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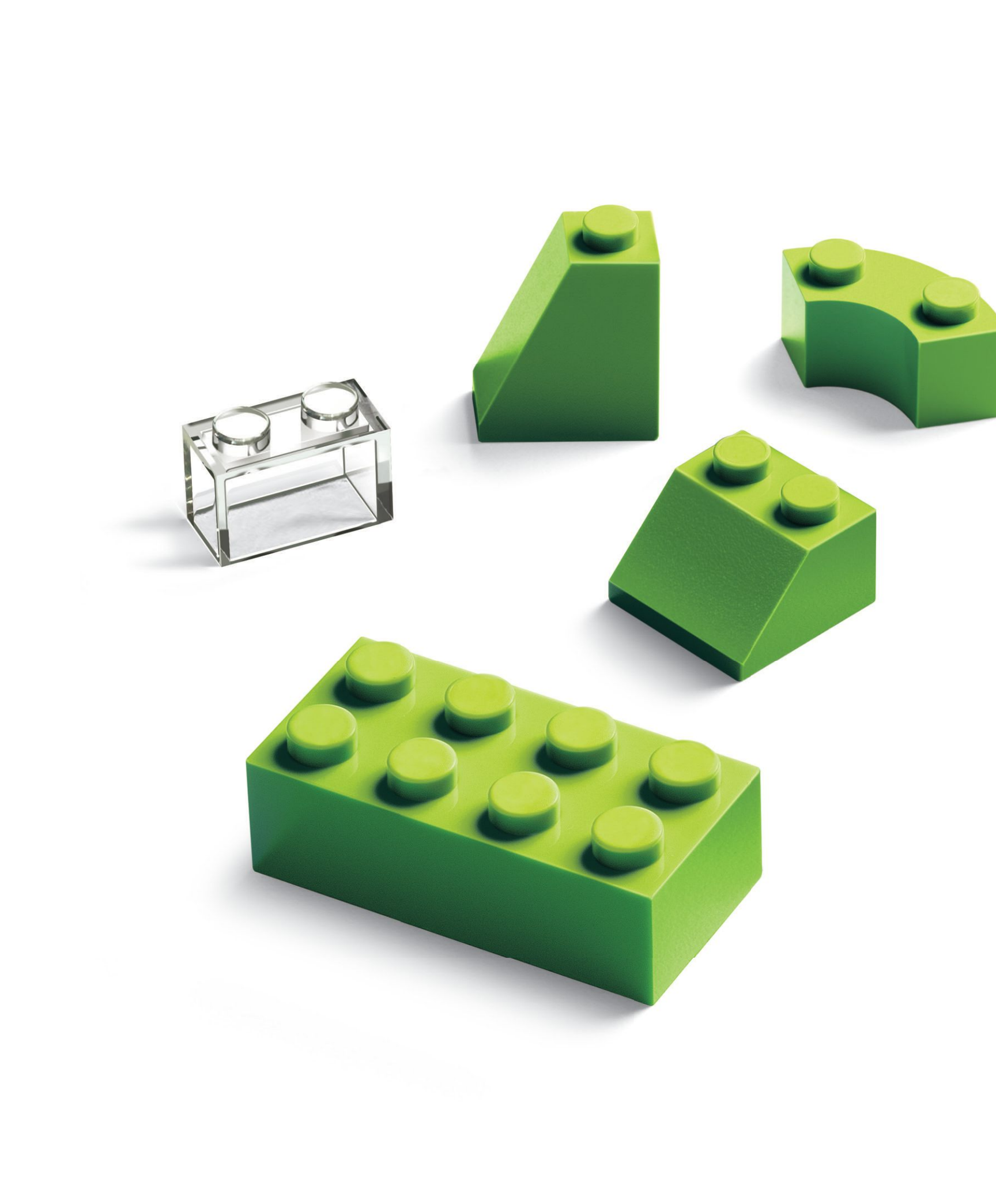

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THIS PAGE: COMMON GROUND HIGH SCHOOL, BY GRAY ORGANSCHI ARCHITECTURE. PHOTO BY DAVID SUNDBERG/ESTO.

COVER: SIMONE VEIL SCHOOL COMPLEX, BY DOMINIQUE COULON & ASSOCIÉS. PHOTO BY EUGENI PONS.

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THE GATEWAY ARCH IN ST. LOUIS BY EERO SAARINEN

SCENES FROM THE NEWS

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Click through our slideshow featuring the work of Paul Revere Williams—the first African-American architect to receive the AIA Gold Medal.

DENVER ART MUSEUM ADDITION
View renderings of the $150 million upgrade and addition, designed by Fentress Architects and Machado Silvetti, to the Denver Art Museum's Gio Ponti–designed North Building.

RENDERING OF THE DENVER ART MUSEUM'S NEW ADDITION

HIGHLIGHTS

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LA CONCHA MOTEL IN LAS VEGAS BY PAUL REVERE WILLIAMS, REINVENTED AS THE NEON MUSEUM

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CIRCLE 35

Social Infrastructure

With political changes looming on the national level, it's a good moment to think globally but act locally.

IN LATE NOVEMBER, the AIA held its first Build America Summit in New York, a conference that had special resonance in the wake of the presidential election. We are facing policy shifts in Washington that could well have a profound impact on the built environment. The topic of rebuilding America's deteriorating infrastructure—and creating jobs—was a hot campaign issue, though neither President-elect Trump nor Hillary Clinton came close to proposing the amount that the American Society of Civil Engineers estimates is really needed, a sum north of $3.5 trillion by 2020. And the President-elect's notion to finance infrastructure largely though mega tax breaks to private developers probably wouldn't help parts of the public realm that require serious funding and really matter to people.

The reason? Infrastructure doesn't just mean big-muscle projects like highways and airports. According to a public-opinion survey conducted by the Harris Poll and released at the AIA conference, 83 percent of the respondents said they considered schools, libraries, and parks part of their community infrastructure—and that those needed investment as much as roads or bridges. Such social infrastructure, and the basic role of local governments in building those projects, emerged as a key theme of the conference.

In addition, almost three-quarters of those polled in the survey believe that schools in good condition are essential to their communities. Yet new school construction has suffered from funding cuts in many parts of the country. K–12 schools account for about one-quarter of infrastructure expenditures on the state and local levels, but capital spending by states overall dropped 37 percent between 2008 and 2013, according to the Center on Budget and Policy Priorities. A recent report, from the 21st Century School Fund, the National Council on School Facilities, and the Center for Green Schools, estimates that, across the nation, there is a shortfall of $10 billion a year for funding new facilities. Studies have repeatedly shown that well-designed classrooms, with ample natural light and good ventilation, improve learning. But the schools that most need upgrading are those least likely to find the means to do so. Municipalities in poor areas, where the tax base has eroded, have struggled to pay for even basic teaching tools. Reform of school financing to create equity in public education is urgently needed in the states and districts that still rely on their localities' property taxes to determine funding.

This is RECORD's annual schools issue, and the innovative K–12 facilities you will see on the following pages, in both the U.S. and abroad, arguably serve the luckiest students. Whether they are public, charter, or private, these schools have in common a sensitive use of materials and daylighting, and they all find ways to connect to nature. A private high school designed by Lake|Flato in Birmingham, Alabama, overlooking a lake, could be a contemporary summer camp, with a cluster of structures that have deep overhangs and generous porches (page 84). On a vastly different scale and budget, the Lycée Schorge secondary school in Burkina Faso by Francis Kéré, reflects its context in its plan and materials, and how it provides shading and cooling (page 96). The Common Ground High School, a charter in New Haven, Connecticut, designed by Gray Organschi Architecture, has an environmental focus in its curriculum and in its building—a wood structure is one of its sustainable elements (page 100).

Later this month, the new administration will take office. Through Congressional hearings for appointees, we'll get a strong sense of how the cabinet will push for policies that will have an impact on social infrastructure. The proposed Secretary of Education, Betsy DeVos, for example, is a staunch promoter of charter schools, and if federal funding heavily favors charters, poor public schools would be left with even fewer resources. The proposed head of the Environmental Protection Agency, Scott Pruitt, is a vigorous opponent of climate change regulations and, if confirmed, could undo some current rules that are making new and retrofitted federal buildings models of green construction (page 19).

Yet decisions about building schools will still reside with states and local districts. And some states and dozens of cities have been leaders in legislating remedies for climate change, as well championing social issues such as raising the minimum wage. So while change is inevitable in Washington, everyone who cares about good design and the public realm can act locally. This is the moment to push for improved social infrastructure in neighborhoods, towns, and cities. The not-so-radical idea that every child deserves a decent, well-designed school would be a good place to start.

Cathleen McGuigan

Cathleen McGuigan, Editor in Chief

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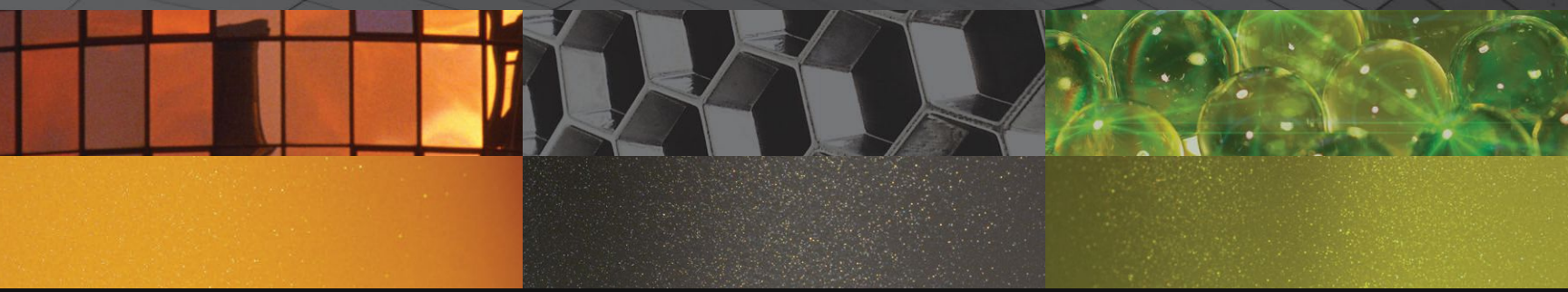

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It is my hope that you will find your medical training coming in handy . . . You will, I hope, come to see that the national housing crisis is equally a national health crisis.
—Dallas Morning News *architecture critic Mark Lamster in an open letter to Dr. Ben Carson, nominated as HUD Secretary.*

What the New Administration Could Mean for Green Buildings

BY CAMILLE VON KAENEL

PRESIDENT-ELECT DONALD Trump and some of his cabinet nominees—including Rick Perry at the Department of Energy and Scott Pruitt at the Environmental Protection Agency–have rejected the mainstream science on climate change and vowed to roll back environmental rules like the EPA's Clean Power Plan. This has architects worried that Trump's administration could reverse other regulations, including those relating to green buildings.

Trump railed against green office buildings specifically in a 2012 interview on CNBC's *Squawk Box*, saying they were "green because they don't give you enough energy." Only a couple of the properties associated with his name, such as the new Trump International Hotel in Washington, D.C., have sought LEED certification, according to a directory kept by the United States Green Building Council.

Todd Myers, the director of the Center for the Environment at the Washington Policy Center, who has fought green building standards for schools, sees the election as an opportunity for the federal government to do away with regulations like the General Services Administration's requirement of LEED certification for federal facilities. "The current administration has wanted to look green. The problem is, looking green and being green are two different things," Myers says. "If the Trump administration only cares about results, we may actually do better at creating energy-efficient buildings, because they will go with what works rather than earning plaques," he says, referring to the USGBC emblems displayed in LEED-certified buildings.

Federal buildings have been seen as leaders in energy-efficient retrofits and new green construction—but that could change. Trump has vowed to rescind many of President Barack Obama's executive orders, which could include the one signed in February 2015 requiring that federal buildings cut energy use by 2.5 percent each year through 2025.

Experts say that officials in Trump's administration could not singlehandedly dismantle existing environmental regulations set forth by bodies such as the EPA. (EPA offices in Washington, D.C., above.)

Regardless of what action Trump takes with his predecessor's executive orders, the GSA would still be required by the Energy Independence and Security Act of 2007 to follow general sustainable-building principles (the agency updates its requirements in a yearly policy document). Pruitt, whose record of suing the agency he may soon lead has worried environmentalists, could not single-handedly revoke GSA's LEED-certification requirement. The EPA does have several discretionary programs that seek to facilitate green building, like Water Sense, Energy Star, and Portfolio Manager, that "may receive some scrutiny or be impacted under the new administration," says Taryn Holowka, the senior vice president of Marketing, Communications and Advocacy at USGBC.

Department of Energy efficiency standards have also become a target, with the House Freedom Caucus asking the Trump administration in mid-December to scrap a slew of new rules for household appliances. But Holowka says she is confident that green-building policy will remain a bipartisan issue and that the private sector would continue to seek out sustainable and energy-efficient buildings.

