New Design Concepts for Elementary and Secondary Schools

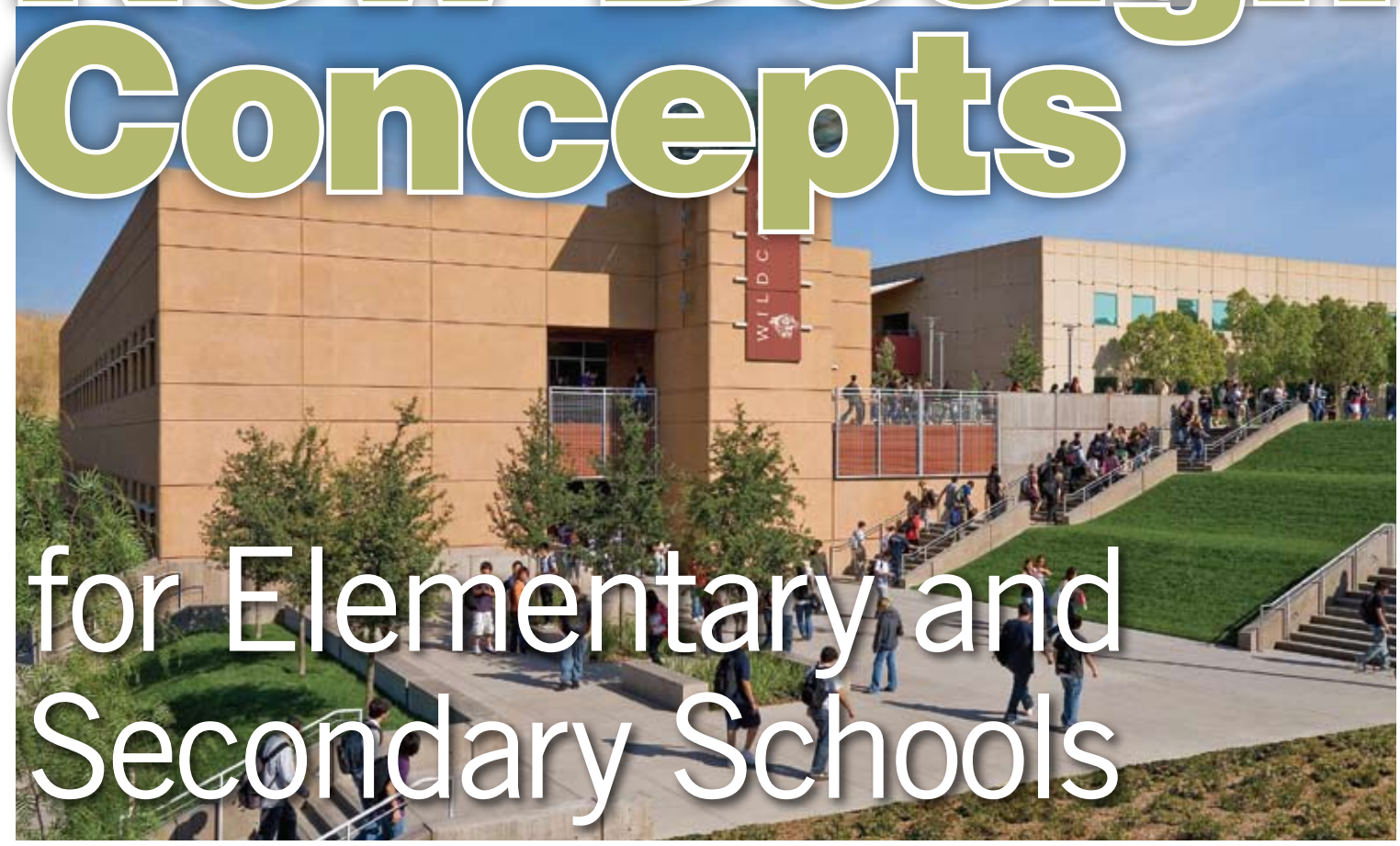

PHOTO: COURTESY LPA

By C.C. Sullivan and Barbara Horwitz-Bennett

Learning Objectives

After reading this article, you should be able to:

