Photo: Norman McGrath

Photo: Robert Mintzes

Sustainable BUILDINGS for Learning

By Peter Gisolfi, AIA, ASLA

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The green building movement is an outgrowth of the worldwide concern for sustainability, especially in the United States, where fully a third of the energy we use is consumed by buildings. Green educational facilities are among the most important expressions of that concern, because it is largely in schools, colleges, and universities that young people are exposed to the ideas that shape their decisions as adults. Green academic buildings are an immensely valuable part of students' environmental education.

Education is going green—and when new construction is not an option, retrofitting strategies help meet challenges.

It is vital, then, that we construct green buildings that are understandable to those who learn and teach in them. With the educational facility as a learning tool, students can observe first-hand the results of strategies that enhance the building's sustainability. They might monitor the amount of electrical energy generated by solar collectors, evaluate the performance of geothermal heating or cooling, or engage in any number of other environmental projects focused on the properties of the building and its site.

Though a language of jargon has evolved that often makes sustainability appear complicated, the reality is that none of the many things we can do to create sustainable buildings is terribly difficult to accomplish. But note that academic institutions planning new green buildings deal with more obvious and straightforward decisions than those that plan to retrofit existing buildings to make them greener. New buildings provide designers with a blank slate to meet the sustainability criteria defined by LEED (Leadership in Energy and Environmental Design), the nationally accepted benchmark for the design, construction, and operation of high performance green buildings. With existing buildings, designers must work with what they have, so options are limited.

LEED criteria for retrofitting existing buildings relate to similar LEED criteria for new buildings. To understand the possibilities for existing buildings, we should first consider the basic LEED principles for new construction.

LEED criteria for new buildings

Here are the basic criteria for new LEED-certified buildings:

1. Develop the site to resemble the natural environment more closely. Pay particular attention to retaining storm water on site, and avoiding heat islands, which can adversely affect the climate of the building and the neighborhood.
2. Use water as a precious resource. Install water-efficient fixtures, reuse at least some water for irrigation, and retain water on site, possibly reusing that water or redirecting it back to the natural aquifer.
3. Create buildings that are energy efficient and do not pollute the atmosphere.
4. Use construction materials that are renewable and obtainable nearby, preferably made of recycled materials.
5. Ensure the quality of the indoor environment by using nontoxic materials and by providing simple, ample ventilation.
6. Be innovative. Find new ways to save energy, preserve the site and, if possible, generate energy within the building and on the site.

There are two overlapping approaches to the design of new, sustainable school buildings. The first, which is critical, is to understand the site and its environment in order to shape a building that responds to nature and local climate. This is not always a simple matter, especially on smaller sites. But in the ideal situation, certain spaces might intentionally be located in sunny areas, and other spaces in the shade. For example, a school might be designed so that south-facing corridors are open to the sunshine, and north-facing classrooms receive reflected light from the sky—an arrangement that also will promote cross ventilation. The second approach is to follow the LEED criteria carefully to achieve healthy buildings with significant energy savings. Combining the two will provide even better results, and if the building also generates significant amounts of energy on site, it can be considered sustainable in the broadest sense, a huge sustainability success.

LEED criteria for existing buildings

Just last year, LEED certification for existing buildings became available. The same criteria for new buildings also apply here, but have different applications and emphasis:

1. To approximate the natural environment more closely, change existing sites to reduce water runoff, retain water on site, and eliminate heat islands by shading parking lots and replacing some pavement with plantings.
2. Improve water efficiency on the site and in the building simply by changing to plumbing fixtures that conserve more water.
3. Reduce energy consumption in existing school buildings, a goal that has been addressed systematically by many schools throughout the last 15 to 20 years. Some ideas for reducing energy use:
   - Replace antiquated boiler plants with more efficient systems.
   - Install new, more efficient HVAC (Heating, Ventilation, Air Conditioning) controls and building management systems.
   - Remove old roofing and replace it with new materials that increase insulation dramatically.
   - Replace single-glazed, leaking windows with double- or triple-glazed windows that resist infiltration and increase the R-value (the resistance to heat transfer) of the windows.
   - Replace light fixtures with new, energy-efficient fixtures that are equipped with occupancy sensors, which turn off lights automatically when rooms are vacant, and possibly with automatic dimming devices that compensate for daylight.
4. Remove hazardous materials, such as asbestos and lead, and use green, locally available materials in renovations.
5. Replace or update poorly functioning ventilation systems. Indoor environmental quality is mostly a ventilation issue.
6. Consider these other innovative ideas:
   - Develop green roofs. Most green roofs consist of vegetation placed on top of flat roofs. The natural grasses absorb water, insulate the roof, and protect the roof membrane.
   - Alternatively, create sloping roofs and attics over existing

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Above, a photo of the Student Center at Manhattanville College in Purchase, NY, illustrates the building's open design, which allows for abundant daylighting and features informal gathering spaces for students. Facing page, Cornell University's White Hall in Ithaca, NY, was built in 1867 and reconstructed in 2002. Reconstruction strategies have helped dramatically reduce energy consumption as well as improve air quality throughout the building.

flat roofs so that air can move over the inhabited spaces.
- Generate air movement in existing attics to enhance cooling and make air conditioning unnecessary.
- Install solar collectors on flat roofs.
- Install geothermal heating and cooling systems in existing buildings.
- Plant vegetation near buildings to absorb water runoff, and shade window openings with deciduous trees to reduce interior heat buildup in warm months.
- Use new types of glazing that collect solar energy and reduce unwanted heat transfer through the glass.

