

Back to School with New Systems, Ideas

Tackling IAQ, energy efficiency and maintenance issues, veteran engineers share some valuable tips for dealing with common K-12 design challenges.

By Barbara Horwitz-Bennett, Contributing Editor -- Consulting-Specifying Engineer, 9/1/2007 1:00:00 AM

As the kids gather their backpacks, notebooks and pencils for the new school year, MEP engineers are working tirelessly through issues of IAQ, energy efficiency and maintenance in their ongoing quests to design high quality, energy-efficient and cost-effective learning environments.

And considering the fact that K-12 enrollment is expected to grow by 3 million—or 5.4%—between 2005 and 2014, according to the National Center for Education Statistics, Washington, D.C., there will be plenty of opportunities to offer innovative design solutions for what is considered to be the largest nonresidential U.S. building market, based upon construction value.

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Being that the nature of classroom spaces is such that they must accommodate a high density of occupants—a typical classroom is between 900 sq. ft. and 1,500 sq. ft. with 22 to 35 kids—most classrooms require 900 cfm to 1,700 cfm of cooling airflow with 30% to 50% outside air requirements.

“This high percentage of outside air has a high level of moisture content that must be dehumidified continuously or humidity levels will rise to unacceptable levels,” explains Brian Cumming, P.E., principal at BCA Consulting & Design Engineers, Maitland, Fla. “Prolonged exposure to humidity levels above 60% in a building can lead to mold and mildew growth, resulting in IAQ issues.”

Terrance R. Liette, P.E., LEED AP, principal and executive director of engineering at Fanning Howey Engineering Group, Toledo, Ohio, concurs that IAQ ranks very high on schools' lists of concerns. “Most school districts have had experiences with poor indoor air quality and, therefore, have high expectations for our approach to HVAC system design that will enhance the IAQ of a new or renovated facility.”

While most A/C systems do a decent job of meeting heating and cooling requirements at full load, humidity buildup often can be an issue when the systems are only operating at part load because they usually respond only to temperature.

Consequently, Cumming, who has specialized in the K-12 market for the past 20 years, stresses, “The design engineer must carefully choose what type of system will dehumidify under all design conditions while minimizing energy consumption.”

One approach Cumming recommends, especially in cases where energy consumption is more important than first cost, are the new static air-to-air heat exchangers that transfer both heat and moisture from the exhaust air to the outside air.

“These heat exchangers media use new material technology, require little to no maintenance and can cost \$6 to \$10 per cfm,” Cumming says. “First cost can be offset by reducing the capacity of the AC and heating equipment, and electrical gear serving that equipment—all of which reduce the equipment's first cost.”

Another HVAC strategy that Cumming finds useful for K-12 projects is the use of small packaged air



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Another HVAC strategy that Cummins finds useful for K-12 projects is the use of small packaged air-cooled chillers.

“For renovations and additions to older schools, we like these small units using multiple scroll compressors with integrated pumps,” he explains. “These have a small footprint and good part-load efficiency with multiple, low cost and readily available compressors.”

But when it comes to specifically dealing with IAQ and ventilation requirements, Martin Schmidt, P.E., LEED AP, mechanical engineer, The Schemmer Assocs., Omaha, Neb., recommends vertical, packaged ventilators designed to serve individual classrooms.

“The ventilators allow designers to retrofit school classrooms to meet the current ventilation requirements and simplifies the installation by eliminating distribution ductwork from a central ventilation system,” he explains. “Its vertical configuration takes up a very small footprint in the classroom and allows it to be worked in with the cabinetry and shelving along the wall.”

Through Liette's holds extensive experience in the K-12 market with more than 400 projects nationwide under his belt, he has had much success with displacement ventilation systems. “Overall, this approach can result in reduced energy use and certainly has a positive impact on the indoor air quality of the classroom spaces,” he says. “There are several manufacturers that have taken very positive steps in the development of the displacement diffuser and the engineering calculations necessary to design an effective system.” Liette also considers geothermal systems as a potential design solution for schools, once a number of variables are evaluated.

Although these systems have higher first cost and maintenance requirements, Liette emphasizes operational cost savings. Furthermore, he points out, “there are a number of high-efficiency heat pump manufacturers, so competition in the bidding environment is quite good, thus closing the gap a bit on bid day costing.”

Along with energy conservation comes water conservation, more fully completing the sustainable picture, which more and more schools are striving to achieve. Consequently, K-12 designers are looking more seriously at products like waterless urinals.

At the same time, it's important to point out that even though retrofitting conventional urinals with no-water urinals leads to significant water conservation, “there is an operational cost associated with the replacement filter systems that treat the fluid, according to John Dale, AIA, principal and pre K-12 studio leader, Harley Ellis Devereaux, Los Angeles. “Districts are sometimes averse to taking on operational costs above and beyond what is required of a conventional system, so products like the no-water urinal need to be refined to answer these concerns.”

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Bright ideas

In the realm of lighting for K-12 institutions—energy efficiency and long life, to minimize maintenance—are key, although fluorescent products, known for these qualities, can be somewhat limiting from a design perspective. That's why Darko Banfic, LC, associate, Peter Basso Assocs., Troy, Mich., prefers MR16 halogen lamps. Although MR16s typically don't offer long life, that is beginning to change with products like an 18,000 hour-life MR16 lamp now coming to market. And with recent advances in metal-halide technology, which offers long life as well as efficacy, newer metal-halide PAR lamps and MR16-style lamps are available.