- ✔ Describe how economic challenges are affecting school facilities and their ability to meet energy and environmental demands.
- ✔ Explain how energy-efficient approaches such as daylighting and heat recovery contribute positively to school design.
- ✔ List interior materials and systems, including lighting, that can benefit a K-12 school's effectiveness.
- ✔ Describe safety-related technologies that are affecting school facility design and operations.

Hard hit by the economy, new construction in the K-12 sector has slowed considerably over the past year. Yet innovation has continued, along with renovations and expansions. Today, Building Teams are showing a keener focus on sustainable design, as well as ways to improve indoor environmental quality (IEQ), daylighting, and low-maintenance finishes such as flooring.

Furthermore, many professionals are hopeful for an economic recovery in 2011 that would encourage future school construction. "We are beginning to see an uptick in school planning initiatives throughout the country," reports Michael Hall, AIA, REFP, LEED AP, chief marketing officer with the K-12 specialty design firm Fanning Howey

A new LPA-designed expansion at Brea Olinda High School in Brea, Calif., performs 30% better than California's Title 24 building standards thanks to HVAC units with economizers, R-19 insulation in the walls, R-30 insulation in the roof, a single-ply cool roof, low-e insulated glazing with mullion extensions on the south side, daylighting sensors, and occupancy sensors in each classroom.

PHOTO: JOSEPH MILLS PHOTOGRAPHY

LWPB's design for the new Coweta (Okla.) Intermediate High School's media center takes advantage of high clerestories to bring in daylighting, while strips of high borrowed lights, transparent door transoms, sidelites, and a large transparent wall between the media center and student commons share daylighting from adjacent spaces.

PHOTO: SIMON HURST PHOTOGRAPHY

Rubber sheet was the flooring of choice for the multi-purpose commons and classroom corridors at a new, 87,000-sf high school in Jones, Okla. LWPB selected a bold floor patterning of deep red and gold, with light gray and green accents to liven up the space and break down the scale.

Toledo, Ohio (www.fhai.com). "Despite lingering economic challenges, many communities are beginning to conduct master plans or similar initiatives. This is an encouraging development in the K-12 sector and should translate to increased school construction over the next year."

Similarly, the firm Harley Ellis Devereaux (www.harleyellis.com), which counts on K-12 projects for about a quarter of firmwide revenues, cites the recent resumption of building and planning by the Los Angeles Unified School District (LAUSD) as a positive trend. The district is planning $7-10 billion dollars in modernization and construction projects to occur over the next five to seven years, says John Dale, FAIA, associate principal and K-12 studio leader with Harley Ellis Devereaux's Los Angeles.

He goes so far as to predict that K-12 will lead the recovery in the education sector. "I anticipate that as the overall economy gradually stabilizes, the forces we have seen at work in the last year will intensify," says Dale.

However, many are more skeptical with regard to how soon this will take place. Although tax revenues are anticipated to pick up, John S. Poelker, AIA, LEED AP BD+C, an associate in the Atlanta office of Perkins+Will (www.perkinswill.com), points out that there will be at least a year's delay until this impact is seen in school district budgets. He foresees the renovation and expansion trend continuing until school coffers reach the point where new replacement facilities become more realistic.

"We have a backlog of designs—new schools, additions, and renovations—that are complete, ready to bid and construct," confirms Anthony Robert Ansaldo, AIA, director of architecture for the Charlotte Mecklenburg Schools (www.cms.k12.nc.us) in Charlotte, N.C. However, these plans are on hold while the 175-school district awaits funding. At the same time, Ansalado is prepared to go with the flow and is optimistic that anything can happen.

