false: Less than 5% of college students surveyed said they would be willing to pay an additional $20 per month just for the benefit of living in a sustainable residence.
   A. True.
   B. False.
7. For adaptive reuse projects, the inherent features of older buildings can contribute to a more sustainable campus and operational cost savings, such as:
   A. Operable windows for natural ventilation and nighttime purge systems.
   B. Thick masonry walls for improved thermal mass and reduction of HVAC loads.
   C. High floor-to-floor heights for improved indoor air stratification and occupant comfort.
   D. All of the above.
8. An example of "building less" to promote sustainability in campus buildings is the use of flat-slab, cast-in-place concrete rather than a structural steel system for a repetitive multistory building. According to Stephen Flanagan, AIA, LEED AP, this could result in a more sustainable choice by:
   A. Reducing floor-to-floor heights, thus saving on materials.
   B. Reducing the embodied energy of the construction materials.
   C. Reducing the window openings and glazed area, cutting heat loss.
   D. None of the above.
9. According to Greg Mella, AIA, LEED AP, when it comes to selecting flooring materials, colleges and universities often give priority to which of the following factors:
   A. Material content that is recycled or renewable.
   B. Effect on indoor air quality, such as VOC content.
   C. Durability and maintenance.
   D. None of the above.
10. College campuses are beginning to locate academic and student-life facilities within the same programs and buildings. This trend toward integrated learning and living environments, sometimes called "learning landscapes," is a reflection of which of the following factors:
   A. Learning is not isolated to classes and academic buildings.
   B. Learning is an inherently social process.
   C. Learning takes place in informal settings, such as student lounges.
   D. All of the above.

HIGHER EDUCATION FACILITIES

every time we construct a building we need to be smart about how a product or material is used," he says. "We must use it wisely, efficiently, and effectively. We use locally manufactured and recycled products, and we use materials that are long lived and require little or no maintenance."

For instance, Flanagan says that by choosing a flat slab, cast-in-place concrete structure in place of a structural steel system for a repetitive multistory building, the floor-to-floor height can be reduced by 3 feet, resulting in significant materials and construction costs, not to mention building maintenance.

While life cycle costing does offer many benefits, a few obstacles can hinder its application in some situations. For example, life cycle costing is based on estimates, and many variables and complexities need to be factored in when trying to compare different choices. Life cycle cost assessments

Today's Campuses: More Sustainable, More Secure

Although campus security may not immediately bring green design to mind, the effort to protect students, faculty, staff, and guests that frequent a college campus remains a vital and pertinent topic in higher education—and one that makes it sustainable in the broadest sense.

With the proliferation of new technologies—access control, CCTV, mass notification, or lock-down hardware—the integration of proper and effective security systems is becoming more viable for many colleges.

Access control systems. "We are really seeing a rise in access control in general," notes Jon Niemuth, AIA, NCARB, LEED AP, a principal with AECOM Ellerbe Becket, Kansas City. "The more widespread deployment of wireless technology represents a significant democratization of buildings and technology. Where once it was difficult to introduce technology to existing or historic structures, wireless makes this process seamless and almost invisible to the public."

It makes it more sustainable, too, requiring less hard construction work and making all campus structures equally viable for the long term.

Another access-control trend, notes David L. Damon, AIA, LEED AP, an associate principal with Perkins+Will, Boston, is the use of multiple card swipes for dormitory access. For example, at Roger Williams University's new North Campus Residence Hall, Bristol, R.I., students have to swipe their card four times: once to enter the building, once to access their floor, once to access their suite or apartment, and once to enter their bedrooms.

Some of the latest capabilities create efficiencies while improving student experience. Examples include programming smart cards to serve multiple functions beyond building access, such as meal plans, banking, library privileges, student data storage, and campus vending.