The vast majority of policies that could affect green building, from incentives to energy codes to building codes, is set at the local level, according to Russel Unger, the executive director of the Urban Green Council in New York. "When you drill down to any individual city, whoever's in federal office doesn't affect the industry that much," he says. "There's tremendous innovation going on, and a lot is driven just because the market and owners want to make a better building than the last one, and [this innovating] is grounded by a suite of local laws and state programs."

The belief in the power of individual cities to shape environmental policy was borne out by the mayors of 90 of the world's leading megacities. In December, at a conference sponsored by the organization C40 Cities, held in Mexico City, they vowed to redouble their efforts to cut greenhouse-gas emissions. The mayors identified buildings as the sector with the most cuts to offer, primarily through building data reporting, new energy codes, and municipal and commercial building retrofits.■

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Guggenheim Helsinki Scrapped

BY ALEX KLIMOSKI

IN A 53-to-32 vote on November 30, the Helsinki City Council rejected a proposal to build a new Guggenheim-satellite museum on the Finnish capital's waterfront. The decision not to proceed with Paris-based Moreau Kusunoki Architectes' design is the culmination of five years of fierce dispute that has rattled Finnish politics and sparked debate within the architecture community.

Johanna Lemola, a spokeswoman for the Helsinki municipal government said the Council's meeting was "highly emotional," adding that some councillors were even concerned for their safety. Those in favor of the project, mainly from the political right, argued that the museum would be a boon for the city, like the Guggenheim Bilbao. The political left and the populist Finns Party, meanwhile, objected to paying for the $138 million museum with public funds.

Helsinki residents have had similar concerns, especially as the government has imposed significant austerity measures. Other objections included a perceived lack of transparency during planning, sensitivity over the project's prime waterfront site, and the belief that the local art scene is robust as is.

Ari Lahti, a Finnish businessman and the chairman of the Guggenheim Helsinki Supporting Foundation, suggested that the City Council's ruling did not represent public opinion. "If the government would have been formulated differently, or had the Finns Party not been struggling to keep their voters satisfied, we could have seen a different outcome," he said in an e-mail.

Beyond Finland, criticism of the museum tended to be in response to the expanding influence of institutions. "I find the concept of the imperial museum to be quite galling," says critic and RECORD contributor Michael Sorkin, one of the editors of a new book, *The Helsinki Effect: Public Alternatives to the Guggenheim Model of Culture-Driven Development*.

Lahti, however, disagrees: "As I see it, a museum with mostly Finnish staff, promoting opportunities for Finnish artists to succeed is far from 'cultural imperialism.'"

Moreau Kusunoki Architectes' design proposed a collection of nine interconnected charred-wood volumes.

The architects, who beat over 1,700 submissions in 2014's blind design competition, are choosing to remain optimistic. "We are confident that this project represents a stepping-stone and the possibility of an exciting future for our firm and for the field of architecture," Moreau Kusunoki said in a statement.

Until further notice, the project site—considered to be some of the most valuable real estate in the city—will remain a parking lot. ■

Paul Revere Williams, Unsung Hero

BY ANNA FIXSEN

PAUL REVERE WILLIAMS (1894–1980) was a man both embraced and dismissed by the field in which he practiced. Though the architect, who was black, amassed a wide range of enviable commissions—from glamorous homes in the Hollywood Hills to large commercial and institutional projects—he struggled to be acknowledged as an equal: white clients routinely refused to shake his hand. After he redesigned the Beverly Hills Hotel, he was denied entry to the pool. He even learned to draw upside down, so that white patrons wouldn't feel uncomfortable sitting at his side.

"I came to realize that I was being condemned, not by lack of ability, but by my color," Williams wrote in a 1937 essay. "I wanted to vindicate every ability I had. I wanted to acquire new abilities. I wanted to prove that I, as an individual, deserved a place in the world."

Over his five-decade career, the architect designed more than 3,000 buildings and became the American Institute of Architects' first African-American member, as well as the first black person to be inducted into its college of fellows. Now the AIA has named Williams the recipient of its 2017 Gold Medal—the first black architect to be so honored.

"When I learned about Paul Revere Williams as a student, the message to me was, 'I can do anything,'" says Phil Freelon of Perkins + Will, who presented Williams's work to the awards jury. "It gives you hope. And that's what this award is about."

Williams's life story unfolded like a movie in which his Hollywood clients acted. Born in Los Angeles in 1894 and orphaned at the age of 4, he was raised by a family friend. The only black child in his elementary school, he was discouraged from pursuing architecture because, his teachers told him, white clients wouldn't want to work with him.

Undeterred, Williams became a licensed architect in 1921 and established his office at the age of 28. Southern California real estate was booming, and the firm thrived, building hundreds of opulent residences in styles ranging from Tudor Revival to Regency, French Chateau, and Mediterranean. Williams's designs became so popular that Frank Sinatra, Barbara Stanwyck, and Lucille Ball and Desi Arnaz commissioned him for their houses. He also designed the Beverly Hills Saks Fifth Avenue, the Palm Springs Tennis Club, and a renovation of the star-studded Beverly Hills Hotel.

But Williams was also an architect for the less privileged. In the late 1930s, he collaborated with fellow African-American architect Hilyard Robinson on Langston Terrace, the nation's first federally funded public housing project. In 1962, he designed the St. Jude's Children's Research Hospital pro bono for comedian Danny Thomas, the hospital's patron.

"To him, the end result was the most important thing," says Williams's granddaughter and biographer, Karen Hudson. "He thought those buildings would stand as a testament to excellence and be an inspiration to other people."

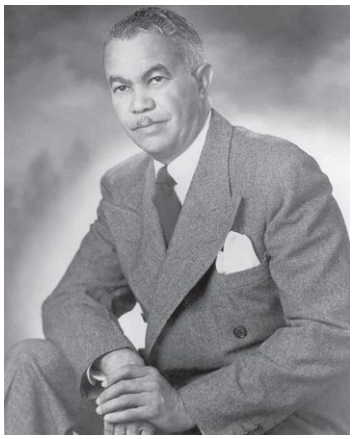
The award comes at a time when the AIA has been under intense scrutiny for its lack of diversity (the late Julia Morgan became the first woman architect to receive the Gold Medal in 2014). Less than 2 percent of AIA members are African-American, according to the organization's most recent diversity survey.

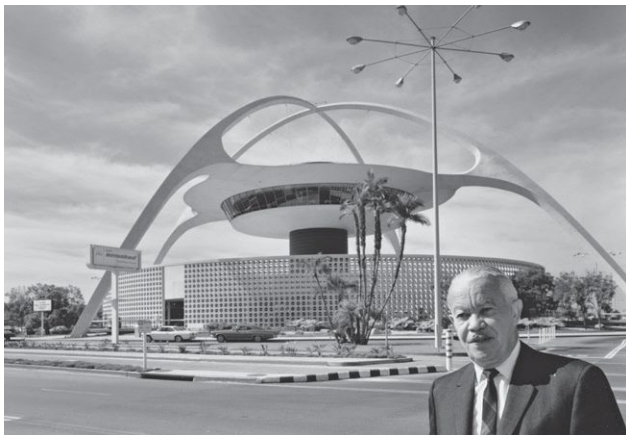
When asked why the jury didn't select a living African-American architect, Gold Medal jury chair Stephen Maher says, "I had a similar discussion. But when you learn about Williams's work and what he was able to achieve, he was too special to pass on."

The road to the AIA Gold Medal is a complicated process. This year, a pool of 16 contenders was submitted to the jury, who then whittled the list down to three finalists. (RECORD has learned that the other two were British architects Richard Rogers and the late Zaha Hadid.) The AIA's board of directors and strategic council select the winner.

"It was long overdue," says advocate Julia Donoho, AIA, of Williams's win. She helped spearhead his nomination with Freelon, along with architects William Bates, William J. Stanley, and Kevin Holland, the president of the National Organization of Minority Architects.

But the work is not over, says Freelon. "The AIA can't stop and say we're done, we gave a black guy a medal, so we can check off diversity for 2017. That's not enough. Nor is that the reason for this recognition—he deserves it regardless," says Freelon. "But I want to keep this on a positive note, and I commend the AIA for their choice." ■

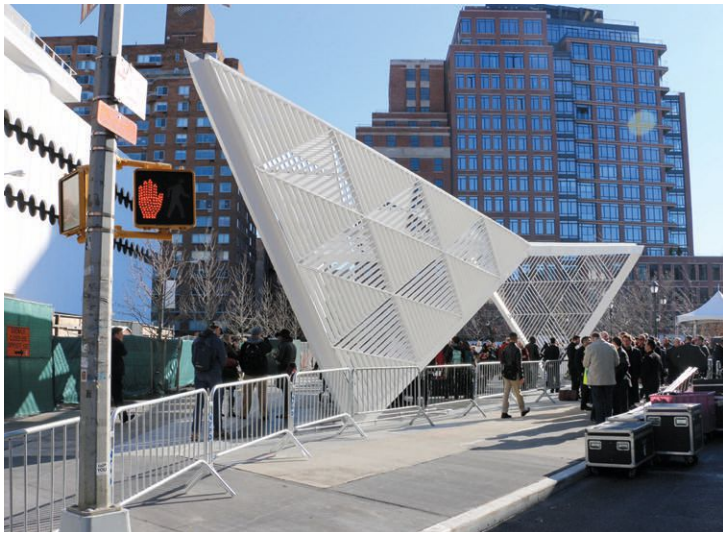




Paul Revere Williams (above, left) worked in a variety of styles, from Spanish Colonial revival for the 1928 Rossetti Residence in Hollywood (top), to Googie for LAX's 1961 Theme Building (above, right), designed with William Pereira.

NYC Unveils AIDS Memorial

BY ANNA FIXSEN



A sculptural pavilion by Brooklyn-based studio ai became New York's first public memorial to those affected by the AIDS epidemic.

PHOTOGRAPHY: © ARCHITECTURAL RECORD

IN 1988, at the height of the AIDS crisis, activist Vito Russo compared the epidemic to trench warfare, a nightmarish battle in which "every time a shell explodes, you look around and you discover that you've lost more of your friends, but nobody else notices."

Nearly three decades after Russo spoke those words—he later succumbed to complications from the disease—New York wants to make sure that everyone takes notice.

On World AIDS Day, December 1, government officials and grassroots leaders dedicated the city's first major public monument to all who were affected by the plague, honoring the more than 100,000 New Yorkers who died as a result of AIDS.

Invoking Russo's words, memorial cofounder Christopher Tepper said at the dedication, "With this memorial I hope we have given our dead and our leaders from our community a drop in the ocean of recognition they deserve."

They are memorialized by an elegant 18-foot-tall pavilion designed by the Brooklyn firm studio ai architects. The white steel-and-aluminum canopy rests delicately on the northern tip of the 0.4-acre park like a piece of origami. Its open, lattice-like roof and walls—made up of slatted triangular panels—surround a central fountain.

An installation by conceptual artist Jenny Holzer anchors the pavilion's crisp, white geometries: excerpts from Walt Whitman's "Song of Myself" spill across dark granite pavers in a dizzying spiral of text.

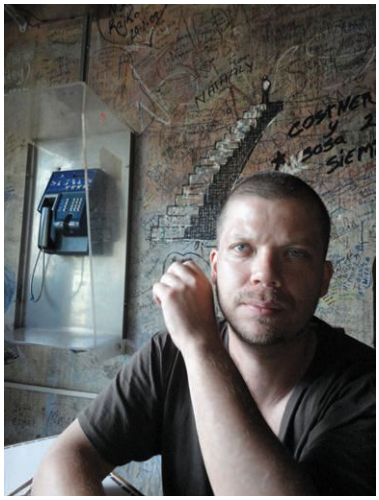
Passersby have already been treating the memorial like a familiar fixture in its Greenwich Village neighborhood, pausing to contemplate the text, or allowing their dogs to drink from the fountain. "I realized the importance of the memorial beyond the design," says Esteban Erlich, who created the pavilion with partners Lily Lim and Mateo Paiva. "The room makes room—it makes room for people to come and live in it, and use it, and feel it." ■

[NEWSMAKER]

Eric Cesal

BY MIRIAM SITZ

SINCE ITS establishment in 2008, the Curry Stone Design Prize has recognized practices and projects that use design to address social justice issues, making one unrestricted grant of $100,000 each year. But in 2017, the organization will celebrate its 10th anniversary by honoring 100 firms and practitioners, collectively dubbed the Social Design Circle, with stipends of $1,500 each. Small groups of the winners will be revealed month by month, starting in January with Teddy Cruz and Fonna Forman, Mark Lakeman, Arquitectura Expandida, Santiago Cirugeda, Pico Colectivo, and Ctrl+Z by Gianluca Stasi.



Special-projects director Eric Cesal and prize director Emiliano Gandolfi will speak with the honorees on a new weekly podcast, launching January 5, called Social Design Insights. Cesal chatted with RECORD about the year ahead.

What prompted the organization to mark its anniversary in this way?