INDOOR ENVIRONMENT TOPS CONCERNS

When addressing one of the more important concerns in K-12 educational facilities, indoor environment quality, or IEQ, Harley Ellis's Dale likes to riff on the acronym by linking it to student performance. He and his colleagues use the term "Improving Educational Quality" as the other side of the IEQ coin.

Recent research and ongoing studies of student performance and health directly connect these ideas also. For example, the availability of daylight and fresh outdoor air in classrooms has been shown to boost test scores and reduce absenteeism.

One of the best-known daylighting studies is the Gold River, Calif.-based Heschong Mahone Group's 2003 study (www.h-m-g.com/projects/daylighting/projects-pier.htm), which showed that students in optimally daylighted classrooms scored between 7% and 18% higher on tests than those with less daylight. Similarly in the IEQ area, a University of Tulsa-led 2006 program (www.ncbi.nlm.nih.gov/pubmed/17100667) studied the effects of ventilation. The Tulsa researchers reported standardized test scores that were 14-15% higher for children in classrooms with higher outdoor air ventilation rates.

While the evidence is compelling, actually achieving good IEQ is not always easy. Key mechanical design strategies include displacement ventilation, dedicated outdoor air systems coupled with energy recovery, and chilled beams.

Displacement ventilation. Unlike conventional cooling, with displacement ventilation, air is delivered at a constant velocity and slightly higher temperature at or near floor level in the classroom, explains Dale, a frequent industry lecturer and author and active member of several AIA education committees. "As the air is heated, it gradually layers, with warmer air rising to the ceiling," he says. "Apart from the advantage of significant energy savings, classrooms are quieter because of the constant lower velocity, and students are healthier because the natural layering of air means less mixing of air contaminants."

By way of example, Gonzalez Goodale Architects, Pasadena, Calif. (www.gonzalezgoodale.com), recently designed a large thermal displacement ventilation system at the Robert F. Kennedy Community School

PHOTO: COURTESY TLC ENGINEERING FOR ARCHITECTURE

As one of the five replacement schools that TLC Engineering for Architecture and Reynolds, Smith and Hills designed for the Charlotte County School District in the aftermath of Hurricane Charley, Peace River Elementary School in Charlotte Harbor, Fla., is a new LEED Silver-certified facility.

campus in Los Angeles, which serves classrooms, office areas, the auditorium, and the library. "The system has been in use for one year in phase one of this two-phased campus project, with excellent results," reports the firm's principal, Harry R. Drake, AIA. "The supply air is delivered in wall-mounted large diffusers at a low velocity, and at 65°F, rather than at 55°F." In addition to related energy savings, says Drake, thermal displacement ventilation is improving indoor air quality as the supply air carries germs and dust from the floor level up to ceiling-mounted return air grilles and away from students, teachers, and staff.

Although thermal displacement technology has traditionally involved a more significant upfront investment, newer packaged units are bringing the cost down, in addition to offering more flexibility, notes Dale. Moreover, specifiers can choose between corner supply diffusers or an exterior wall supply location for greater design flexibility, points out Ian Hadden, PE, LEED AP BD+C, client liaison for engineering and sustainable design with Fanning Howey.

RECOVERING ENERGY FOR SAVINGS

When it comes to specifically boosting indoor air quality, a number of firms that specialize in K-12 school design recommend using a **dedicated outdoor-air system (DOAS) coupled with energy recovery**. With this strategy, approximately 70% of the waste heat from the DOAS is harnessed to help preheat the outside air before it comes into the occupied space. This ventilation air is then heated or cooled to a neutral temperature, usually between 60°F and 65°F, and can then be directly delivered to classrooms and other spaces via pressure-independent air terminal units, chilled beams, or water-source heat pumps.

With this design approach, "We can often provide up to 30% more ventilation air than required by the code without higher energy costs, due to the energy recovery feature," says Robert N. Roop, CPD, LEED AP BD+C, a principal with Peter Basso Associates (www.pbanet.com), Troy, Mich.