While access control is generally an effective technology, problems can result when students pass their cards to unauthorized visitors or engage in "piggybacking" or "tailgating," where multiple users access a service or building simultaneously. To combat these abuses, many schools with special access-control requirements are transitioning to a combination of biometrics and smart cards to increase monitoring and limit the ability for access to be transferred, says Niemuth.

Some additional suggestions delineated by the recent National Clearinghouse for Educational Facilities (NCEF) report Security School Technologies (http://www.edfacilities.org/pubs/security_technologies.pdf) include:

- Video monitoring or on-site security personnel that trigger alarms when piggy-backing occurs.
- Video recording of incidents to identify intruders.
- An access-control response, such as a lockdown of a second door preventing further entry, and an immediate response from security guards to confront intruders.

In addition, the NCEF report discusses ways to incorporate additional layers of security, such as personal identification numbers or biometrics.

The NCEF paper also recommends that, if feasible, the original system designer be on hand to issue new cards, cancel old ones, and operate and maintain the equipment. Also, electronic systems should have an emergency back-up power source. To save costs, the NCEF suggests that access control portals be strategically placed at key points such as exterior doors.

CCTV systems. Video monitoring and recording is an essential part of a campus security package, now offering much greater resolution, improved processing power, and intelligent video analytics.

Jon Ecker, president and CEO of Peace of Mind Technologies (www.pomtec.com), a New York City-based security technology company specializing in educational facilities, recommends a minimum recording capacity of 30 frames per second and 480 frames per second for live viewing, with a 16-camera system as a benchmark.

According to the NCEF report, a 1.3 megapixel high-definition camera tends to be today's typical recommendation, as cameras with higher capacities may overwhelm the recording and bandwidth capacities of today's typical equipment. Yet as with most fast-changing technologies, this is likely to improve in the next year or two.

As for smart cameras, the technology has come of age with impressive capabilities and a reasonable price tag. According to James R. Black, CPP, PSP, CSC, CET, senior security consultant, TRC Solutions (www.trcsolutions.com), an Irvine, Calif.-based engineering, consulting, and construction management firm, systems are now available for a few hundred dollars.

NCEF notes the ability of smart cameras to use algorithms to spot and track selected shapes or movements and thereby identify individuals entering through an exit, leaving behind a suspicious package, lingering in a suspicious location, hopping a fence, or tampering with a security camera. The technology also can count the number of people entering through a door, calculate attendance at large events, read license plates, and help analyze pedestrian traffic patterns.

Of course, the most advanced technological capabilities won't go very far if the cameras aren't positioned strategically. According to Ecker, key areas of placement include entrances and exits, drop-off and pickup areas, rooftops, parking lots, computer rooms, sports equipment rooms, and places where students congregate such as hallways, stairways, gyms, cafeterias, and libraries.

Mass notification systems. The most sophisticated mass notification systems were traditionally developed and implemented exclusively in the government sector, but thanks to a presidential order, the U.S. government has been sharing information with the private sector. The result has been a major proliferation of new technologies on the market that are smarter, faster, smaller, and less expensive than older systems, according to William Sako, chairman of the board, Sako & Associates (www.sakoinc.com), a subsidiary of The RJA Group, Chicago.

But even with such high-tech solutions in place, experts recommend a multi-level strategy that incorporates "low-tech" and "no-tech" notification plans into the overall program. For example, mass notifications systems should ideally include a variety of notification strategies, such as text messaging, radio, television, instant messaging, phone calls, audio paging, loudspeakers, voice-equipped fire alarms, PDAs, and two-way radios.

In developing such an emergency response plan, Sako recommends identifying potential threats, creating worst-case scenarios, evaluating existing systems, and identifying hardware and software upgrade issues.

Once this groundwork is laid, Sako advises campuses to create a phased implementation plan with budget estimates and detailed specifications for each system. Once bids are awarded and construction begins, the services of a qualified security consultant are essential to oversee testing and commissioning and obtain required code approvals. Included in this process should also be training for both operations staff and the larger campus population. This ultimately involves establishing a mass notification emergency responses plan and testing it.