Old building, new sustainability

White Hall is a significant case study that shows how an older structure can be reinvented as a green building. It is the second oldest building on the Cornell University campus in Ithaca, NY. It is a stone structure built in 1867 and reconstructed in 2002, before there was LEED certification for renovating existing buildings. It was originally constructed to accommodate student dormitory rooms and classrooms, and was reconstructed to house offices and classrooms for two academic departments. The transformation addresses a number of sustainability issues:

- The new interior space is constructed of natural building materials obtained from local sources.
- The high ceilings are preserved, maximizing natural lighting.
- A direct outside air system uses and meters outdoor inflow, linking it to occupancy sensors.
- The new mechanical system uses lake water for cooling.
- A new underground mechanical room was constructed for energy efficiency and to make more usable space inside the building.
- Energy consumption is dramatically reduced.
- A 19th-century building has been saved and recreated as a new building for the 21st century.

Comprehensive sustainability strategy

The new Student Center at Manhattanville College in Purchase, NY, just opened this year. The building accommodates many student activities, including the radio station and TV studio, a fitness center, an experimental theater, music and dance rehearsal spaces, computer technology classrooms, independent student workspaces, an art gallery, and student lounge spaces. The building, which is occupied nearly all day every day, is the gateway to the campus—the demonstration of a new attitude toward collaborative learning and green architecture. From the very beginning, the building was designed to be sustainable:

- It is sited to shape a new south-facing quadrangle, which will be an outdoor center for student life.
- It is constructed of locally obtained, natural materials.
- It uses minimum amounts of water.
- The cooling system uses an evaporative chiller that consumes 25 to 40 percent less energy than air-cooled chillers.
- Solar collectors on the roof generate 12 to 15 percent of the electrical energy for the building.
- The high thermal mass building changes temperature slowly, conserving energy.
- All interior spaces are daylit, and electric lighting is controlled by occupancy sensors.
- The building consumes 55 percent of the energy of a code-compliant building of similar size.
- The building has received Gold LEED certification.

Challenges ahead

The challenge of sustainability in the United States is demanding, but the rewards for designing intelligently are immediate and valuable. The inventiveness required for successful solutions does not come from architects and engineers alone; it also comes from owners and users who operate the buildings. For many years, we have designed classrooms where lights can be turned on at two or three different levels, but the energy conservation comes only from user participation. Someone must set appropriate levels.

The lessons to be learned by students from a green school building can involve both active and passive sustainability. Students and their teachers are fascinated by such mechanical devices as geothermal wells and solar collectors, active tools for energy conservation. On the passive side, they can also understand north light in a classroom and sunshine that warms the corridors on a bright winter day. As designers and decision-makers, we can provide both. We can create buildings that work passively with nature, and also function at a sophisticated technical level to save energy and improve the environment.

E. O. Wilson, the Harvard professor who is known as the father of biodiversity, states that the ecological footprint of the average American is 30 to 40 times that of the average person in the developing world. Another startling statistic: The average American consumes twice as much energy as the average western European, even though the European's standard of living is at least equal to ours.

Clearly, we have a long way to go to transform ourselves into a sustainable society. Designing green educational facilities that are understandable to their occupants is an important step along the way. ■

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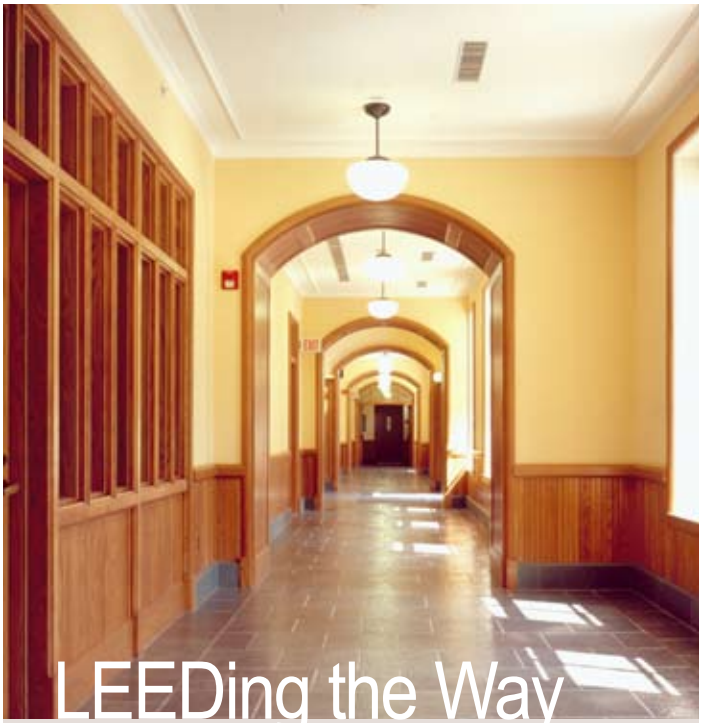

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LEEDing the Way to Green Buildings

The U.S. Green Building Council is a nonprofit organization working to move the building industry toward sustainability—that is, designing and constructing buildings that are environmentally responsible.

LEED provides a set of standards for environmentally sustainable construction. LEED certification provides independent, third-party verification that a building project, whether new or renovated, is sensitive to the environment. Points are awarded for each other building's sustainability elements, and a building can earn certification on any of four levels—Certified, Silver, Gold, or Platinum—depending on the number of points accrued.

The LEED for Schools Rating System recognizes the unique nature of the design and construction of educational facilities. It addresses such issues as classroom acoustics, master planning, mold prevention, environmental site assessment, and other matters related to school design and operation. By recognizing the distinctiveness of school spaces, and concerns about children's well-being, LEED guides architects and planners to design academic buildings that are healthy for students, appropriate for teachers, and cost-effective.