In some cases, **demand-control ventilation**, or DCV, can be added to the package. By tying the system into occupancy sensors or CO2 sensors, air delivery can be trimmed based upon occupancy, in turn reducing the DOAS operational levels as well. "Combining DOAS with the DCV strategy can have dramatic effect on the cost of providing superior ventilation and improved IAQ," says Roop, a founding member of the Michigan Chapter of the Council of Educational Facilities Planners International (www.cefpi.org).

Some other strategies Roop's team typically employs include 30% prefiltration and 65% final filters on all systems to reduce contaminants. This becomes even more effective after employing a duct-cleaning process to remove construction dust and debris prior to commissioning air-handling equipment. Roop also recommends a pre-occupancy purge of the spaces through filters with a minimum efficiency rating value (MERV) of 13 using 100% outside air to minimize VOCs and construction contaminants.

Taking a broader look at IEQ, the material and product selection process is typically done in a much more rigorous manner in order to reduce or eliminate volatile organic compounds (VOCs) and other potentially irritating chemicals that can off-gas from new furnishings, finishes, and construction materials. To aid in this process, Perkins+Will has actually developed its own "Precautionary List" (http://transparency.perkinswill.com), which identifies harmful building products and their effects.

Once such environmentally friendly products are in place, the next step is managing potential sources of pollutants, says Erik Ring, PE, LEED AP, a mechanical engineering director with LPA, Irvine, Calif. (www.lpainc.com). Products like walk-off mats at building entrances reduce contaminants tracked into the school environment. Other prerequisites for better indoor air: flooring materials that are easily cleaned; closed-cell elastomeric duct linings rather than fibrous duct linings; stainless steel,

PHOTO: COURTESY FANNING HOWE

To enhance daylighting and security, Fanning Howey specified 90-minute fire-rated glass to meet code requirements while enabling office staff to observe visitors entering Troy (Ohio) High School.

drain-dry condensate pans; and proper HVAC systems filters.

Experts agree that running a building well is just as important as the design and construction phases. "Operations and maintenance is another significant component in achieving and maintaining the best IEQ," adds Shannon Goodman, RA, LEED AP BD+C, Perkins+Will. "We encourage building owners to establish maintenance protocols and checklists such as pest control and green cleaning, conducting regular building inspections, including source control, checking HVAC systems, moisture mitigation, and closely monitoring indoor humidity levels."

While every Building Team essentially develops its own best practices when it comes to air quality and IEQ, Svigals + Partners, New Haven, Conn. (www.svigals.com), has found the U.S. Green Building Council's LEED program to be an excellent resource in this regard. "Our strategies are based in the excellent design concepts found in LEED guidelines," explains principal Jay M. Brotman, AIA. "These include the use of low-VOC materials, whether for floors, ceilings, paints, and cabinetry, as well as the segregation of spaces utilizing chemicals, such as janitorial spaces, science rooms, and cooking areas. Also, good construction practices are important, such as sealing ductwork, cleaning wall cavities, and ventilation air flushing before occupancy."

Editor's Note

Additional required reading online! To earn 1.0 AIA/CES learning units, complete the required reading and take the test posted at www.bdcnetwork.com/AIA-CES/k12schools

K-12 SCHOOLS EDUCATION MODULE

Pass this exam and earn 1.0 AIA/CES learning units. You must go to www.bdcnetwork.com/AIA-CES/k12schools to take this exam.