When the prize started, it began with a focus on emerging practices in an emerging field. After a decade of the prize, we made the choice to honor 100 practices because of how far the social design movement has come. Many of our past winners have gone on to worldwide acclaim—we now live in a time when social designers are earning Pritzker prizes. We wanted the plan for 2017 to validate the progress that has been made in the field over the last 10 years, so the Social Design Circle was conceived to be exploratory and celebratory.

What about the selection of winners? How was it different from the method in years past?

The selection process did not involve a jury this year—it was internal amongst the Curry Stone team. Most of the candidates were drawn from the practices that we've examined over the years, the ones that took our thinking in new directions. We began with an archive of nearly 500 practices, and then we started asking ourselves, which are the 100 that most inspired us, and most changed the field?

What are some of the main characteristics of the winners you selected?

We decided to organize the year around 12 questions we think are the most urgent and daunting in social design now. We started looking at practices that were answering these questions through their work—for example, January's question of "Should designers be outlaws?" So we asked ourselves, what practices are really flirting with illegality, challenging conventional notions of illegality, and working in informal communities?

You're announcing the winners month-by-month in small groups, rather than all at once. What was the thinking behind that?

I think our ambition was to create a dialogue throughout the course of 2017. We wanted to stimulate conversation in the social design community and create space for our audience and Circle members to think about these questions.

What led to developing a podcast around the winners and these themes?

I think there was a certain sort of natural enthusiasm for it. I mean, these are practices that we've admired for years and wanted to bring to the public's attention, so the podcast becomes, essentially, an armature for facilitating a year-long discussion about the state of social design and where it might go in the next 10 years.

Can you give us a sneak peek of any interesting conversations that emerged as you were talking with winners for the podcast?

I can tell you about one from January. The interview with Mark Lakeman, of the City Repair Project in Portland, on the subject of "Should designers be outlaws?" was an extremely interesting, historically based conversation about colonialism: how urban policy in the early 20th century essentially turned communities into economic vehicles, and roads into means to do shopping and promote commerce. The City Repair Project's work is really about inverting that, and returning to a more humane way of organizing neighborhoods, where the street is a public space, controlled and commanded by the people who live there, rather than vehicles.

What's the future of the prize? Next year, will it return to the old model?

Yes. Next year, we plan to return to our previous format, so there will be between one and five winners. ■

noted

Antarctic Research Center to Be Moved as Ice Shelf Cracks

The Halley VI Antarctic Research Station, designed by Hugh Broughton Architects for the British Antarctic Survey, will be towed almost 15 miles inward from its current location on the Brunt Ice Shelf. Two chasms in the ice sheet have started to grow, threatening to break and trap the station on an iceberg.

Studio Gang to Design Arkansas Arts Center

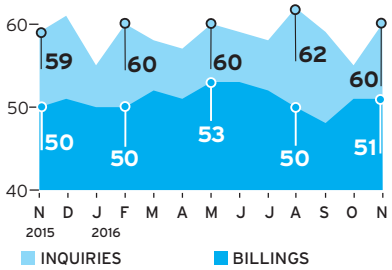
The Arkansas Arts Center has selected Jeanne Gang and her firm to lead the redesign of the central Arkansas cultural center located in Little Rock's historic MacArthur Park. Studio Gang beat out finalists Allied Works, Shigeru Ban, Thomas Phifer, and Snøhetta in winning the commission.

Brett Steele Appointed Dean of UCLA School of the Arts and Architecture

Currently the director of the Architectural Association School of Architecture in London, Steele will assume leadership of the UCLA school in August 2017, following interim dean David Roussève, who has held the office since July 2015.

London Mayor Announces Winner of Illuminated Bridge Competition

Sadiq Khan, the mayor of London, announced the winner of an international contest to illuminate several bridges along the River Thames. American artist Leo Villareal—who illuminated the San Francisco–Oakland Bay Bridge in 2013—and architects Lifschutz Davidson Sandilands will design the permanent installation, to be revealed later this year.



ABI Holds Steady

After a few turbulent months, the AIA's Architecture Billings Index (ABI) remained on steady footing in November, reaching a score of 50.6, a slight decrease from a score of 50.8 in October (any score above 50 indicates an increase in billings). The new projects inquiry index, meanwhile, increased by 4.1 points to score 59.5. AIA economist Kermit Baker cautions that these indicators may shift with the new presidential administration, but "so far, the market seems to be reacting positively."

PHOTO: COURTESY ERIC CESAL

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perspective **house of the month**

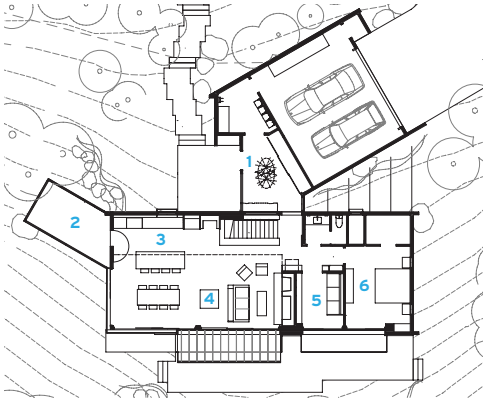
STUDIO BERGTRAUN ARCHITECTS BUILDS A CUSTOMIZED MOUNTAIN RETREAT FOR OUTDOORSY CLIENTS. **BY MIRIAM SITZ**

WHEN AN adventure-loving couple decided to build a second home in the mountains for hosting friends, grown children, and—someday—grandchildren, they enlisted California-based Studio Bergtraun Architects to design it on a steep site in the Sierra Nevadas near Lake Tahoe. The firm took cues from the owners' active, family-focused lifestyle to create a highly customized house on a challenging terrain.

Situated on a 23-degree slope that receives some of the region's heaviest snows, the steel-frame structure's poured-in-place concrete-mat slab is pinned to the hill's underlying granite. Lead architect Alex Bergtraun undertook a considerable study of the steep site to create a driveway with a less than 5 percent incline that would allow the clients to pull in easily and, after a long day of skiing, enter the mudroom without having to navigate stairs.

In order to accommodate different combinations of occupants, Bergtraun designed a two-level structure with a lower floor that can be closed off. There, built-in bunk beds (accessible via rock-climbing holds) and two bedrooms for the couple's adult children flank a central family room. Upstairs, the main floor contains the master suite and kitchen, living, and dining areas. A concrete bridge extending off the kitchen provides a small patio for grilling but requires minimal snow shoveling. (Thanks to the installation of climbing hooks on the edge, it also provides a platform for rappelling down to the creek below the house.)

The architect used local granite boulders and native plants in the landscaping (top and above). A Bay Area designer created dining room chairs (bottom) with recycled canvas hose from the local fire department.



GROUND-FLOOR PLAN

0 16 FT. 5 M.

1 ENTRY
2 DECK
3 KITCHEN
4 LIVING/DINING
5 LIBRARY
6 MASTER BEDROOM

"When it's just the two owners, they can close off the lower section and heat only their area," says the architect, "but in the future, when the whole family is present, the lower floor can become a space for younger generations to bond."

LED uplights throughout the house reflect warm tones from the Douglas fir ceilings, while hot-rolled steel on the fireplace and cabinets provides contrasting texture. Custom furnishings continue the rustic-and-industrial theme: Bergtraun built an extra-long dining table with a galvanized-steel top, large industrial wheels, and leftover glulam.

"The clients wanted to make this a place that was really their own," says Bergtraun. "It's already become a hub of activity for family and friends, and it will be for years to come." ■

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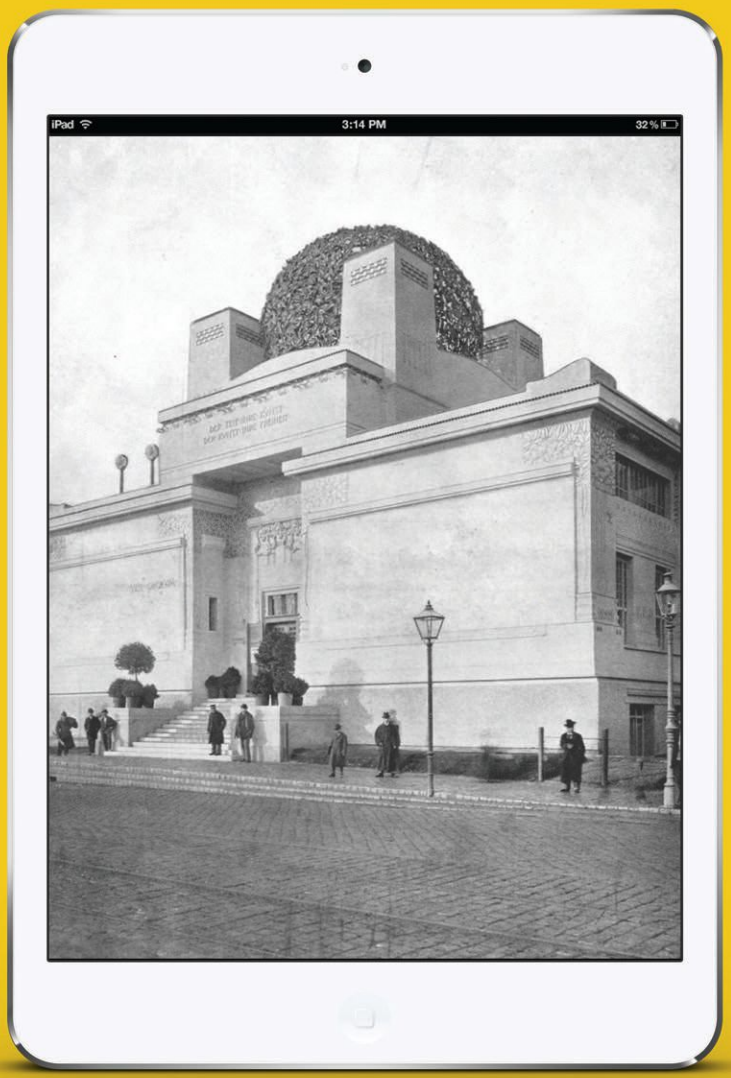

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perspective**interiors**

SHANGHAI-BASED X+LIVING CREATES A LANDSCAPE OF BOOKS IN HANGZHOU, CHINA. **BY CLIFFORD A. PEARSON**

With a mirrored ceiling reflecting its well-stocked walnut shelves, the reading room of a new Zhongshuge Bookstore invites customers to sit and read on its tiers of pillowed platforms.

PHOTOGRAPHY: © SHAO FENG

FOR CENTURIES, Chinese artists have drawn inspiration from Hangzhou's scenery—its forests and famed West Lake. Today, the city—110 miles west of Shanghai and connected by high-speed rail—has become a high-tech hub, with e-commerce giant Alibaba Group based there. Li Xiang, founder and design director of the Shanghai firm X+Living, skillfully fuses these influences—nature and technology—in her design of a 10,800-square-foot Zhongshuge Bookstore in the city's Binjiang commercial district, close to the Qiantang River.

As customers enter the store, they discover a "forest" of white columns that double as vertical bookshelves. Mirrors on the ceiling and back wall of this space multiply the book "trees," while glossy white floors provide a machine-honed ground plane. "Trees offer oxygen for lives," says Li. "We tried to convey the idea that people need knowledge just as people need oxygen."

Walking through a threshold in the mirrored wall, customers cross a long "reading corridor" lined with floor-to-ceiling walnut bookshelves and arrive at an oval-shaped reading room that steps up in a series of terraces. Bookshelves, also walnut, wrap around readers as they sit on beige cushions scattered on the tiered platforms. A wood floor and brass reading lamps add warmth to a space that feels like a cocoon for learning. Again, mirrors on the ceiling play games with the perception of space, fooling the eye into seeing an expanding universe of colorful publications. The 9-foot 2-inch shelves seem to go on forever. "We used round, stepped bookshelves to represent Qiantang [West] Lake," says Li.

The Hangzhou shop, which has 20,000 books, is the fifth that X+Living has designed for Zhongshuge, after three in Shanghai and one in Yangzhou. Each has its own character but shares a certain DNA with the rest of its retail family, luring customers with a procession of dramatic spaces that entice them to browse, sit, and read. Each tells a story, says Li. In Hangzhou this involves the connection between the natural and man-made worlds.