For instance, with its new mass-notification system designed in response to the Virginia Tech tragedy, the University of Pennsylvania recently completed such a test for one aspect of its program, sending out more than 74,000 SMS text messages and more than 53,000 email notifications to all students, faculty, and staff in less than seven-and-half minutes.

For more on mass notification systems, see Sako's article, "The challenge of mass notification systems on American campuses," Consulting-Specifying Engineer (www.csemag.com/article/175692-The_challenge_of_mass_notification_systems_on_American_campuses.php?q=mass+notification) and Dave Barista, "Securing the Campus" (http://www.bdcnetwork.com/article/375720-Securing_the_Campus.php).

Doors and hardware. In a rapid departure from a more traditional approach to locking down buildings quickly by alerting individual departments to manually lock doors, colleges and universities are switching to centralized electronic systems. With such systems in place, it is now possible to lock down a building, groups of buildings, or even an entire campus with the click of a button, according to TRC Solutions' Black.

As for other door hardware upgrades, the NCEF's recent publication, "Door Locking Options in Schools" (http://www.edfacilities.org/pubs/door_locks.pdf), recommends that academic facilities add a key cylinder to the door's interior to enable locking without leaving the room. NCEF also suggests upgrading to ANSI F88 locksets, which enable faster lockdown, and switching from older panic exit hardware to hardware that cannot be chained shut. The guide recommends assessing the strength, durability, and composition of the door, hinges, and frames, as well as the latching and locking hardware, in your product evaluation.

Additional useful guidelines from the California Department of Education's School Safety and Violence Prevention Office (http://web.archive.org/web/20040331234412/http:/www.cde.ca.gov/challenge/tk_pdf/sf2.pdf):

- Eliminate locks and handles on exterior doors.
- Choose doors constructed of steel, aluminum alloy, or solid-core hardwood. If glass, the doors should be fully framed with burglar-resistant tempered glass.
- Double doors should be secured with heavy-duty, multiple-point, long-flush bolts.
- All exit doors with panic push-bars should also be equipped with deadbolt locks to prevent easy exit by criminals or vandals.
- Exterior doors should have as little exposed hardware as possible.

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are not detailed analyses, says Earl Wong, PE, PMP, LEED AP, discipline leader in mechanical engineering at L. Robert Kimball & Associates (www.kimballcorp.com), Pittsburgh. Consequently, he says, "they are not as useful as rigorous assessments because the life cycle analysis can be made to appear better than it is to obtain a magnitude of payback."

AECOM Ellerbe Becket's Niemuth concurs: "There are still significant hurdles in the area of life cycle assessment relative to data and measurement that we anticipate will provide significant challenges for its use as anything other than a high-level evaluation and decision-making tool." And because university construction budgets are almost always handled separately from operating budgets, it may be difficult for institutional owners to appreciate the long-term value gained by any increase in first cost.

Fortunately, some inroads are beginning to be made on this front, says ZGF's Brickman, who specializes in LEED and green building consulting: "Increasingly, campuses are recognizing this problem and either reconciling those budgets or creating a revolving fund for green building expenditures with a life cycle payback. Harvard was an early adopter of such a revolving fund, and many other institutions have followed."

SHARP FOCUS ON ENCLOSURES

Building Teams are sifting through dozens approaches to greening campuses and green building systems design on behalf of their clients. A few kinds of improvements stand out, however.

SmithGroup's Mella, for example, observes that the so-called "low-hanging fruit" for making existing buildings more sustainable begins with basic envelope improvements, such as replacing windows with high-performance glazing or increasing wall and roof insulation. Whether it's simply sealing the enclosure, using cool-roof materials to lower thermal gain, or replacing windows with insulated glass units and thermally broken frames, Mella and others recommend these "simple strategies with quick paybacks and significant energy benefits."