1. Studies by Heschong Mahone Group and the University of Tulsa confirm that student scores can increase by as much as 15% in classrooms with:
   A. Reduced levels of VOCs in building materials.
   B. Improved ventilation only.
   C. Better daylighting only.
   D. Increased daylighting or improved ventilation.
2. Thermal displacement ventilation differs from conventional HVAC system designs in that:
   A. Supply air is delivered at higher velocity and higher temperatures.
   B. Supply air is delivered at lower velocity and higher temperatures.
   C. Supply air is delivered at lower velocity and at lower temperatures.
   D. None of the above.
3. True or false: Foot traffic into school buildings and fibrous HVAC duct filters can negatively affect school air quality.
   A. True.
   B. False.
4. Which of the following design features, if properly implemented, can improve daylighting in a school facility?
   A. Light shelves.
   B. Sunshades.
   C. Clerestory windows.
   D. All of the above.
5. In schools, mass-notification systems offer an improvement over traditional horns and strobes because they:
   A. Can deliver specific event-related instructions.
   B. Alert students of the need to evacuate.
   C. Provide special notification to disabled students.
   D. Can be used at multiple facilities.
6. True or false: The 2006 International Building Code permits the use of wired glass in areas subject to human impact, such as sidelites and doors.
   A. True.
   B. False.
7. In a building assembly, glass that that provides protection against radiant heat can be called:
   A. Fire-rated.
   B. Fire-protective.
   C. Fire-resistive.
   D. None of the above.
8. Rubber flooring is considered by some specifiers to be a good alternative to vinyl composition tile (VCT) because:
   A. It improves sound attenuation, reducing the noise of foot traffic.
   B. It needs to be replaced more frequently.
   C. It requires more maintenance and cleaning.
   D. None of the above.
9. The state of Florida requires a life cycle cost analysis (LCCA) for all school projects involving HVAC upgrades with new total air-conditioning capacity of:
   A. 10 tons or more.
   B. 20 tons or more.
   C. 30 tons or more.
   D. No minimal tonnage.
10. According to schools interior design expert Carla Remenschneider, alternative flooring choices for K-12 facilities include:
   A. Bamboo planks.
   B. Epoxy-coated concrete.
   C. Porcelain tile.
   D. All of the above.

In the Charlotte-Mecklenburg Schools, district architect Ansalado is helping lead a major effort to assess and evaluate IEQ-related issues. The project team is evaluating a range of factors, including lighting, acoustics, and ventilation in each of the district's 7,000 classrooms. Ultimately, this document will then be used to prioritize capital and maintenance projects to improve IEQ.

Of course, major school districts like LAUSD and Charlotte-Mecklenburg are incorporating higher IEQ standards into new construction projects, down to the finest detail. "We design our sites to provide hardscape entries and step-off rugs to reduce tracked-in dirt and debris," says Ansalado. "We keep plant material away from entries, intake grills, and operable windows to reduce blooms, litter, and leaves from entering the building."

BALANCING LIGHTING AND DAYLIGHTING

While bringing high levels of natural sunlight indoors can do much to boost IEQ in a school, it can also make quite a dent in a school district's energy bills. A wisely designed lighting system for today's educational facilities should take advantage of technologies such as occupancy sensors, daylight harvesting, high-performance glazing, and energy monitoring to make the most of the natural resource.

This goal is critical for keeping schools financially stable. In fact, says Wendy Rogers, AIA, LEED AP, a design principal with LPA, K-12 schools in the United States are currently spending more on annual energy consumption than on books and computers combined. "The best way to rein in this cost is through effective power management, where the energy usage for each space can be tailored to its use and adjusted continually as required," she notes.

Although the different systems required to achieve this do carry an upfront cost, Rogers is confident that end users ultimately reap the benefits. By way of confirmation, the Energy Center of Wisconsin recently conducted an experiment at the Energy Resource Station in Ankeny, Iowa (www.ecw.org/resource_detail.php?resultid=301), and discovered that an optimally designed daylit space captured savings of more than 20% in lighting and HVAC operating costs, translating to about $1.13/sf, as compared to a conventionally illuminated space.

