Beyond Glass–Transforming Learning Environments

Above. A two-story window wall incorporating clear and colored glass fills the Sandy Hook Elementary School central lobby with natural daylight. *Robert Benson Photography*

Listen to our podcast interview with architect Julia McFadden to learn more about the new Sandy Hook school. Hear it at commercialarchitecturemagazine.com/1703agcglass06.

Right. Spaces at Fredrick County Middle School were designed with open learning areas, including movable benches and tables that provide students with a creative, collaborative, and adaptable environment. Classrooms are defined with floor-to-ceiling glass walls with uninterrupted sightlines.

Schools become hallmarks of well being and energy efficiency with the thoughtful use of glass.

Across the United States, the landscape is dotted with schools: some new, beautiful beacons of unique and innovative design, others reminders of a style rooted in another century with a minimum of windows buried in vast fortresses of brick and steel. While it is commonly recognized today that natural daylight and broad expanses of windows can improve the performance and well being of building occupants, whether children or adults, there was a time when windows incorporated into a school design were seen as nothing more than a distraction for children with wandering minds.

Other issues that resulted in fewer windows and minimum use of glass in 20th-century school designs were concerns about the cost of heating and air conditioning. With rising energy costs in the 1970s, extensive use of glass on school exteriors began to be seen not only as an operating-budget concern, but also as poor stewardship of natural resources.

When decades of studies revealed enhanced performance for students and greater well being for occupants in buildings incorporating daylighting principals, the pendulum began to swing toward school designs that include greater expanses of glass, allowing natural light to flood education spaces. Unlike earlier versions of the United States Green Building Councils' (Washington) LEED green building program, LEED v4 for New Construction and Renovation places an emphasis on human health. Recognition of the advantages of daylighting and the ability to reach high levels of energy efficiency with large expanses of glass is expressed in LEED v4 requirements, which include several considerations for enhancing individual human health and well being while also optimizing energy performance. Detailed within the "Indoor Environmental Quality" category, subcategories include daylight and views, thermal comfort, and lighting, among other goals to achieve points in the category.

LEARNING IN 20TH-CENTURY SCHOOLS

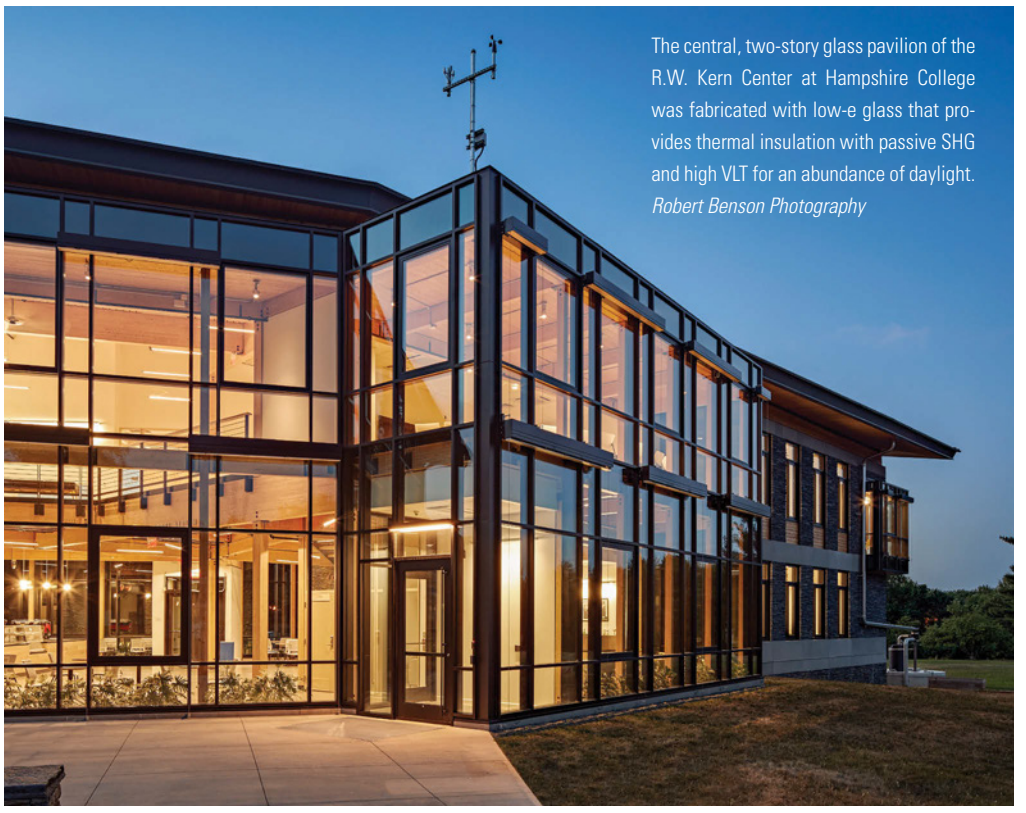
Why so much concern over last-century school design? Because so many are still in service. The most recent information available from the U.S. General Accounting Office, Washington, shows that the average age of public schools is more than 50 years. Thousands of "old design" schools are neither energy efficient nor deliver the benefits of better learning and enhanced performance experienced in an environment where daylighting principles have been applied. These schools are calling out for intervention by design professionals who have the creative vision and technical skill to create energy-efficient, healthy, light-filled spaces for 21st-century learning environments.