"Insulating the walls and roofs of historic buildings can greatly improve their energy performance with minimal effect on their appearance," agrees Wolfram. "Many campuses are doing these types of upgrades—even on minor renovation projects."

LPA's Flanagan also sees this is a big trend and has observed many universities removing traditional, single-pane, quarter-inch float glass, with virtually no insulation or UV qualities, and installing one-inch insulated glass units with low-e coatings, offering immediate and significant improvements in energy efficiency, glare control, heat reduction, and UV protection. "In addition, built-up roofing systems, which typically retain heat, can be replaced with light-colored, single-ply roofing systems that reflect the sun's heat, thus reducing a building's energy consumption from cooling loads," he says.

Wolfram points out, however, that enclosure upgrades may not be as straightforward as they might seem. For example, replacing single-panel glass with double glazing can be expensive. "It will also alter the appearance of the building, as double-glazed glass has a slight pillow appearance, and the maximum size of double-glazed may not be large enough to match existing conditions," he says. "Another option is to install interior storm panels, which will improve performance, but can create maintenance problems."

Some additional strategies to improve building envelope performance include adjusting the building orientation of new structures or additions. Whether for new or existing buildings, Leitch adds that the architecture can include solar overhangs, vertical and horizontal shading, light shelves, and solar-tracking skylights.

Flanagan notes that the building enclosure design is also responding more directly to climate issues in certain geographies. "In California, we have always had the luxury of beautiful year-round weather," he says. "As a result, most of our buildings built in the last century were designed with little consideration for energy efficiency," he says. "Today, things are different and energy costs are considerable, so every exterior surface should be viewed as an opportunity to save energy with new materials and products."

INTERIOR UPGRADES: FLOORING

Although sustainability is also a value when it comes to flooring selections in higher education facilities, durability is often the leading priority in these assessments, overriding other green building factors. "Products need to have a long life and the ability to withstand student use and abuse, along with the need to be easily maintained in an economy where campus maintenance budgets are being cut," says Mella. "These concerns often trump more typical sustainable considerations like a material's recycled or rapidly renewable content."

Consequently, some trendy green interior finishes have been criticized for not offering the longevity required for highly trafficked campus buildings. "The popularity is there," acknowledges David L. Damon, AIA, LEED AP, an associate principal in Perkins+Will's Boston office, "but not everyone is seeing it through. We start many projects with aspirations and interest in cork and bamboo, but often the products don't make it into the installation due to either concern of maintenance or cost."

Even so, Perkins+Will has undertaken its first cork flooring project for Clarkson University's new 57,000-square-foot Student Center in Potsdam, N.Y. "We proposed cork flooring in the student activities and organization spaces, selling the idea as a product that the students can embrace and celebrate as a sustainable endorsement," says Damon.

Winston Bao, LEED AP, an interior designer in LPA's Irvine, Calif., location, applauds manufacturers for investing in such materials to establish more efficient, cost-effective, and sustainable processes, ultimately producing more product options at reasonable prices.

Regardless of how well these options are accepted, universities tend toward a short list of flooring materials that deliver good performance over time. Common examples of resilient flooring choices also offering sustainable value are linoleum and bio-composite tiles. "The items we are looking at are the materials that are more bullet-proof, but yet incorporate a higher level of recycled content or advanced manufacturing technology," says AECOM Ellerbe Becket's Niemuth.

Beyond durability, variables to evaluate when specifying flooring include budget, aesthetics, the intended occupancy and use of the space, and environmental impact, says Paul W. Erickson, AIA, NCARB, REFP, president of ATS&R Planners/Architects/Engineers (www.atsr.com), Minneapolis. Ask: What kinds of traffic patterns and loads are expected? What kinds of tasks will be performed in the space? Are there any special requirements for acoustics, slip resistance, or hygiene?