A sound daylighting plan begins with optimal site location that orients the classrooms to capitalize on natural light from the north and south and reduce the heat gain that comes from eastern and western exposures. For instance, Harley Ellis Devereaux recently designed an elementary school for LAUSD where the entire classroom wing was oriented so that the rooms face either north or south. In addition, "All classrooms are furnished with ample windows with light shelves that bounce direct light onto the ceilings and deep into the room. The south-facing classrooms are also equipped with deep sunshades, set at about seven feet above the floor, so that they are shading the lower windows while allowing light through the upper windows onto the interior light shelves," notes Dale.

For the east and west façades of the building, the architects specified large clerestory windows running the full length of a multipurpose room's halls. Placed above the main ceiling height, the space benefits from natural light without the heat gain affecting the occupied space at floor level. "On a reasonably bright day, artificial light in this space is unnecessary because the natural light coming from several directions is balanced and the room is glare-free," Dale explains.

PHOTO: COURTESY FANNING HOWEY

Used for everything from school dances to band practice, the Carmel (Ind.) Freshman Center's cafeteria features a durable, attractive terrazzo floor.

Similarly, a media center at the new Coweta (Okla.) Intermediate High School utilizes **strategically placed clerestory windows** to maximize natural light. "High clerestories bring daylight directly into the interior of the media center, while strips of high borrowed lights, as well as transparent door transoms and sidelights, share daylighting from adjacent spaces," explains Lisa M. Chronister, AIA, LEED AP, principal of Oklahoma City-based firm LWPB Architecture (www.lwpb.com), which designed the school. In addition, a large transparent wall between the media center and student commons brings in even more daylighting, she says.

As for electrical lighting, one low-cost strategy LWPB likes to employ is **dual switching** for classrooms. By placing half of the typical 2x4-foot fluorescent lights on a separate switch, electrical lighting can easily be shut off on days where ample daylight fills the space. While lighting control systems are certainly more sophisticated, this is a nice low-cost alternative.

For Charlotte-Mecklenburg, the district has developed an extensive prototype approach for lighting/daylighting design in its new facilities. Highlights include enlarged window openings on fenestrated walls, separate switching of the outboard exterior light row in classrooms, and daylight sensors that switch off the electric lights in atriums, corridors, common areas, and other spaces with daylight. As for electrical lighting, the following measures are included:

- **Relamping and ballast refurbishment program** to swap T-12 lamps or metal halides for new T-8s or T-5s. (Through the U.S. Department of Energy's mandated obsolescence of magnetic ballasts and grant

RENDERING: COURTESY LPA

Classrooms were creatively clustered around a single collaborative space at the Early College Academic and Technical School in Long Beach, Calif.

monies, the school system has retrofitted T-12s with T-8s, resulting in a 40% energy savings in converted fixtures.)

• **Occupancy sensors for many classrooms**, including mobile and modular units and offices.

• **A turn-off-the-lights campaign to encourage students**, staff, and visitors to turn off lights, personal appliances, and equipment when not in use.

The district is also joining the University of North Carolina at Charlotte's Daylighting Lab in monitoring existing classrooms and developing a scientifically proportioned classroom that will be used as a model for our future elementary school rooms.

In terms of the latest T8 technology, Rogers sees 28-watt T8 lamps, as opposed to 32-watt models, as offering the best value at the moment. Even though the lumen output is slightly reduced, the lamps still leverage a higher lumen-per-watt value, coupled with a longer lamp life of 36,000 hours. "Considering the quantity of lamps powered on a K-12 campus, a few watts here and there really start to add up," she notes.

SAFE AND SECURE AT SCHOOL

Lighting also plays an important role in emergency situations, but when it comes to life safety for K-12 settings, perhaps one of the most discussed topics these days is the use of mass-notification systems. While traditional horns and strobes can alert building occupants of the need to evacuate, they fall short with regard to imparting important event-related instructions.