Trained at Birmingham City University in England, Li founded X+Living (formerly XL-Muse) in Shanghai in 2011, offering services in architecture, planning, interiors, landscape design, engineering, and design consultation. In 2015, she also started a furniture brand, Xiang Casa, building on this multidisciplinary approach. At the Hangzhou Zhongshuge store, Li filters traditional Chinese fixations—a forest, a lake, an outdoor scene—through a modern, international sensibility to create a series of memorable rooms that engage the store's customers in a book-lined embrace. ■

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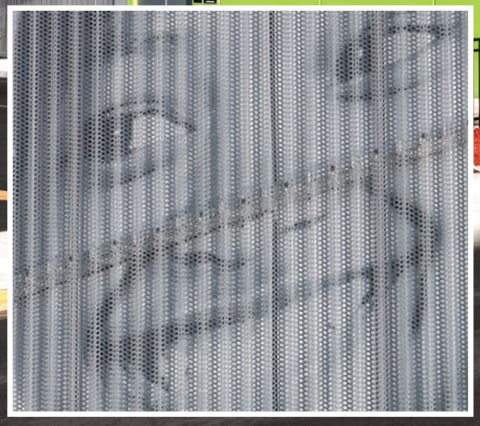

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The answer to the November issue's Guess the Architect is **THOMAS JEFFERSON**. After Jefferson had retired from the presidency of the United States, he helped found the University of Virginia in Charlottesville in 1819. He also conceived the plan and design of this handsomely proportioned and detailed classical style "academical village," among several other architectural projects.

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Blurring the Boundaries

An architect looks back on the contributions of landscape architect Diana Balmori.

BY JOEL SANDERS

Landscape architect Diana Balmori died of lung cancer on November 14 in Manhattan at the age of 84. Balmori was born in Gijón, Spain, and grew up in Tucumán, Argentina, where she studied architecture and met her husband, César Pelli. The couple migrated to the U.S. in 1952. Balmori earned a Ph.D. in urban history at UCLA and, after the two moved to the east coast, she turned to landscape design, working in Pelli's New Haven office and teaching at Yale University. In 1990, she founded Balmori Associates in New York, and designed major landscape and urban design projects for Bilbao and Sejong, South Korea, among other places. Her longtime collaborator, architect Joel Sanders, reflects on Balmori's contributions.

Once in a lifetime, fortune puts us in contact with an individual who changes how we see the world. For me, that person was Diana Balmori. Our first encounter was a post-lecture dinner at the Yale School of Architecture in 2002, where we both were teaching. A lively conversation evolved into an eye-opening, 14-year professional collaboration that exposed me to a new discipline—landscape—which had not been central to my way of thinking or working.

Diana possessed an expansive intelligence that allowed her to make connections across disciplines, resulting in her conception of environmental design as a practice shaped by the intersection of formal, technical, social, and political concerns. Although she was private by nature, I came to realize that her diverse interests and mind-set stemmed at least in part from the influence of her father, Clemente Hernando Balmori, a linguist, and her mother, Dorothy Ling, a pianist and composer, who fled the Spanish Civil War for political reasons, eventually settling in Argentina. There Diana studied architecture, but her student activism prevented her from getting her degree.

A polymath, Diana studied urban and landscape history, and worked in a variety of academic and professional contexts in the U.S. before launching her own office in New York. Her unorthodox career trajectory made her a wonderful collaborator and teacher—an agile thinker who addressed design problems from multiple perspectives and brought sustainable principles to her formally and programmatically provocative projects, which wove together people, buildings, and sites.

An elevated linear park is part of a master plan for the Administrative Complex, Sejong, South Korea, by Balmori Associates, in association with Haeahn Architecture and H Architecture.

Diana understood that this integrated model of practice required a new way of thinking and working. Although we came from different generations and backgrounds, Diana and I shared a common bond: we were each sensitive to the way gender stereotypes shaped design approaches and professional conduct, leading to the marginalization of landscape as a practice tainted by an association with feminine and decoration. Diana bristled when she recounted the way architects invited her to "shrub up" their completed "object" buildings. She championed an inclusive design process, advocating that landscape architects be involved with a project from its inception.

I suspected that Diana's experience as an activist and feminist motivated her to become a polemical advocate for landscape as a profession and for its own set of design principles. That, and her fierce determination and independent spirit gave her the confidence to strike out as a sole practitioner at an age when others would be contemplating retirement.

Endlessly curious, Diana continued to acquaint herself with innovative developments in art, design, science, ecology, and computation. I marveled at her acquisitive eye for the new: identifying up-and-coming designers for our co-edited book *Groundwork: Between Landscape and Architecture* (2011), assembling top-notch consultants for projects we pursued together, or curating itineraries for Yale studio trips to China, Japan, and India. The students and I could barely keep up with her as she navigated the crowded streets of Delhi or strolled the gardens of Suzhou.

Out of respect for Diana's eternally youthful spirit, I resisted the temptation to Google her age, a number I never learned until her death. I am one of many who will miss her as a designer, theorist, historian, and friend. ■

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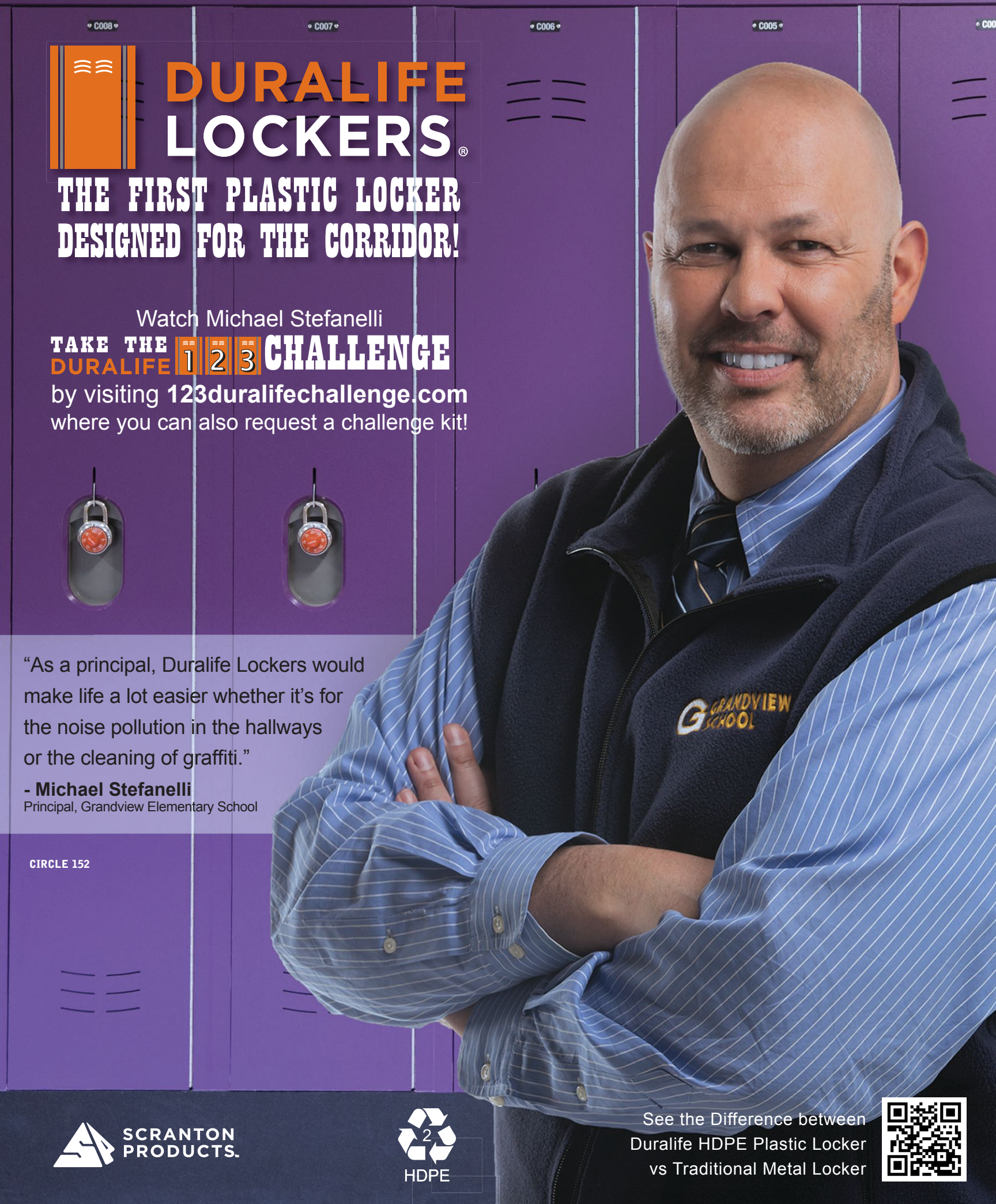

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- Michael Stefanelli
Principal, Grandview Elementary School

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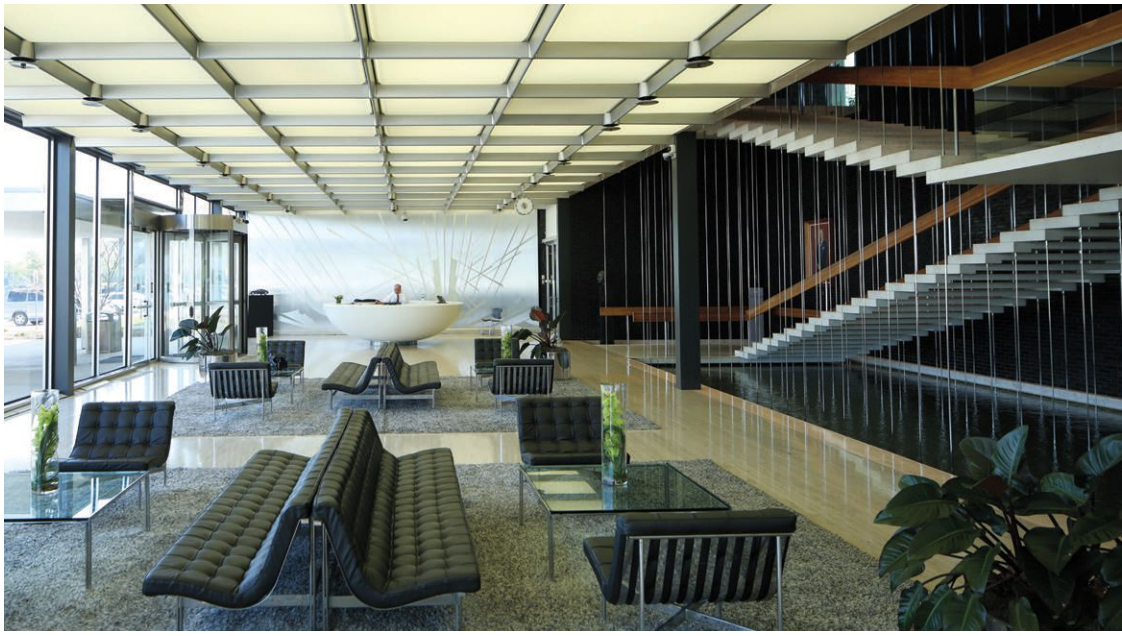
The Saarinens: Father and Son

BY DANTE A. CIAMPAGLIA



A new documentary traces the work and career of architect Eero Saarinen (left) through the eyes of his son, Eric (above). The film explores many of Eero's projects, including the GM Technical Center (top).

WHEN ARCHITECT Eero Saarinen died suddenly in 1961, some of his most important work was still under construction. The TWA Flight Center, Dulles International Airport, and the Gateway Arch were all incomplete—not unlike the truncated relationship he had with his son, Eric. More than 50 years later, Eero's buildings are monuments to his brilliance and creative foresight. But for Eric, they're different kinds of reminders: of an absent father, a man who left his family for another woman, and for his work.

That emotional thicket of appreciation and resentment, of celebration and pain, is at the heart of the documentary *Eero Saarinen: The Architect Who Saw the Future*, which first aired on PBS December 27. Directed by Peter Rosen, with cinematography by Eric Saarninen, it's an ambitious film that attempts more than its one-hour running time can handle. (The DVD version is 68 minutes.) But by introducing Eero's buildings through Eric's exploration of them, we engage with the architecture on a human rather than a purely conceptual level.

The documentary is mainly a profile of Eero Saarinen, born in 1910 in Finland. His father, Eliel Saarinen, emigrated to the U.S., founded his own practice, and became the architect and president of Cranbrook Academy of Art in Bloomfield Hills, Michigan. Eero joined Eliel's firm in 1936, bested him in 1948 by winning the St. Louis Jefferson Memorial competition with his design for the Gateway Arch, then took over the business when Eliel died in 1950. This began a torridly productive 11-year period: the General Motors Technical Center, the TWA Flight Center, Ingalls Rink at Yale, the Miller House, North Christian Church. Eero had become one of the world's preeminent Modernist architects, and then suddenly died after surgery for a brain tumor.

In all, the film covers 11 projects, and his furniture line with Knoll, at a breakneck pace that necessarily gives us surface-level examinations of the work. But this is mitigated by interviews with associates like designer Niels Diffrient and architect Kevin Roche, whose own career took off by completing the CBS Building, among others, after Saarinen's death. They add a level of intimacy to Saarinen's work that elevates the building tour above simple cataloguing, as do insights about the work and life by architect Robert A.M. Stern, biographer Jayne Merkel, and RECORD editor in chief Cathleen McGuigan.

But, still, the core of the film is Eric's search for closure with his father. He felt abandoned when his father left him, his sister, and mother in 1954 to marry journalist Aline Louchheim, with whom he'd been having an affair. But the estrangement began even before the affair, as Eero prioritized career over family. He spent little time at home, sacrificing his family for his drafting table and oversized design models. When he died, he left an open emotional wound that Eric found difficult to suture.