In terms of aesthetics and maintenance, there are endless colors, patterns, and textures to choose from, but it's important to make sure that the product offers good resistance to scratching, staining, and fading. Overall, it is also recommended that Building Teams select flooring materials with low or no volatile organic compounds (VOCs). These materials should, if possible, also repel dust, mitigate mold and mildew growth, and augment daylighting through reflectivity and light colors.

UPGRADING MECHANICAL AND ELECTICAL SYSTEMS

With regard to mechanical and electrical systems, ZGF's Brickman sees the campus central plant as another big area where higher education institutions can make immediate improvements. "One of the very first steps institutions have been taking is improving their ability to monitor resource consumption," she says. "Interest in metering, measurement, and verification are at an all-time high."

Many campuses are looking at upgrading their central plants as a significant way to cash in on better efficiencies and savings. Arup's Leitch also points out that cost savings from energy and water efficiency investments can be reinvested into additional upgrades, as has been the case with Harvard's Green Campus Loan Fund.

One interesting sustainable decision was recently made by Ohlone College, Newark, Calif., to include two enthalpy energy-recovery wheels in their new Newark Center for Health Sciences + Technology building, designed by Perkins+Will. With its ability to transfer sensible and latent heat, the enthalpy wheels rotate between the exhaust air and intake air streams, capturing up to 95% of the passing energy, which is usually lost. Highlighting this unique technology as an educational feature, Ohlone actually installed a viewing window and electronic display in the building's main lobby to better promote this sustainability element.

Renewable energy. Yet another active arena for higher-education green building has been the implementation of renewable power projects. "Many feel it is not enough to simply purchase green power or carbon offsets, and want campus

When Art and Architecture Meet, Sustainability Can Be Enhanced

Colleges and universities are looking to enhance what Barry Svigals, FAIA, principal of Svigals + Partners, New Haven, Conn., alls the "humanistic aspects of sustainability." This can include adding original sculptures and other artworks to the campuses to reinforce institutional values, as his firm has recently done at Boston College (Chestnut Hill, Mass.), Norwalk (Conn.) Community College, the University of Connecticut (Storrs), and Albertus Magnus College, New Haven.

Such projects herald the return of an age-old campus tradition. "Figurative sculpture can bring to life the purpose and meaning of a building," says Svigals. "Today, perhaps more than ever, we need this reminder of our humanity."

Integrating artworks into campus architecture is another way to express the university's environmental mission. "Attention to the timeless needs of humanity—the telling of our stories on buildings—is at the heart of a successful design," says Svigals. "In this way, the function and spirit of a building are inseparable."

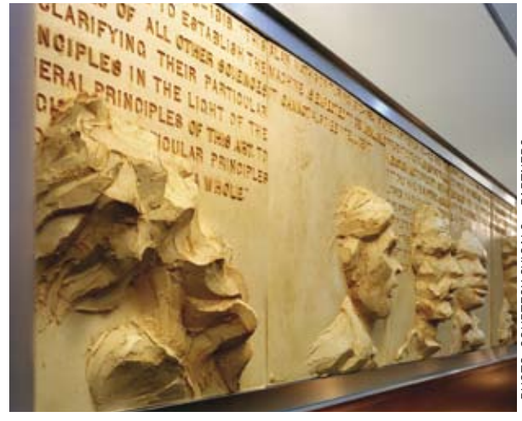

PHOTO: COURTESY SVIGALS + PARTNERS

At Norwalk Community College, figurative sculpture is a way to express the values of the institution, including its interest in sustainability and focus on students. The sculpture is integrated into the trusswork.

renewable projects to be a more visible expression of their commitment to future energy," says SmithGroup's Mella. Whether it's photovoltaics, combined-heat-and-power (CHP) cogeneration systems, or geothermal technology, alternative energy projects are becoming more and more common.

"Many institutions have executed or are planning central systems to take advantage of the efficiencies of district energy as well as regionally available resources such as biomass, food waste, solid waste, and waste thermal energy," notes ZGF's Brickman. "CHP systems are not a new technology, but the degree to which they are recognized broadly as a climate protection strategy and learning opportunity, as well as a means for utilizing renewable resources, has certainly risen."