According to the Alliance to Save Energy, Washington, schools currently account for 10% of all energy used in non-residential buildings, making schools the third-largest consumer of energy in the United States. With yearly energy expenditures for K-12 schools at $8 billion and another $6 billion spent at the university and college level, the combined total exceeds expenditures for both computers and textbooks.

Can natural light and energy efficiency co-exist? While numbers re-

flecting current energy consumption in schools may indicate otherwise–the answer is "yes." When technologically advanced glass products are used that deliver design aesthetics and high-level code performance, beautiful, efficient, light-filled schools become a reality.

Low-emissivity (low-e) coated glass products meet and exceed the most stringent code requirements. These high-performance glass solutions go beyond what is required today, positioning architects and design professionals to meet the challenge of designing schools for the future. Options are available to meet performance requirements for projects in every region of the country. Spectrally selective glazing allows architects, designers, specifiers, and glass fabricators to address solar heat gain (SHG), insulating value, and visible light transmission (VLT) levels–while bringing a unique vision to life for each project.



The central, two-story glass pavilion of the R.W. Kern Center at Hampshire College was fabricated with low-e glass that provides thermal insulation with passive SHG and high VLT for an abundance of daylight. *Robert Benson Photography*

SANDY HOOK SCHOOL

In September 2013, Svigals + Partners LLP, New Haven, CT, was selected to design a new 86,800-sq.-ft. school in Newtown, CT. The design process was a collaborative effort including town officials, governing boards, community groups, neighbors, parents, teachers, and school administrators. The school design was also planned to achieve LEED Gold standards. The successful process culminated in the Sandy Hook Elementary School, which opened for its inaugural year in August 2016.

The collaborative design process resulted in the placement of the school along the southern edge of the site, with a north-facing, undulating wood façade. Along the rear of the facility, classroom wings incorporating vast walls of glass benefit from the southern daylight and views of natural-wooded wetlands. A two-story window wall incorporating clear and colored glass fills the central lobby of the school with natural daylight.

Said Julia McFadden, AIA, associate principal, Svigals + Partners, "Our use of glass helps students connect to the natural beauty of the site, and it also allows in lots of sunlight and views that help make schools more nurturing and healthy. Colored daylight splashing across the lobby adds a warm and inspiring touch."

McFadden continued, "To make this concept work best, we designed the building and site for optimal daylighting in the fall, winter, and spring. Svigals + Partners specified insulated glazing units and framing to minimize thermal bridging and reduce unwanted solar heat gain. The glass panels are specified with specialized coatings for a neutral appearance and low reflectivity, as well as the best possible solar control. Yet the glass also offers high visible light transmission to increase daylighting efficacy. Two different kinds of glass coatings were used, depending on the orientation of the windows–one for north facing and another for E/S/W orientations–to maximize energy efficiency and available daylight harvesting. Due to some challenging orientations of the classroom wings (southeast and southwest), we didn't sacrifice the amount of glazing, daylight, and views by adding colorful vertical fins to help block direct sun."

Atelier Ten, New York, served as the environmental and lighting-design consultant for the project. A 35.1% energy cost savings was achieved by optimizing the building envelope with well-insulated wall and roof construction and high-performance glazing and curtain-wall systems. According to Larry Jones, LEED AP BD+C, associate director with Atelier Ten, "Various glazing types were studied throughout design from triple glazing to high-performance, double-glazed units. The building was constructed using double-glazed, low-e units with a U-value equal to .28 and SHGC equal to .40 for the northern orientations and U-value equal to .29 and SHGC equal to .30 for all other orientations."

NEW ENGLAND'S "LIVING BUILDING"

Is it possible to meet award-winning energy standards when designing with glass? The 17,000-sq.-ft. R.W. Kern Center at Hampshire College in Amherst, MA, was designed with the goal of certification under the Living Building Challenge. A "Living Building" is defined by the International Living Future Institute, Seattle, as a building that creates more resources than it uses. As the one-year anniversary of achieving this standard is marked, the Kern Center is recognized as New England's largest Living Building.

Bruner/Cott & Associates of Cambridge, MA, designed the Kern Center as a self-sustaining building, supplying its own water and energy on site. It was constructed with materials free of red-list chemical products and sourced locally. Incorporated into the design is a floor-to-ceiling glass pavilion featuring locally manufactured high-performance windows with triple-pane glazing and high-efficiency coatings.