The documentary exists as part memoir and part therapy, in the spirit of *My Architect* (2003), Nathaniel Kahn's portrait of his father, Louis Kahn. The familial dynamics at play in that film are different from what Eric experienced with Eero, but there is a similar need to understand who this man was and the price those around him paid for his relentless striving.

As Eric explores his father's buildings, he sees many of them with fresh eyes—not necessarily dispassionately, but critically and appreciatively and often with wonderment. Through him, we experience Eero's architecture with a similar sense of awe. Through the architecture, Eric solves the crisis at the center of his relationship with his father. "I never saw it from his point of view," Eric says; "I forgive him for his genius." It's an emotional application of a lesson Eliel taught Eero: "Perhaps the most important thing I learned from my father was that any design problem should 'see' the solution in terms of the next-largest thing," Eero says in the film. "A chair in a room, a room in a house, a house in an environment."

A dysfunctional dynamic between father and son is surely more complex than a design problem. But by fostering this kind of connection across three generations of Saarinens, *The Architect Who Saw the Future*—despite its compression—taps into a kind of cosmic poetry that's unexpected, expansive, and beautiful. ■

PHOTOGRAPHY: © ERIC SAARINEN, ASC/PETER ROSEN PRODUCTIONS (TOP); PETER ROSEN PRODUCTIONS (BOTTOM, RIGHT); MANUSCRIPTS & ARCHIVES, YALE UNIVERSITY LIBRARY (BOTTOM, LEFT)

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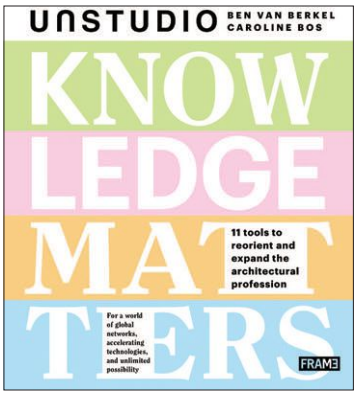
Rules of the Game

Knowledge Matters: Eleven Tools to Reorient and Expand the Architectural Profession, *by Ben van Berkel and Caroline Bos. Frame Publishers, November 2016, 400 pages, $32.*

Reviewed by Anthony Vidler

FROM ITS founding in 1988, the Amsterdam-based UNStudio worked to tame the digital monster by using judicious understanding and historical precedent, abstractly applied. Early on, the studio, led by the authors, Ben van Berkel and Caroline Bos, realized that the formal methods for controlling parametric design were not the same as those of architecture's centuries-old geometrical and proportional applications. The division of the design program into spatial elements and those spaces' careful composition had given way to a topological mathematics of surface.



Taking the Möbius strip as the common denominator of their experiments, UNStudio found in the strip's looping continuous surface a model for the distributed forms of domesticity as they changed and shifted from day to night. The result was the Möbius House of 1998 in Het Gooi, the Netherlands. With great ingenuity and an innovative plasticity, the studio then developed this matrix into an interlocking circulation route for the Mercedes-Benz Museum, which opened in Stuttgart, Germany, in 2006.

Now, employing their accumulated knowledge in a compendium of 400 pages, van Berkel and Bos have developed a guide that not only serves as a record of their own practice and approaches to design, but acts as a primer for any office concerned with controlling the parametric with acuity and architectural force.

The studio's approach is refreshingly down-to-earth in a moment when fictions about the "parametric style" are flooding the internet with fake news of innovation. The book's chapters deal with the tools required for what the authors call "the twist," "the managed void," and "the big detail" (which includes ceilings and stairs, roofscapes and facades).

A well-thought-out historical introduction sets the scene: a profession trained to deploy design in the service of single buildings is now called upon to display expertise in a widening range of tasks. This expanding role, the authors say, is performative—in the sense of forecasting what design does and in developing a hybrid knowledge that draws its force from a wide range of formerly distinct disciplines. The 11 "tools" relate to the work of UNStudio and are framed according to the dominant characteristics of its projects.

This is at once a version of an *oeuvre complète* in the process of being assembled (the lesson of Le Corbusier has been well learned) and a "how-to" manual on the order of a Bucky Fuller handbook or even the old-fashioned composition treatises handed out to the Beaux-Arts students.

The difference between these two examples, of course, is in the level of technical and technological knowledge being applied, and the complexity of the interrelations among the 11 knowledge tools. Here, perhaps, following the exhilarating journey through the firms' trajectory over many decades, we might want a smaller and more concise guide to the new world of information and its potential controls. Regarding the book's graphics, a little more control of color (digital "color" is at best a poor version) and a more sober use of blow-ups and scale changes would have led to a less giddy ride.

This said, I have yet to come across the equal to this investigation of the recent past and the potential future; and I have yet to find a firm as knowledgeable, and as aware of the appropriateness of differing scales and movements in urban design.

Whether one stands on UNStudio's Erasmus Bridge (1996) that leads to the old transatlantic terminals of Rotterdam—with its extraordinary tension of cables and support—or spirals down the ramps of the Mercedes-Benz Museum, the control of the architect seems ever-present, refusing to be coerced by the hyperdramatics of Grasshopper or the deceiving perspectives of Maya software. This book demonstrates how these works were achieved, and endows them, if not with "theory" in the conventional sense, with a narrative of process. ■

Anthony Vidler, the author of a number of books on history and theory, is the former dean of the Cooper Union School of Architecture.

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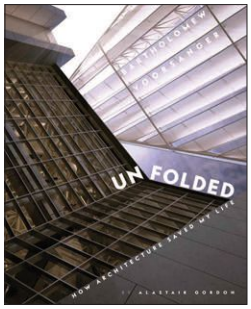
Design as Salvation

UNFOLDED: How Architecture Saved My Life/Bartholomew Voorsanger, *by Alastair Gordon. Oro Editions, 184 pages, $34.95.*

Reviewed by Fred A. Bernstein

BARTHOLOMEW VOORSANGER is best known for museum projects, such as the Asia Society Museum renovation in New York (2001), and a series of sprawling houses from Martha's Vineyard to Montana. To his credit, the architect expounds on disappointments as well as successes. Describing a competition he lost—for a World War II museum in Poland—he tells Alastair Gordon that he "failed to understand the national culture and the intent of the jury." He concedes that his rejected entry for the expansion of the Brooklyn Museum didn't provide an iconic space. But most of Voorsanger's candor is reserved for his personal life. Born in 1937 in Detroit, he and his twin brother, Neil, spent three years in the Hebrew Orphan Asylum of New York after their seamstress mother gave them up. They were occasionally "chosen" by foster families, and then returned to the facility weeks or months later. Voorsanger remembers the grim orphanage as a series of wards, set enfilade, and has always avoided such linearity in his work. At age 3, the boys were adopted by a prominent San Francisco couple named Voorsanger, known for their interest in the arts. But the damage had been done. Bart was a terror as a child—he once struck a teacher and had to be home-schooled; another time, he vandalized a neighbor's marble mansion with black shoe polish. His twin, at age 11, blinded himself in one eye by firing a pistol.



But architecture, says Voorsanger, gave him an outlet. At 13, he saw Bernard Maybeck's First Church of Christ, Scientist (1901) in Berkeley. Overwhelmed by its beauty, he decided to become an architect. After studying at Princeton and Harvard, Voorsanger worked for the urban planner Vincent Ponte in Montreal, then spent 10 years with I. M. Pei in New York before forming a partnership with Ed Mills in 1978.

His devotion to his work, he says, led to the breakup of his first marriage, to Lisa Livingston, with whom he had adopted a daughter and a son. He endured tragedies: his second wife, curator Catherine Hoover, died of cancer. His daughter was murdered, and her son was killed in a snowmobile accident. (Voorsanger is now married to the museum executive Peggy Loar.)

Voorsanger & Mills won a number of important commissions including the Hostos Community College Allied Health Complex in the Bronx (1991), and a "garden court" joining sections of the Morgan Library on Madison Avenue (1992). But the partnership with Mills ended in 1989. "It was like being in another bad marriage," Voorsanger recalls. And in a setback not mentioned in the book, the Morgan Library demolished the 10-year-old garden court to accommodate Renzo Piano's 2006 expansion.

His firm, now called Voorsanger Architects, has completed such projects as the multiphased National World War II Museum in New Orleans (2009–2019), offices for the designer Elie Tahari (2003), and a number of houses distinguished by expansive roofs. Gordon sees the roofs, which often unfold like interlocking planes, as representing the shelter Voorsanger has been seeking since his childhood. He's come a long way from the orphanage. ■

Design Museum Redux

The London institution reopens at its new location in an adapted 1960s landmark, refreshed and reimagined by a trio of notable firms.

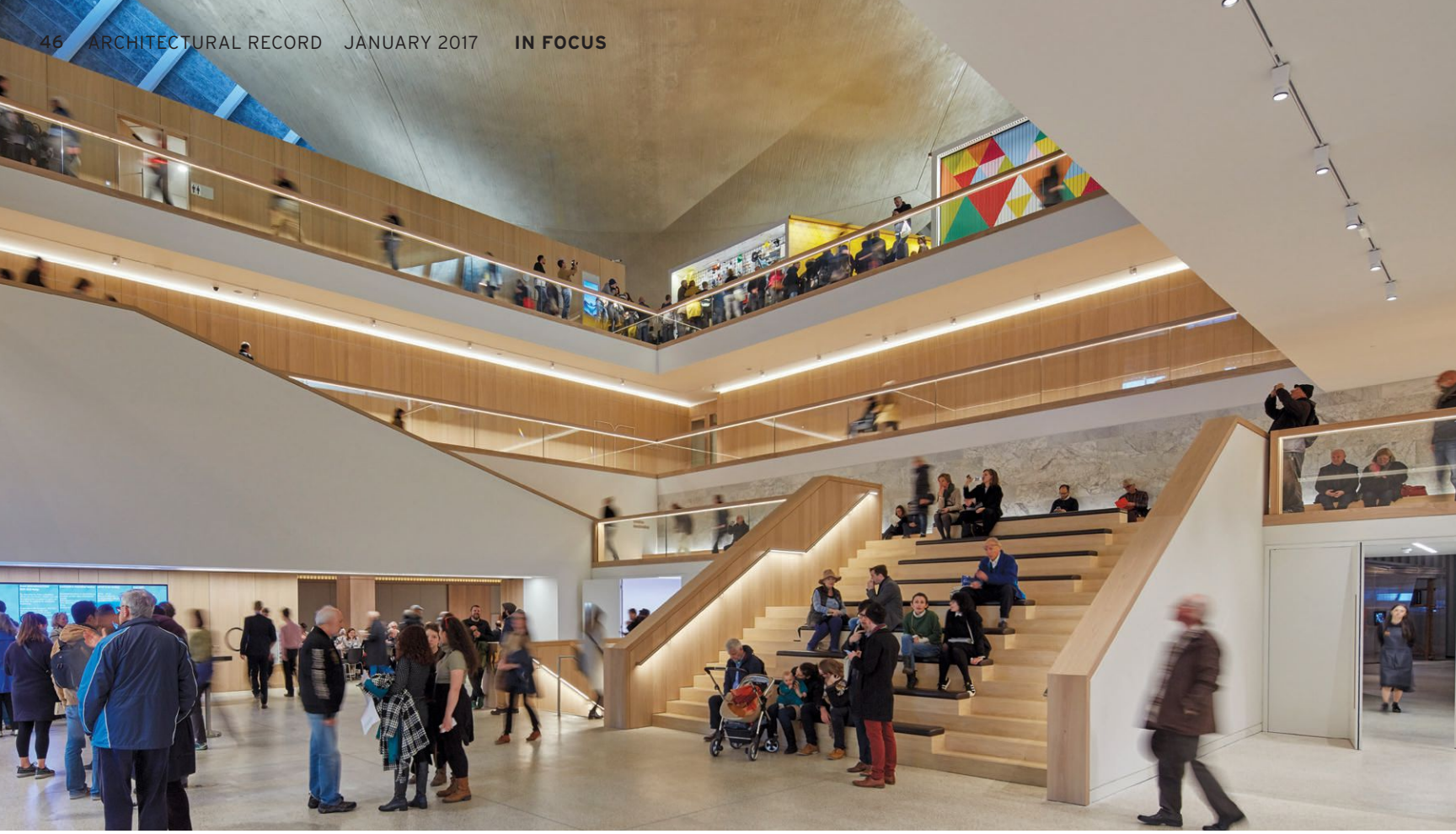
BY CHRIS FOGES
PHOTOGRAPHY BY PAUL RAFTERY

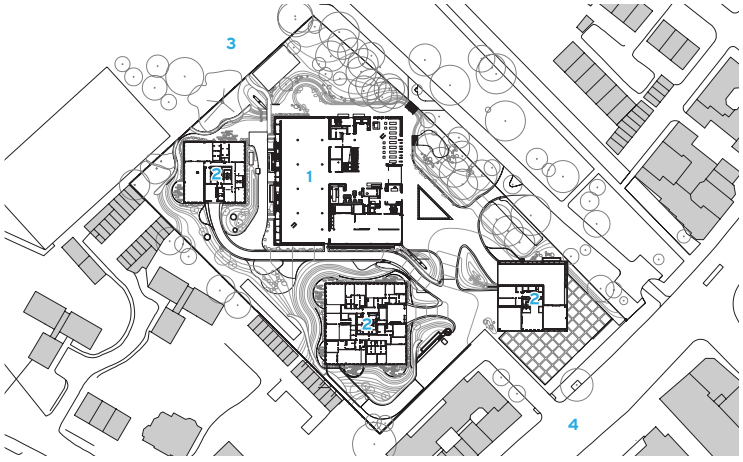
The museum occupies a renovated modernist landmark, now flanked by three OMA-designed residential blocks (Holland Green) set in a landscape by West 8 (left). Visitors enter the site through double-height arcades in the base of one of the apartment buildings on Kensington High Street (above).