"Students are also demanding renewable energy," says Mella, pointing to the recent student funding of a green power-purchase agreement and geothermal well installation for St. Mary's College of Maryland.

Lighting improvements. Lighting upgrades are also popular, as significant savings can accrue by reducing lighting energy. "Lighting upgrades, such as replacing incandescent lights with compact fluorescents or adding occupancy sensors to rooms to turn off lighting, have very high return on investment," says Mella. "These approaches typically pay for themselves within a few years, so schools are increasingly taking this on both to save energy and to save money." AECOM Ellerbe Becket's Niemuth sees lighting controls as increasingly a standard specification, whereas just a few years ago they were a novelty.

As for the next big trend, LPA's Flanagan predicts that light-emitting diode (LED) luminaires and systems will eventually take off. "This low-maintenance, low-heat-load, energy-efficient light source is very durable and seems ideally suited to the higher education market where maintenance and operations budgets appear [to be] almost nonexistent," he says. As LEDs keep finding their way into new and different types of fixtures, Flanagan goes so far as to predict that "it's only a matter of time before LEDs are the standard on campuses around the world."

Building automation systems. A new technology that is just beginning to catch on is "building dashboards," which publicly monitor and display resource use to increase awareness and encourage conservation.

"These are interactive systems that compare building performance and allow for energy-conservation competitions between residence halls or academic departments," says Brickman. "They also provide live feedback on energy use as an educational tool and have become increasingly popular."

Hamilton College, Clinton, N.Y., integrated a new building dashboard system with the campus building automation system (BAS), making real-time resource use data available in a user-friendly, educational platform display (http://buildingdashboard.com/clients/hamilton/). With easy access and tracking of such information, the school hosted a dormitory energy-use competition. The winning facility in the two-week contest successfully decreased its energy use by 40%. John Petersen, associate professor of environmental studies and biology and environmental studies program director at Ohio's Oberlin College, reports up to 56% reductions in electricity use as a result of building dashboard student competitions.

University facilities personnel have discovered that dashboards can also be used for visual diagnostics to track regular usage patterns. "It has been a useful tool because we know that if there is a spike, something is not working on the mechanical side," reports Steve Bellona, Hamilton College's director of facilities. Other institutions using the technologies include the University of Missouri, Elon University, Harvard, the University of North Carolina at Chapel Hill, St. Mary's of California, and the University of Vermont, many of whom claim they are already reaping savings from their building dashboards.

Currently, ZGF Architects is designing a new residence hall at the University of Oregon to incorporate such a system, and Brickman predicts that these systems are poised to take off. "Given the didactic opportunities inherent in tracking and trending performance, we expect to see a continued upswing of interest in implementing these systems as part of campus climate initiatives," she says. "I also expect that we'll see increased sophistication in these systems resulting from increased market demand. In particular, there will be improvements in mobile applications for access to the BAS systems and campus dashboards eliminating the need for hardwired occupant interaction interfaces in each residence room."

TODAY'S PROJECT, TOMORROW'S GREEN CAMPUS

There are many more building systems and components that can be addressed from a green design and planning perspective, according to Building Teams active in the university market.

Niemuth sees the ultimate green strategy as designing buildings with as much flexibility and adaptability as possible. "If we can provide the best and longest possible life span for a structure, we are providing the most 'green' solution," he says. "A building that can be renovated and adapted takes less energy to maintain and sustain than one which needs to be built from scratch."

Regardless of the strategy, many campuses are actively involved in countless aspects of sustainable planning, building, and construction. "During the last couple of years, we have seen a paradigm shift in the mindset of administrators, presidents, chancellors, and higher education leaders to be green," notes Flanagan. "They are starting to see the importance, as educators, to be leaders in providing sustainable solutions and educating their respective communities. After all, they are educating tomorrow's leaders." **BD+C**