"Unfortunately, we have all heard of the tragedies that have occurred on school and college campuses recently," relates Peter Basso's Roop. "By incorporating a system of various alarms—often color coded—in the mass notification system, building occupants can be notified of various threats the building may be encountering so that administrators can

take appropriate actions."

While a mass notification system, or MNS, can be specified as a stand-alone component or integrated into the fire alarm network, Thomas V. Barnum, PE, senior consultant and fire protection engineer with Schirmer Engineering Las Vegas (www.schirmereng.com), believes that in most cases, "A relatively small number of strategically placed speakers or speaker arrays is sufficient to effectively reach virtually all building occupants." Barnum adds that an MNS should communicate not only internally, but also with external emergency response services—the police, paramedics, and fire departments.

BETTER SAFETY GLAZING

Another area where significant change is occurring is in the realm of fire-rated materials. While small wired-glass windows and opaque walls and doors were once the standard, major advances with fire-rated glass products have significantly altered the landscape.

These days, high-performance, fire-rated glass has opened up entirely new possibilities for designers offering improved aesthetics, increased daylighting, and better security—for example, by creating greater transparency in stairwells.

Another important point is that glass ceramic and even standard annealed glazings have actually been deemed safer than old-school wired glass, as reflected in the newer building codes. "The wires that run through the glass itself compromise the strength of the glass sheet, so wired glass is actually easier to break than annealed panels," explains Roop. Moreover, in the unfortunate case in which a child might accidentally go through the wired glass, extrication can be dangerous and difficult due to entanglement within the wires. Reflecting this reality, the widely adopted 2006 International Building Code does not permit wired glass in areas subject to human impact, such as sidelites and doors.

Furthermore, points out Dennis L. Hacker, AIA, a specification writer and manager with Fanning Howey, "Newly developed laminated-glass lites with intumescent interlayers and gel-filled, dual- and triple-glazed lites have an advantage over wired glass in that they also reduce radiant and conductive heat transfer."

This, in fact, is an important distinction, as glass that has been fire-rated simply means that the structure has been tested to remain intact for a certain period of time when exposed to a fire. However, notes Barnum, "It does not mean that the temperature inside that enclosure will be low enough to support human life." Consequently, it is critical for designers to determine whether the glazing is fire-protective, which is more limited, or fire-resistive, thereby providing radiant heat protection. The latter, of course, will provide a significantly better level of protection when evacuating a school facility that is on fire.

When choosing a suitable fire-rated product for a particular application, "The requirements for the selection of fire-rated glazing assemblies are complex, and there are many factors to consider," cautions David Eaves, AIA, LEED AP, an architect and associate with LPA. For example, fire protection and impact safety requirements vary based upon location in the building and the expanse of glass desired. Furthermore, assorted products offer different kinds of aesthetics, maintenance requirements, and durability levels.

"A great deal of research is required to determine the right fit for any specific product to suit the needs of the project," Eaves adds.

(For additional information about fire-rated glass, see "5 Myths About Fire-rated and Protective Glass," at http://www.bdcnetwork.com/article/5-myths-about-fire-rated-and-protective-glass.)

SPECIFYING LOW-MAINTENANCE FLOORING

Flooring selection criteria have evolved over the years, with low maintenance apparently trumping cost and aesthetics when it comes to today's scholastic interiors. The traditional choice of vinyl composition tile (VCT) is being eroded by other choices that are easier to maintain and, in the opinion of some specifiers, more environmentally friendly. Examples include carpet tile, linoleum sheets, rubber, and polished concrete.

"Carpet tile provides a durable high-performance floor, versatile maintenance options, easy installation, and high marks for its recycled content, whereas linoleum sheet offers excellent durability in high-traffic areas and is also made from recycled materials," explains Perkins+Will's Poelker.

While VCT does offer a low first cost and a nice high-gloss shine, school districts are concerned about the maintenance required to strip and wax the flooring. Even though rubber is usually about three times the price and doesn't offer as much of a shine, the process of buffing the floor is much simpler.