FOR ALMOST 30 years, the Design Museum in London occupied a converted warehouse on the South Bank of the Thames, a compact building with a Bauhaus-inspired aesthetic that chimed with the mission of its founder, Sir Terence Conran: to champion good design for industrial production. Its move to a new home in west London, which opened on November 24, is a moment of reinvention both for the growing institution and for a celebrated modernist landmark that has been transformed by architects OMA, Allies and Morrison, and John Pawson to accommodate it.

With design now a hugely popular—and ever broadening—subject of public interest, the museum aims to triple its visitor numbers to 600,000 people a year, and to foster a deeper understanding of how design thinking can shape social, economic, and physical environments. “It is a museum of ideas rather than things,” as director Deyan Sudjic puts it. The inaugural show, *Fear and Love*, links design to such subjects of urgent concern as the impact of dating apps, anxiety at the rise of robots, and Britain’s post-Brexit identity. As the museum’s role is to “steer a debate about where design is going, exhibitions must be part of a wider ecosystem of discussions and events,” says chief curator Justin McGuirk. At 100,000 square feet, the new building is three times the size of the old, with spaces for conversation, programs, and hands-on creation as well as exhibitions.

Located on the southern edge of Holland Park, the original building, designed by RMJM, was built in 1962 for the Commonwealth Institute, to house a permanent exhibition about the nations of the former British Empire. Though protected, it had been empty since 2002 and was sufficiently dilapidated that demolition was considered before a developer, Chelsfield, stepped in with an offer to restore it in return for permission to build high-end apartments (now the Holland Green development) on the surrounding land. Working for the developer, OMA explored numerous reuse options, including a fashion-show venue for Prada and a





SITE PLAN

1 DESIGN MUSEUM
2 HOLLAND GREEN APARTMENT BUILDING
3 HOLLAND PARK
4 KENSINGTON HIGH STREET

References to the building's history are made through the selective reuse of original materials, including marble flooring that now lines a wall on the mezzanine within the atrium (top) and a stained-glass window that was relocated to the museum shop (above).

concert hall for the BBC, but then the Design Museum emerged as the likely occupant, lured by a 175-year, rent-free lease.

To adapt the structure, OMA and collaborating architect Allies and Morrison retained its unique copper-clad hyperbolic paraboloid roof and replicated the glassy aquamarine exterior walls with blue-fritted high-performance glazing, but they reconstructed the interior's floor slabs and structural cores above a new basement. Shorn of a chunky administration wing that adjoined its west corner, the rejuvenated building appears as an elegant, freestanding pavilion in the park, though closely flanked by three cubic housing blocks, by OMA, whose gridded facades contrast with the swooping, tentlike roof of the museum. Visitors approach from the south, off Kensington High Street, through a landscape created by West 8.

The renovation reinterprets the Institute's eccentric interior in a rationalized form that "strikes a balance between paying tribute to the building as it was and the needs of the museum," says OMA partner Reinier de Graaf. Previously, an asymmetric atrium was ringed by two

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Replacement glazing admits daylight and views to spaces such as the second-floor restaurant (above), but maintains the outward appearance of the original opaque, blue-glass facades during the daytime. At night, the fritted glass allows electric light to seep from the building (left).

upper tiers of open-fronted exhibition space, accessed via bridges from an elevated circular dais at the center of the plan. Though still organized around a central void that cuts through two upper levels to reveal the sculptural roof, the dais and bridges are gone, and a more compact, orthogonal form at the center increases usable space around the perimeter.

The entrance foyer leads directly into the new atrium that is the building's organizational heart, providing sight lines to two large galleries that occupy the northern half at the ground and below-grade levels, and to most of the principal spaces above: offices, restaurants, and rooms for education and events. The museum's interior architect, John Pawson, has created a grand processional route, beginning at a new central stair and spiraling upward around the atrium to a new mezzanine and the permanent-collection display on the top level.

The ground floor and basement have terrazzo floors and white-painted walls, while the upper levels are lined with oak, in counterpoint to the gray concrete vaults above. Warm light from discreetly concealed fixtures washes wood walls and sparkles on glass balustrades. Memories of the original building are preserved in reclaimed materials used as accents: chipped-marble flooring now lines one wall, and a stained-glass window illuminates the museum shop. With the soaring roof more fully exposed and well lit, it is a dramatic interior, but the new additions have a warm and quiet material character that is almost domestic. "I didn't want to make an overt display of design," says Pawson. "I wanted to make a space which curators can use as they choose, and where people can gather, relax, and enjoy themselves."

Broad steps that double as seating rise up to the mezzanine, where light spills from behind a long oak bench. The deep circulation routes are also meeting places and can be used for exhibitions, with picture rails integrated into the oak wall lining. This colonization is already evident in a scrolling advertising sign on the upper level that announces the permanent-collection display. Although a self-proclaimed "minimalist," Pawson is sanguine: "It's a design museum; it will always contain many voices." And while these relaxed spaces invite occupation, their spatial and material character will not be overwhelmed by the noise as more join in the conversation—a happy balance for an institution that wishes to be a forum, not a temple. ■

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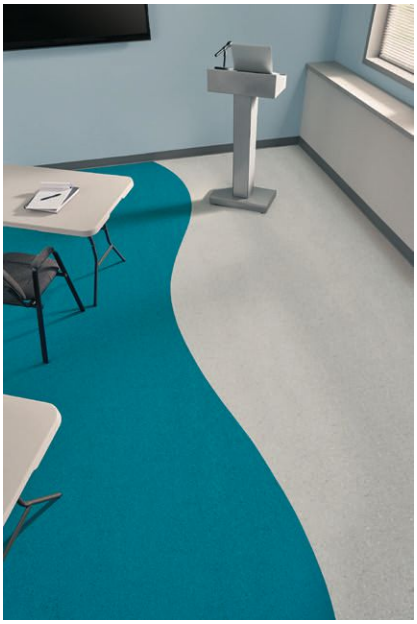
By Julie Taraska



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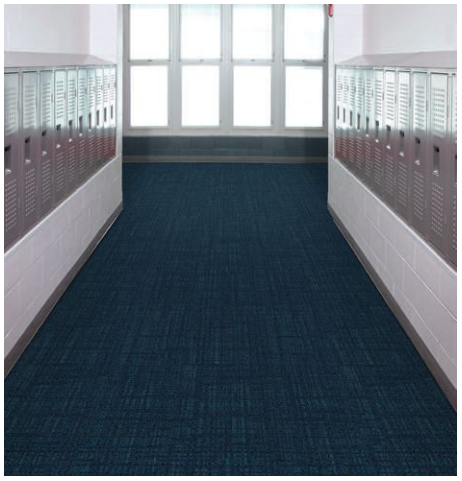

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HEAVY METAL

Steel is often used as structure and copper in the fine details. When these two very different metals are used as cladding, though, it is often to striking effect. This month, we feature two buildings that exemplify that. The weathering-steel exterior walls of a new concert hall at the Idyllwild Arts Academy in California blend in with the similarly hued wood buildings of the campus's bucolic setting. Conversely, the now-shimmering copper-clad Suvela Chapel contrasts sharply with the bland concrete structures that dominate the landscape of its Helsinki suburb. But its architect selected the material for more profound reasons. "Over time, the copper will acquire a beautiful green patina," says Anssi Lassila. "In that way, signs of age are visible in the building's face and contribute to a sense of the building being alive."

PHOTOGRAPHY: © MARC GOODWIN

SUVELA CHAPEL BY OOPEAA

William M. Lowman Concert Hall
Idyllwild, California | Sander Architects

For a Song

A high school for the arts gets a world-class performance space on a tight budget.

BY SARAH AMELAR

PHOTOGRAPHY BY SHARON RISEDORPH

From the gently sloping approach path, the William M. Lowman Concert Hall rises into view through a screen of tall pines at the Idyllwild Arts Academy. At first glimpse, the hall's reddish-brown cladding resembles the wood buildings that dot the surrounding rugged terrain, high in California's San Jacinto Mountains. This 205-acre property was once a summer camp. And though it evolved, about 30 years ago, into a professional-caliber boarding high school for the performing and visual arts, the campus has retained its original rustic character. But as you near the new concert hall, you realize its cladding isn't wood but pleated weathering steel, and the building's quiet complexity begins to reveal itself.

The facade—an irregularly faceted sheer face with a mountainlike roofline silhouette—echoes Lily Rock, the massive granite outcropping in the background. In designing the hall, Los Angeles–based Sander Architects (SA) cut back dense growth to reopen sight lines to this natural monument in the landscape; the designers also borrowed the rhythmic cross-section of folds across the hall's rusted skin from the ascending and descending notes of a musical score. Yet virtually nothing about the building is an indulgent or purely poetic gesture.

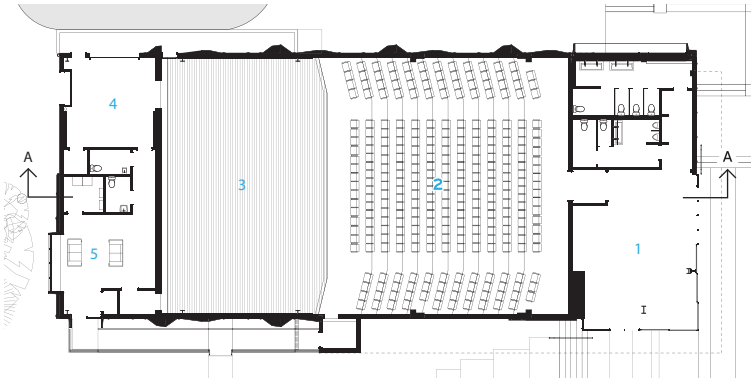
"From the inception, this was a real collaboration between architect and acoustician," says SA director of interiors Catherine Holliss. Nick Antonio, the project's acoustics consultant, then with Arup, was on board from the outset. "There was continuous melding of aesthetics, acoustics, structure, and sense of place."

The academy aspired to create a world-class performance hall for orchestral music, but its budget was extremely lean—ultimately translating into $4.3 million in construction costs for an 8,150-square-foot building. The architects responded by inventively adapting off-the-shelf and utilitarian building components, beginning with the structural skeleton: a prefabricated steel system more typical of ware-

house or farm-shed construction. SA already had extensive experience transforming such cost-effective, pre-engineered systems, "but bringing this approach to a cultural institutional project," says SA principal Whitney Sander, "was unusual."

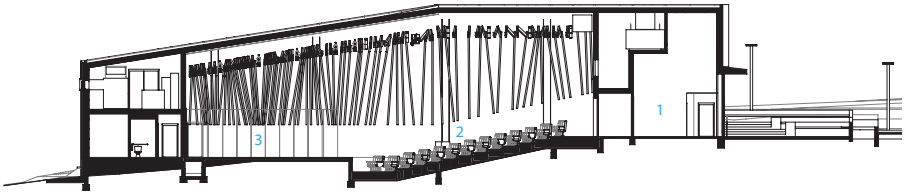
With Antonio, the architects determined the optimal proportions for the 300-seat hall and the need for a 54-foot clear span across it. Based on these design parameters, along with anticipated snow loads, wind, and seismic forces, building-system software proposed structural frames "with an interesting M-configuration on their undersides," Sander recalls. Though these steel profiles were calculated for practicality—including minimizing cost—aesthetically, he says, "we found the forms quite beautiful." Once Antonio confirmed

MUSICAL LANDSCAPE The concert hall is sheathed in weathering steel (above and opposite). The panels have an irregular topography derived from an abstracted musical phrase by composer Richard James. The rusted skin also alludes to the landscape of folded rock.