The central, two-story glass pavilion was fabricated with low-e glass that provides thermal insulation with passive SHG and high VLT for an abundance of daylight, while also meeting strict Massachusetts building codes for energy efficiency. The triple-pane configuration includes a solar-control low-e coating on the number 2 surface and passive-solar coating on the number 5 surface for improved thermal insulation. A virtually undetectable coating delivers a neutral, clear appearance with a low level of indoor and outdoor reflectivity. These features allow architects and design professionals to incorporate glass as a design element and a source of light without compromising energy performance or the benefits of daylighting.

According to Brian Shaw, vice-president of sales and marketing for Solar Seal in South Easton, MA, "The Energy Select low-e glass coatings on the number two and five glass surfaces gave us a high visible light transmission of 61% for the curtain wall, and the half-inch thermally broken spacer and Argon gas in both air spaces of the insulating glass units allowed us to attain a desirable U-value of 0.13."

FREDERICK COUNTY MIDDLE SCHOOL

Frederick County Middle School (FCMS), Winchester, VA, was designed to create a student-centered, collaborative, and adaptable learning environment that would also serve the community. Designed by Stantec Architecture, Charlottesville, VA, with input from advocates representing students, teachers, and citizen groups, the design departs from traditional concepts of school design. Spaces were designed with open learning areas, including movable benches and tables that provide students with a creative, collaborative, and adaptable environment. Classrooms are

defined with floor-to-ceiling glass walls with uninterrupted sightlines.

To achieve the benefits of daylighting while maintaining energy-efficiency goals, high-performance glass with advanced coating technology was used, which included Energy Select 28 on the number 2 surface. According to Rob Winstead, AIA, LEED AP BD+C, NCARB, principal at Stantec Architecture, "Glazing was a critical component of a high-performance building envelope. Glazing properties including U-value, SHGC, and VLT were carefully considered during the design, specification, and submittal process. External shading devices are tuned to the specific solar orientation. Interior light-shelves and advanced lighting controls maximize available daylight. A green light indicator communicates when temperature and humidity are such that operable units allow natural ventilation of all primary instructional spaces. These strategies contribute to a building that is designed to use 70% less energy than a typical school in the region."

Winstead noted the value of daylight in educational spaces. "Research has demonstrated that daylight and views directly affect learning outcomes and improve health and wellness. Dramatic views of the site are a major part of the experience of the building, connecting students to nature and inviting them to make use of a variety of landscaped outdoor spaces designed specifically for learning," he said.

Winstead continued, "Glass was incorporated into the design of FCMS to harvest daylight, celebrate views of the surrounding landscape, and create connections in the learning environment. Windows are located and sized to harvest daylight for 100% of the instructional spaces that make up the Small Learning Communities. Large areas of glass bring light and views into the Learning Commons, a grand central space that is the heart of the school."

With informed glass selection, designers were able to deliver a desirable neutral glass aesthetic to complement the stone and brick exterior of the school. Winstead described the integration of glass and natural materials. "As a design element, the glazing at FCMS was intended to 'disappear'–a transparent thermal membrane spanning between masonry elements of stone and brick and the hovering wood ceiling floating above major public spaces. In this way, the beauty of the site is integral to the experience of the building and becomes a natural extension of the learning environment. The blue-green tint and the precise, cool, and reflective properties of the glazing systems are an effective counterpoint to the warm and rough qualities of the masonry and wood. Daylight and the ever-changing qualities of the site animate the interior space and the building glows like a lantern at night–a beacon in an underserved part of the community."

A successful combination of beauty and energy efficiency, Frederick County Middle School has been designated a Platinum Level Green School by the Virginia School Boards Association, the highest level of achievement in the Green School Challenge.

GLASS AS DESIGN INSPIRATION

As schools age out of usefulness and are renovated or replaced with new facilities, architects and designers are in a position to create high-performance schools that enhance student performance while delivering energy efficiencies. The understanding that students perform better when surrounded by natural light is tied to designs with extensive glass features that employ principals of daylighting. Glass manufacturers who invest in new technologies and continue to develop greater energy efficiencies make choosing the right products easier as well as inspirational to design professionals. CA

Information for this article provided by AGC Glass North America Inc., Alpharetta, GA, us.agc.com.

R.W. Kern Center Specifics

The R.W. Kern Center at Hampshire College in Amherst, MA, was designed with the goal of certification under the Living Building Challenge. Installation configured as specified resulted in the following performance characteristics for the facility:

- Winter U-factor/U-value: 0.13
- Visible light transmittance: 61%
- Summer U-factor/U-value: 0.13
- UV–transmittance: 10%
- Solar heat gain coefficient: 0.34
- Solar energy–transmittance: 28%
- Shading coefficient: 0.39
- Visible reflectance out: 14%
- Relative heat gain (Btu/hr.-ft.^{2}): 80
- Visible reflectance in: 16%
- Light to solar gain: 1.78
- Reflectance solar energy out: 32%.

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- Watch a video on Living Buildings—**commercialarchitecturemagazine.com/1703agcglass04**
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