

Maximizing Efficiency

When education institutions are spending about one-third of their maintenance and operations budget on gas and electricity, it's no wonder that administrators and facilities managers are seeking solutions to maximize energy efficiency. Moreover, their efforts are part of a broader sustainable-design movement that is being embraced by institutions, architects and engineers, and supported by state and local initiatives. For example, California school bond measures provide additional funds for school construction projects that exceed California's Title 24 energy-efficiency standards through sustainable design.

Under control

site orientation often are difficult for schools to control. However, three fundamental design strategies are feasible for virtually any new school construction project: an integrated lighting system that maximizes natural light; reduction of the building envelope through consolidation; and consolidation of the mechanical system as a ground-level central plant.

The strategies:

- **Integrated lighting**

Integration of natural and artificial lighting creates a high-quality education environment while saving energy. To be effective, it must be an automated system that enhances the teaching environment and is easy to use. An effective system incorporates louvered skylights and windows with light sensors that automatically control the amount of light entering the classroom and raise the level of supplemental artificial lighting as necessary to achieve the optimal illumination level. A good system also incorporates a user-friendly electronic control panel near the marker board or teacher's workstation that allows a teacher to override the automatic controls, adjusting lighting by choosing from preset teaching modes — for example, lecture using the marker board or chalkboard, desk-to-desk interaction or projection.

- **Reduction of the building envelope**

The building envelope is a major source of heat gain and loss, depending on the season, and contributes to fuel and electricity consumption. Consolidating separate buildings into one or massing individual buildings appropriately to reduce the area of the building envelope enhances energy efficiency. At the same time, this strategy reduces the building footprint and increases outdoor play and gathering spaces. By reducing impermeable surface area, a school can better control storm water runoff and the associated cost of storm water management. It also is key to the third fundamental strategy: integrated building systems.

- **Integrated building systems**

Appropriate campus consolidation and building massing creates the ideal condition for use of an integrated mechanical system. This strategy uses an energy-efficient, ground-level central plant piped to school campus buildings' air-handling units rather than the less efficient rooftop package units that typically are found on standalone buildings. At the same time, this strategy removes the structural load of rooftop

equipment, curtailing construction costs, for example, by reducing the quantity of structural steel.

Adding a pretreatment component to the central plant enhances energy efficiency further. Pretreatment component elements use a heat-exchange system to pre-warm winter air using the heat from exhaust air, warming fresh air by 5 to 6 degrees before it is heated by the heating system. In the cooling season, an evaporative cooling element pretreats fresh air by 5 to 6 degrees before it is cooled by the chiller. Pretreatment enables reduction in the overall size of the central plant and reduces operating costs. Ideally, this strategy should be developed through a team approach by the architect; mechanical, electrical and structural engineers; contractor; and school maintenance team.

Sparing natural resources

These strategies are part of a broader strategy to reduce consumption of natural resources and materials — an approach that is inherent in sustainable design. If a project team aims to reduce consumption, then energy conservation follows as a product of that approach to planning and design. In contrast, a narrow focus on reducing energy use often fails to produce the desired results.

The process of sustainable design requires the project team to question design assumptions and habits. It also benefits from value engineering from the earliest schematic design stage, which enables the team to optimize life-cycle savings. To be sure, solutions must be tailored to the individual institution's goals, programs and capabilities of its maintenance and operations staff. This is why it is important to integrate the design process with administrators, educators and facility managers. In the end, educationally effective, operationally efficient schools result from a sustainable-design strategy that focuses on the educational program, quality systems and products, and quality construction.

Parks, AIA, is principal at Stafford King Wiese Architects, Sacramento. Architect Kip Grubb is a principal at the firm. The firm worked on the projects in the sidebar, p. 34.

Three schools that maximize energy efficiency

Three new schools in California employed one or several strategies to reduce consumption of natural resources and maximize energy efficiency. As a result, they exceeded the state's Title 24 requirements for energy efficiency, earning additional funding and/or pursued certification under the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program.

Some of their methods:

- Ronald E. McNair High School, a new 260,000-square-foot high school for 2,200 students in Stockton, Calif., and part of the Lodi Unified School District, exceeded individual Title 24 requirements by as much as 26 percent, earning the largest award ever granted by the State of California, Office of Public School Construction (OPSC), and a substantial award from Pacific Gas & Electric through its "Savings by Design" program — about \$1 million total. Initially, the school district's vision was a campus with multiple buildings. To reduce capital cost while enhancing energy efficiency, the architects consolidated nine buildings into a single 190,000-square-foot academic complex; there are four additional standalone buildings. Daylighting, controlled by

10- to 15-foot window overhangs, louvered skylights and automated lighting controls, was used in all large spaces, including the gym, multipurpose center, atrium, administrative areas and library.

- Dry Creek Unified School District is pursuing LEED Gold certification for Morgan Creek Elementary School, a new 65,000-square-foot school for 750 students in Roseville, Calif., because it wants to make a public statement about the importance of sustainable design. Among the strategies employed: the building is oriented on the site to maximize solar exposure and minimize wind effects. Roughly three-fourths of the building area of the campus is under one roof, which allowed use of a ground-level central plant with a pretreatment component and reduced construction costs. The design also cut the Title 24 requirement for a maximum lighting load of 1.5 watts per square foot almost in half using an integrated lighting system that maximizes natural light. The campus also features a dry creek that filters storm water runoff from the roof and runs to a lake on an adjacent golf course.
- George W. Bush Elementary School, a new 65,000-square-foot elementary school for 900 students in Stockton, Calif., is the first recipient of California's OPSC grant. The campus is the third site adaptation of a prototype that was developed 10 years ago based on effective sustainable-design principles. The campus is designed as a group of relatively large classroom buildings around common resource rooms, and has site-built and modular buildings — both designed to the same performance criteria. Louvered skylights were introduced into this project for the first time, providing almost 100 percent of the lighting required in the multipurpose gymnasium. The campus surpasses minimum Title 24 performance requirements by 20 percent.

NOTABLE

33%

Amount of the school M&O budget spent on energy/utilities, based on median dollars per FTE student.

33%

Amount of the college M&O budget spent on energy/utilities, based on median dollars per FTE student.

Source: American School & University's 34th Annual M&O Cost Study, April 2005.