FIRST-FLOOR PLAN

1 LOBBY
2 CONCERT HALL
3 STAGE
4 STORAGE
5 GREENROOM



SECTION A - A

credits

ARCHITECT: Sander Architects

ENGINEERS: Costa and Associates (structural); Macasero Engineering (mechanical); JMD Engineering (electrical); C.A. Lampman Associates (plumbing); Stevens Group (civil)

CONSULTANTS: Arup (acoustics and theater); Exponent (fire and safety); Facility Builders & Erectors (pre-engineered metal building)

GENERAL CONTRACTOR: Hamel Contracting

SIZE: 8,150 square feet

COST: $4.3 million

COMPLETION DATE: April 2016

SOURCES

ENTRANCES: Kawneer

WOOD DOORS: Graham Wood Doors; Assa Abloy

PAINTS AND STAINS: Sherwin-Williams

TILE: Daltile

CARPET: Shaw

PLUMBING: Kohler

WINDOWS: Western Window Systems

FINE TUNED In the plywood-clad lobby, 40 pendant globe lamps hang at various levels (opposite, left). The 4-by-8-inch wood ribs that arch up the side walls and across the ceilings of the performance space are slightly offset to evoke a forest of trees and to scatter the sound and create cleaner acoustics for the performers (opposite, right, and above).

that such bends could enhance the acoustics, the architects exposed and extended them over the hall's entire ceiling.

This synergistic design process resulted in a state-of-the-art hall that fits comfortably into its laid-back campus. At the building's main entrance, wide, perpendicular glass doors slide apart, opening a corner of the lobby to the outdoors. The siting in relation to existing buildings defines an open-air gathering space, and the corner invites concertgoers out onto the terrace.

Inside, the lobby is a harmonious composition of simple elements. With a celestial quality, 40 pendant globe lamps hang at various levels overhead, swaying gently with air movement. The architects considered $10,000 chandeliers, but found this economical solution (at barely $100 per fixture) far more engaging—playing against a soaring ceiling, glossy concrete floors, and highly figured plywood wall panels, with metal channels for hanging artwork.

But the greatest achievement was the intimate performance space. In contrast to many concert-venue configurations, it's a rather simple box, but one animated by its acoustic and visual elements. In tuning the hall, Antonio called for sound-diffusing features, which the architects rendered as fins of exposed lumber, 4-by-8-inch planks, that extend up the side walls and follow the ceiling's M-shaped contours. "The surrounding pine forests," says Sander, "inspired ribs that lean at different angles the way tree trunks deflect slightly from the vertical." And, Antonio confirmed, this deviation from the parallel contributed to the acoustics. SA extended the "Hall of Trees" metaphor with dark green paint for the exposed wall surfaces and for the beams and ceiling above the zigzagging fins, where it tucked lighting and other equipment. Holliss chose paler green upholstery for the raked seating, furnishings also devised to maintain the hall's acoustic qualities whether it's packed or empty. Hidden under the chairs is an ultraquiet and efficient supply-air plenum that vents cooled or heated air from slits in the stair risers.

Compared with many other concert venues, Lowman Hall has a remarkably low cost per square foot. "A facility of this nature and quality could easily be double or triple the price," says performance-space expert Robert Young of Arup, who consulted on the project. Besides the interdisciplinary teamwork and deft use of inexpensive elements, it helped that this quiet bucolic site didn't require costly acoustic isolation from the outdoors. But the budget did not provide for such wish-list items as administrative offices or rehearsal rooms.

Since Lowman Hall opened in September—leaving the campus's older, far less musically sympathetic theater to drama and dance—the new hall has enjoyed constant use. Apart from performances and master classes, students are welcome to slip in and practice on stage throughout the day. As one young virtuoso violinist recently put it, "It's not just a beautiful hall—it's an amazing place to play." ■

Suvela Chapel | Espoo, Finland | OOPEAA

Going to the Chapel

A striking copper-clad assembly combines the sacred and the secular for a diverse community.

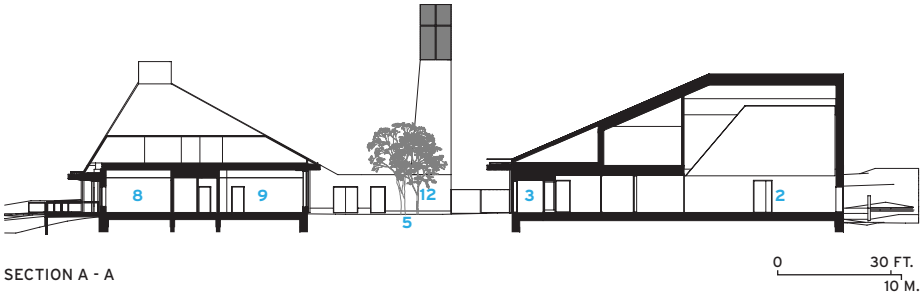
BY PETER MACKEITH

PHOTOGRAPHY BY MARC GOODWIN

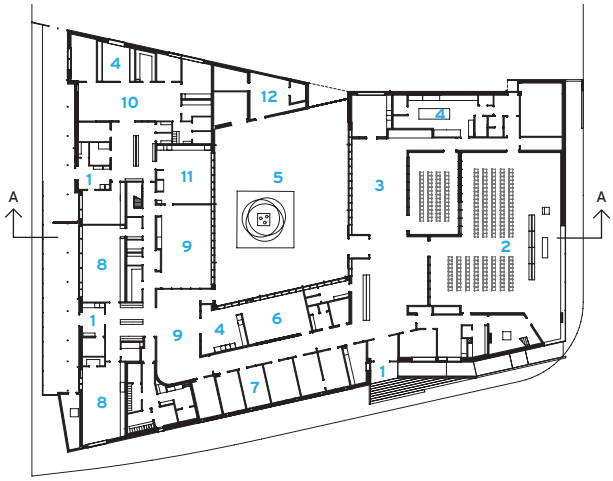
THE RIGHT ANGLE The dramatically pitched-roof form of the worship hall is clad entirely in copper.

In the darkening late-autumn twilight of Suvela, a Helsinki suburb, a young Chinese couple steps down from the bus at the neighborhood stop, returning home from their research day at the nearby Aalto University. Three Somali youths kick a soccer ball down the sidewalk, courteously allowing a hijab-adorned mother to push along a stroller. Behind them, inside the angled, prow-like form of the copper-striated, softly glowing Suvela Chapel, parishioners engage in spirited discussion with their pastors under the high, canted, and spruce-paneled surfaces of the worship hall. Across the chapel's interior cobblestoned courtyard, children of all backgrounds laugh, draw, paint, and perform throughout a series of colorful classrooms, each opening onto a playground and the adjacent park.

"What is a church supposed to look like?" asks OOPEAA principal Anssi Lassila. "There is no prototypical way of making a Finnish church. For us, it is a meeting place—a community center more than a place of worship." Lassila's assertions bear weight, coming after OOPEAA's completion of four significant and highly regarded Lutheran parish churches throughout Finland in the



SECTION A - A



GROUND-FLOOR PLAN

1 ENTRANCE
2 CHAPEL
3 CAFÉ
4 KITCHEN
5 COURTYARD
6 MULTIPURPOSE ROOM
7 PARISH OFFICES
8 DAYCARE
9 SPACE FOR YOUNG PEOPLE
10 KINDERGARTEN
11 HOBBY ROOM
12 TECHNICAL ROOM AND BELL TOWER

credits

ARCHITECT: OOPEAA (Office for Peripheral Architecture) – Anssi Lassila, architect in charge; Iida Hedberg, project architect (construction phase)

ENGINEERS: Pöyry Finland (structural, fire); Geotek (geotechnical); Ramboll Finland (electrical)

CONSULTANTS: Akukon (acoustics); Wise Group (HVAC)

GENERAL CONTRACTOR: YIT Rakennus

CLIENT: Parish of Espoo

SIZE: 25,800 square feet

TOTAL COST: $13.8 million

CONSTRUCTION COST: $7.4 million

COMPLETION DATE: September 2016

SOURCES

COPPER CLADDING AND WINDOW FRAMES: Porvoon Vaskisepät

WOOD CLADDING: Taskisen Puu

CUSTOM WOODWORK: Nikari

INTERIOR AMBIENT LIGHTING: Secto, Glasshütte Limburg

SPACE FOR ALL The building's site, adjacent to a park, encouraged the inclusion of a kindergarten and teen center (opposite). The interior courtyard facades are glazed structures of glue-laminated wood columns (above). The dramatically pitched-roof form of the worship hall has a sculptural and symbolic character (top, right).

last 15 years, a sequence now punctuated by the September 2016 dedication of the Suvela Chapel, a parish center already a finalist for the Finlandia Prize, the country's highest architectural honor.

Despite the open-ended nature of Lassila's question, the parish center provides an intense statement of OOPEAA's design approach: careful understanding of context, of purpose, and of construction—along with a keen sense of traditional Finnish typologies—intertwine to inform elegant design decisions.

Suvela is a rapidly growing district in the Helsinki municipality of Espoo, 9 miles west of the city center. While Espoo contains Tapiola, the quintessential "city in the forest" of ambitious post–World War II planning efforts, Suvela's peripheral architectural and urban character is more prosaic: mainly six- to eight-story housing blocks, constructed of blandly colored prefabricated-concrete panels, spaced judiciously amid the wooded terrain. Socially, the area reflects the increasing multiculturalism of Finland's capital region, with roughly one-third of its inhabitants being of foreign descent. By 2010, the growth led the parish to consider building a new church. A prominent street corner site adjacent to a park made civic needs—a teen center and a kindergarten—a further incentive. The project, paid for by the church and supplemented by rental income from the city, expanded for these combined sacred and secular purposes. "Context" in this built environment included recognition of the community to be served, diverse in background, age group, and need.

The courtyard typology OOPEAA employs is the Finnish vernacular of farm-building complexes, though also visible in more modern religious and civic structures—think of Alvar Aalto's 1952 Säynätsalo Town Hall. But the intelligent ordering of program into a visible U-plan type here is triply site-specific. It produces a definite boundary that addresses the activity and noise of the street corner and park; an enclosed courtyard for general entrance from the parking lots and for community gathering in good weather; and, lastly, a recognizable "head to tail" sequence in the plan, where the larger volume of the worship hall is accorded civic presence on the public corner, and the smaller-scaled program elements—offices, meeting rooms, classrooms, and service areas—are tightly arrayed as the enclosing limbs of the courtyard.

The courtyard organization also establishes an outer layer of public rooms and offices, sheathed in vertical copper panels and punctuated by window apertures specific to each room and orientation, with inflected expanses of wood panels inset by entrances. An inner layer of spaces for entrance, circulation, and meeting forms a territory known as an *aula* in Finnish.

If the courtyard plan responds on several levels to the context, so does the design, with its parallel sectional qualities of volumetric variation, controlled scale, and admission of daylight, all attentive to the surroundings and ambitions of a project with both religious and civic significance, and their technical requirements. Rising above the courtyard, the dramatically pitched–roof forms of the worship hall and children's learning center possess both sculptural and symbolic character, but their angled volumes also enclose the air-handling units and frame skylights that draw and direct natural light into these spaces.

OOPEAA's multiple commissions demonstrate a strong commitment to building well in the harsh Finnish climate, with distinct material quality, and within budgetary and other constraints. Copper was selected for its long, maintenance-free lifespan and its ability to clad an entire exterior, both walls and roof. The hybrid framing structure

GUIDING LIGHT The pyramidal form of the spruce-slatted worship hall is topped with a large window that directs daylight into the warm and tactile interior (above). In the other interior spaces, an outer layer encases a sequence of rooms for entrance, orientation, movement, and meeting (left).

combines reinforced-concrete bearing walls and steel framing elements, mounted with extensive wood trusswork undergirding the roof forms. The three-dimensional variations of copper panels resulted from a digital analysis of the building's surfaces, correlated to the maximum dimensions of standard copper sheeting. The eventual green patina over the untreated surface is seen by the architect as a desirable sign of age.

A similarly unifying palette was used on the interior, where surfaces are covered in spruce-slatted panels. In the worship hall, beyond the warmth and tactility of the spruce wall and ceiling, is a wealth of detail: softly rounded oak door handles in brass fittings, fritted glass wall panels inscribed with biblical verses in multiple languages, and custom chairs fabricated with the designer Mikko Paakkanen in keeping with a Nordic tradition. The layered glass screen wall behind the altar and baptismal font, vibrantly striated by the color spectrum, is the work of artist Hannu Konola.

In Finland, such commissions are usually awarded through an open competition, but OOPEAA was selected as part of an architect/contractor bid. That led the architects into direct engagement with the community, in a series of searching conversations over many months. Notably, this resulted in a one-story rather than multistory building, to create a welcoming and accessible space.

Suvela Chapel's fitting of form to purpose and its attention to design fundamentals achieve a dignified urban presence. The engaged process of its making, while less visible or material, is perhaps equally substantial: the built work has activated both the sacred and secular life of that community. To paraphrase the architect: in Finland, what else should a church be? ■

Peter MacKeith is the dean of the Fay Jones School of Architecture and Design, University of Arkansas; he has worked as liason between the architectural cultures of Finland and the United States for 25 years.