"Compared to VCT, rubber flooring offers increased durability due to the resilience of the rubber content, better cleanability as only sweeping and mopping is required, and a good range of colors," explains LWPB's Chronister, who has worked on dozens of educational projects over the past 16 years. Another benefit, he adds, is sound attenuation—in other words, fewer sneaker squeaks while students move across a surface. Over time, the natural paraffin eventually rises to the floor surface giving off more of a shine, but in the meantime, a conditioner can be applied with a conventional floor-cleaning machine for some added shine, she says.

Apparently, more K-12 schools are seeing the same benefits in this flooring option, such as Oklahoma's Chickasha Public Schools. "For their new 600-student early childhood center, we are specifying rubber tile flooring for almost the entire floor area, including corridors, classrooms, dining area, and storage rooms," relates Chronister. "The school district has not previously used rubber flooring, but after a lot of research and site visits to other facilities in which it has been used, they were sold on its attractiveness, durability, and low maintenance—despite the higher cost."

For another LWPB project, an 87,000-sf high school in Jones, Okla., rubber sheet flooring was specified for multipurpose commons area and classroom corridors. Taking advantage of the product's color palette, the school chose a bold floor patterning in deep red and gold with light gray and green accents to liven up the space and break down the scale. "The building has just opened and we expect that the client will truly realize the maintenance savings over the summer when they do not have to schedule staff for annual stripping and waxing activities," says Steven Sprague, AIA, a senior associate with LWPB.

As for other popular flooring choices, Kate Mraw, LEED AP, an interior designer with LPA, says, "Nothing beats the simplicity of concrete flooring finished with a great bright-colored epoxy coating." Also noted for its green building benefits, the concrete slab doubles as a finished product requir-

PHOTO: COURTESY FANNING HOWEY

As part of the recent renovations to the historic Eastern High School in Washington, D.C., linoleum flooring was chosen in selected classrooms to provide a sustainable, low-maintenance solution. Interiors expert Carla Remenschneider also recommends terrazzo, porcelain or ceramic tile, bamboo plank flooring, and concrete floors.

ing little maintenance and no off-gassing adhesives. Offering strength and durability, it's also ideal for highly trafficked K-12 settings.

Beyond the above-mentioned materials, a few other options are being specified as well. Carla Remenschneider, interior design coordinator at Fanning Howey, lists the following possibilities shown to work well for schools:

- *Terrazzo* – Both cement-based and epoxy systems provide rich color, patterning, and texture options. While the initial expense is greater, replacement should not be needed during the life of the building as the material resists stains, scuffs, and color fading. After the initial polish, terrazzo requires routine dry and damp mopping, as well as annual stripping/resealing.
- *Porcelain or ceramic tile* – These flooring materials are also very wear resistant and require regular damp mopping plus a clear coat seal one to two times per year.
- *Bamboo plank flooring* – This "green" option creates a different look and is also low maintenance. This floor system is most appropriate for settings like media centers and administration offices.
- *Epoxy, troweled, or poured concrete floors* – These systems work well in locker rooms.

VISUALIZING THE BIG PICTURE

Clearly, the tradeoff between initial installed cost and long-term performance will drive critical material selections like flooring. Even for systems and products meant to improve IAQ, lighting, and life safety—or simply improve the ambience and motivate kids to learn—it's important to note that schools are ideal settings for technologies which will deliver the best performance and cost savings over time.

In fact, the Florida Department of Education and other school districts and agencies have promoted the use of life cycle cost analysis (LCCA). For projects such as HVAC system upgrades with a new total air-conditioning capacity of 30 tons or greater, LCCA is required by law in Florida.

This is true of the numerous other architectural and engineering systems which go into a school building, adds Roop. "Since school buildings over 50 years old are commonplace, perhaps no classification of building owners benefits more from life cycle cost saving initiatives than school districts," he concludes. **BD+C**