"These products should be a good reason to eliminate the 'bland' right out of the buildings that are meant to be inspirational to the occupants," claims Banfic, who's been working as a designer for the past 22 years with a special emphasis on the education market.

Another issue that Banfic raises is the fact that while occupancy and sensors and relay controls have become easy design solutions for accommodating energy codes, they often are implemented improperly and not understood by the maintenance staff. Fortunately, lighting manufacturers have been addressing this issue by consolidating and simplifying their control systems.

Another product harnesses sunlight from the rooftop and utilizes a reflective tube and lens to redirect the natural light. According to Tonya M. Johnson-Nicholie, associate architect and LEED coordinator with Schrock DeVetter Architects, P.A., Minneapolis, this product "puts a lens on the roof that captures light and bounces it down a reflective tube to a lens in the ceiling tile grid. [In a recent project], we brought natural light down into the core hallway and into the core side of the classrooms."

Also on the electrical side, more attention must be given to growing data centers, which have newly become new required infrastructure for schools. All too often, a school's power infrastructure does not grow at the same pace as the data center, as was recently the case with the Aberdeen School District in Aberdeen, Miss.

"Our primary problem was with our multiple battery backup units and not enough electrical infrastructure to support them and the data center," explains District Director of Technology Kevin Knuckles. "In addition, we had no idea what our battery uptimes were, and we had power cables running across the floor."

What worked for Aberdeen was a redundant, scalable and modular power protection system.

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energy costs. Our cooling system runs more efficiently as well, due to the system dissipating less heat,” Knuckles attests.

In control

In the never-ending search for energy efficiency and reduced maintenance, building controls can play a key role in a school's facilities plan. However, more often than not, attests Bill Cramer, AIA, Schemmer Associates, Omaha, Neb., control systems “can be very complex, sophisticated and dependent on computerized controls. Unfortunately, many times the system doesn't operate as intended initially and needs to go through a 'shake-down cruise.’”

Although Cramer doesn't have any magical products that are completely free of such issues, he does suggest contracting a commissioning provider, which is not a new trend, but something that is increasingly seen as important these days.

“Their specialty is the real 'inner workings' and coordination of the hardware—fans, air handling units, motors, dampers, cooling equipment, piping, etc.—and the controls. The commissioning provider has both design skills—to understand the design intent—and construction expertise needed to trouble-shoot these systems,” Cramer says. His recent K-12 endeavors included overseeing more than \$50 million in work for Millard Public Schools in Omaha, encompassing renovations to 18 elementary schools, two high schools and five new elementary schools.

Abooming market

But whether it is packaged ventilators, displacement ventilation systems, or MR16 luminaires, there will be lots of projects to apply new design approaches in the coming year with construction spending estimated at more than \$80 billion, according to American School & University magazine's “32nd Annual Official Education Construction Report.”

In any case, the trick is keeping up with new technology solutions and products in order to present schools with the most efficient and effective design options available.

New LEED rating system for schools

Expected to drive sustainable design for K-12 schools, the U.S. Green Building Council's new LEED for Schools Rating System is geared for these facilities addressing issues such as classroom acoustics, master planning, mold prevention and environmental site assessment.

Addressing the issue of first cost, a recent study by Capital E, a

Washington D.C.-based consulting firm, “Greening America’s Schools: Costs and Benefits 2006,” concludes that it costs, on average, less than 2% or about \$3 per sq. ft. more to build a green school than a conventional school—and the payback, from energy savings, comes within a year.

“The LEED guide for schools is a good first step in the right direction. However, the budget restrictions that most school districts must face causes the real challenge for engineers,” points out Brian Cumming, P.E., principal at BCA Consulting & Design Engineers, Maitland, Fla. “While the LEED hype says it doesn’t cost that much more, some districts have found out the hard way that some of the LEED points can be very expensive and can add considerable cost to a project.”

Martin Schmidt, P.E., LEED AP, mechanical engineer at The Schemmer Assocs., Omaha, Neb., agrees saying, “The development of LEED for Schools can only help raise the awareness of sustainable options; however, with the budgets that most school districts have to work with, it is questionable whether or not schools will actually pursue the accreditation.”

At the same time, for those that can get over the budget issue, schools like the idea of teaching their students about the importance of environmentalism and sustainability through the built environment, not to mention having a building that is healthier and more comfortable for students and teachers.

All in all, Cumming concludes, “Unlike previous energy conservation programs, I believe the LEED program will drive the trend toward budgeting and building schools considering the entire picture —learning, comfort, environment and conservation of natural resources.”

For more information about the LEED for Schools Rating System, go to www.usgbc.org/LEED.

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TALKBACK

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Great article. I especially liked the bright ideal of bringing sunlight down a tube into a hallway. Which gives me a great lead in to what I would like to share. There is a technology that has been around for a very long time in the IAQ industry that we already have it in schools, hospitals, very large cruise ship companies, and we are the only company that is certified by NASA and the Space Foundation. We have already proven that we can reduce MRSA on surfaces to 97% in 2 hours and 99.98% in 24 hours. And we have similar data from another very prestigious lab in the USA sharing similar data with airborne particles.

We have data for schools of reducing the number of children going home sick because of the common cold by 75%. Our goal is to simply bring mother nature's technologies indoors, to clean up the air people breathe in hopes that translate to a safer, higher quality of life.

You are welcome to contact me at gaumiller@earthlink.net

God Bless
Gordon Aumiller
Santa Cruz Ca

Gordon Aumiller - 9/12/2008 5:17:00 PM CDT

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