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"We sat with the architect for a year and a half to design the building. The students wanted to have this new building be modern and up-to-date and we wanted a facility that implemented environmental best practices."

LAWRENCE BERTE | Principal, Longmeadow High School

GREEN FROM THE GROUND UP

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SCHOOLS OF THE 21ST CENTURY

One size does not fit all when it comes to creating healthy, stimulating pre-K through 12th-grade environments. Budgetary demands, programmatic and capacity needs, culture, and locale are all factors. The architects of this year's featured projects have exceeded the demands of their clients, from a public high school in Arkansas to a grass-roots institution in Africa (pictured), delivering flexible, sustainable, and welcoming buildings—and never compromising quality.

LYCÉE SCHORGE BY KÉRÉ ARCHITECTURE

Fayetteville High School | Arkansas
DLR Group, Hight Jackson Associates, and Marlon Blackwell Architects

The Big Idea

A campus expansion and renovation provides rich opportunities for the students and faculty of a popular high school.

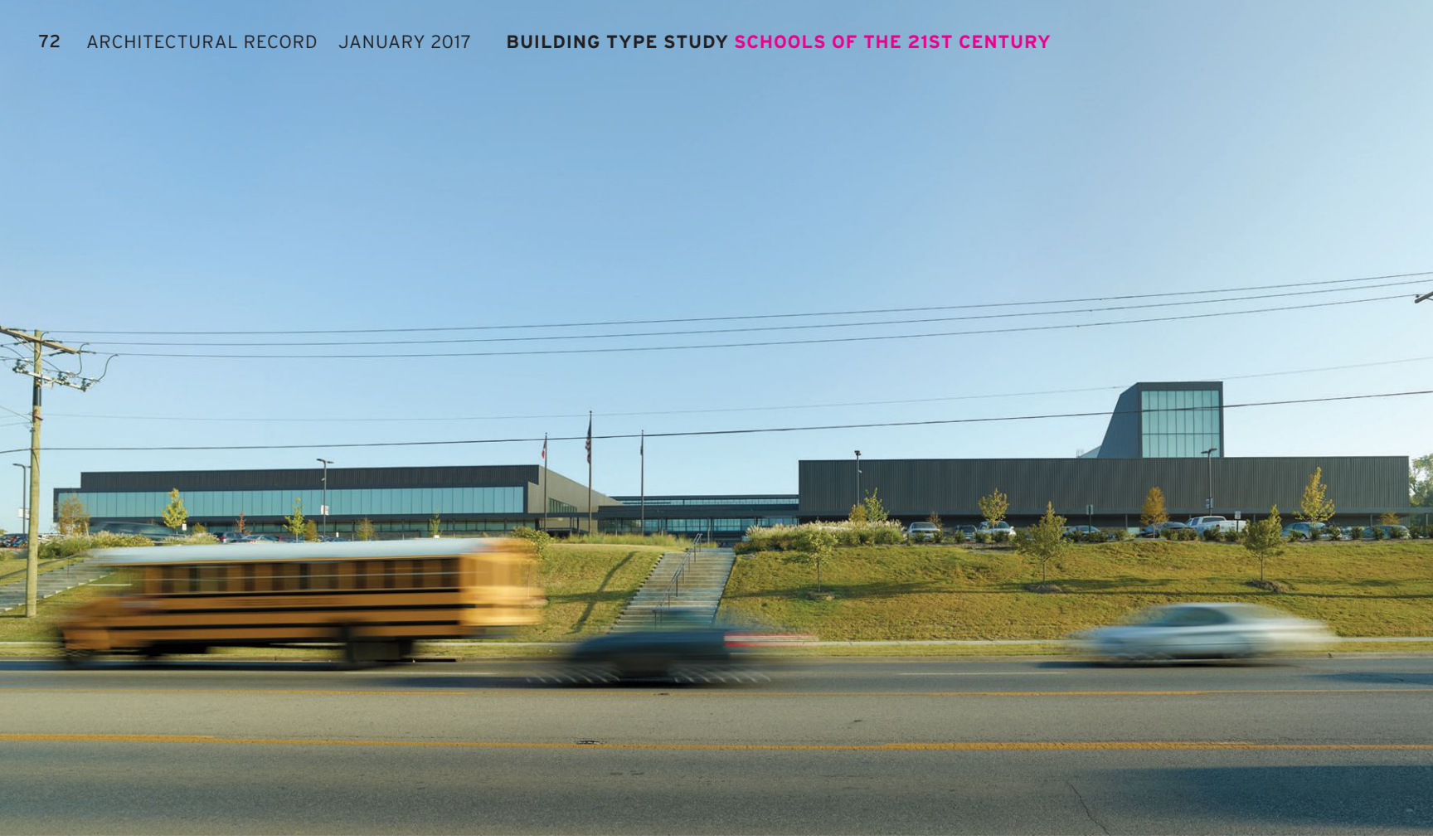
BY MICHAEL COCKRAM

PHOTOGRAPHY BY TIMOTHY HURSLEY

From the bird's-eye perspective of Google Earth, nothing in central Fayetteville or the adjacent University of Arkansas has a larger footprint than the new Fayetteville High School. Its two buildings, each 600 feet wide by 250 feet deep, appear like a supersize equal sign sitting on a hillside site.

Designed by DLR Group, Hight Jackson Associates, and Marlon Blackwell Architects, this 535,000-square-foot project was commissioned by Fayetteville Public Schools to accommodate a growing student body. Faced with an antiquated, undersized facility as well as pressure from the community to keep the central location, the city officials opted to expand and improve the existing 33-acre campus rather than split it into two smaller, distinct institutions. According to school administrator Alan Wilbourn, the district student population has not reached the 14,000-student tipping point to justify two high schools. Large enough for as many as 3,000 students, the modernized campus, built in two phases, was completed in 2015. In the first phase, which took

A LESSON IN RESTRAINT
Marlon Blackwell Architects took a minimalist approach to building form, detailing, and materials. The generously glazed Matthew William Moore Library spans over a shaded gathering space and borders a courtyard.



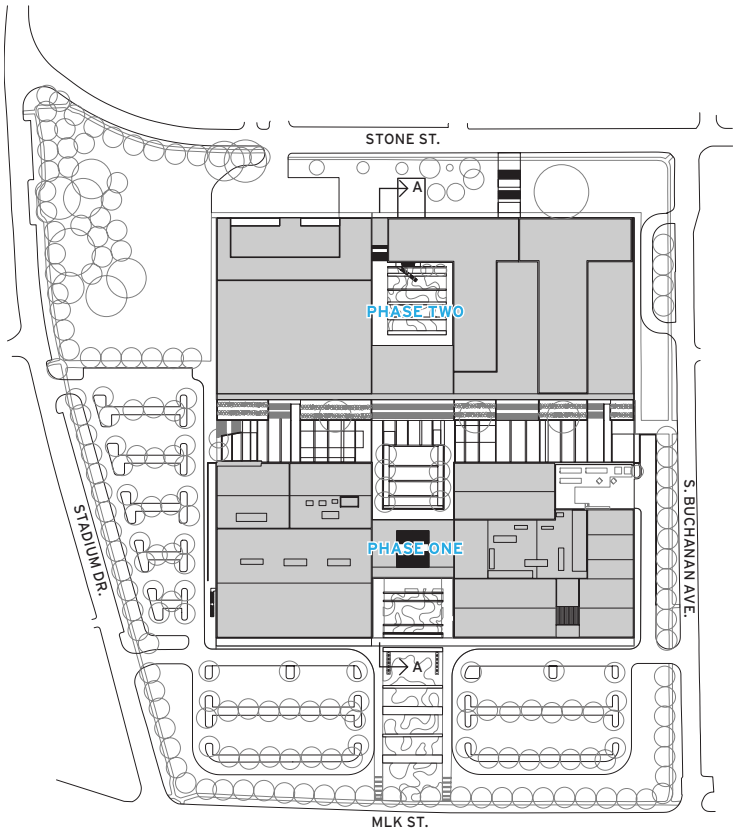
PHASE ONE
The renewed campus has a strong presence from the street (above). The school's main entrance (left) is flanked by a competition gym and the performance hall topped by the "Beacon," which serves as the theater fly for the auditorium. Student athletes (opposite, top) work out in the south-facing weight room. The Social Commons (opposite, bottom) connects to a skybridge between the sports arena and the performance spaces

two years, a new steel-frame and concrete-block structure that replaced elements of the existing school was built on the southern side of the site, near the bottom of the slope. It houses the sports and performing-arts facilities, and the cafeteria. The 36-month second phase involved an addition to the existing classroom building—similar in form and materials to the earlier project—while incrementally renovating much of the existing structure, all without disrupting the school schedule.

We took "a big-box approach," says Marlon Blackwell, whose firm was the design architect on the project. This minimalist strategy, with a spare use of detail, resulted in two massive building blocks that are articulated with large-scale bands of curtain wall windows and sculptural elements such as bridges and stairways that connect the major volumes.

The scheme is defined by a bold cross-axis circulation pattern that features a broad, boulevard-like plaza, named Green Street, that stretches east–west along the 600 feet between the main buildings. A narrower north–south axis follows the slope and traverses a series of broad staircases. The route begins at the main entry of the first-phase building, which is closer to a major road. Moving up the hill, under a glazed circulation bridge and through an open commons, it intersects Green Street and passes underneath the school's new library, which is raised to form another, wider bridge. The procession crosses a verdant courtyard at the heart of the classroom building and ends at the north portal, which connects to the athletic field complex.

The exterior material palette is a study in restraint. "Northwest Arkansas isn't really a red-brick kind of place," Blackwell says. "I joke that our cash crop is rocks." The design team used a 2-inch-thick veneer of local sandstone at the buildings' base, while charcoal-hued vertical-rib metal siding wraps the upper part. The use of simple materials and



SITE PLAN

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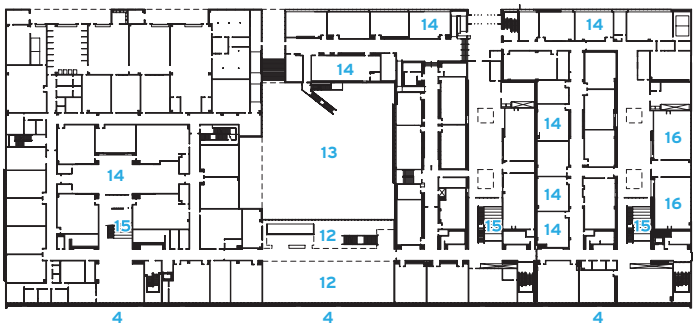
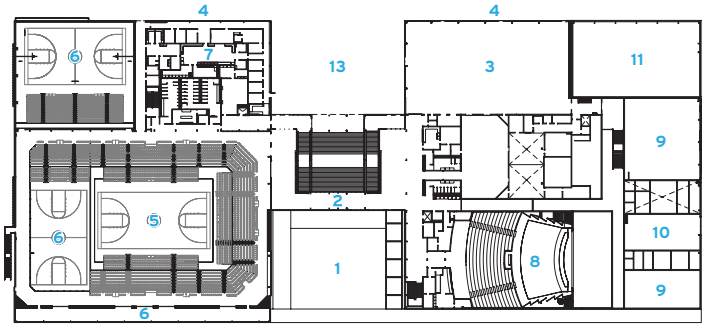
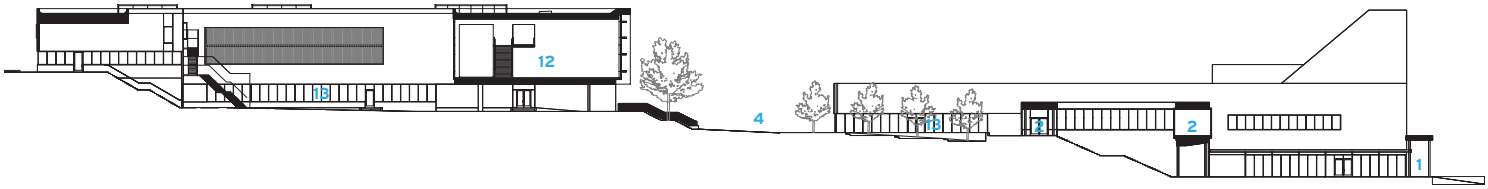


PHASE TWO LEVEL-TWO PLAN



PHASE ONE LEVEL-TWO PLAN

0 30 FT. 10 M.



SECTION A - A

0 30 FT. 10 M.

1 ENTRANCE COURTYARD
2 BRIDGE
3 SOCIAL COMMONS
4 GREEN STREET
5 COMPETITION GYM
6 AUXILIARY GYM
7 ADMINISTRATIVE OFFICES
8 PERFORMING-ARTS CENTER
9 BAND ROOM
10 CHORUS ROOM
11 DOCK/CENTRAL PLANT
12 MEDIA CENTER/LIBRARY
13 COURTYARD
14 CLASSROOM
15 GRAND STAIRWAY
16 SCIENCE LAB

building forms were key in keeping construction costs within the $80 million budget.

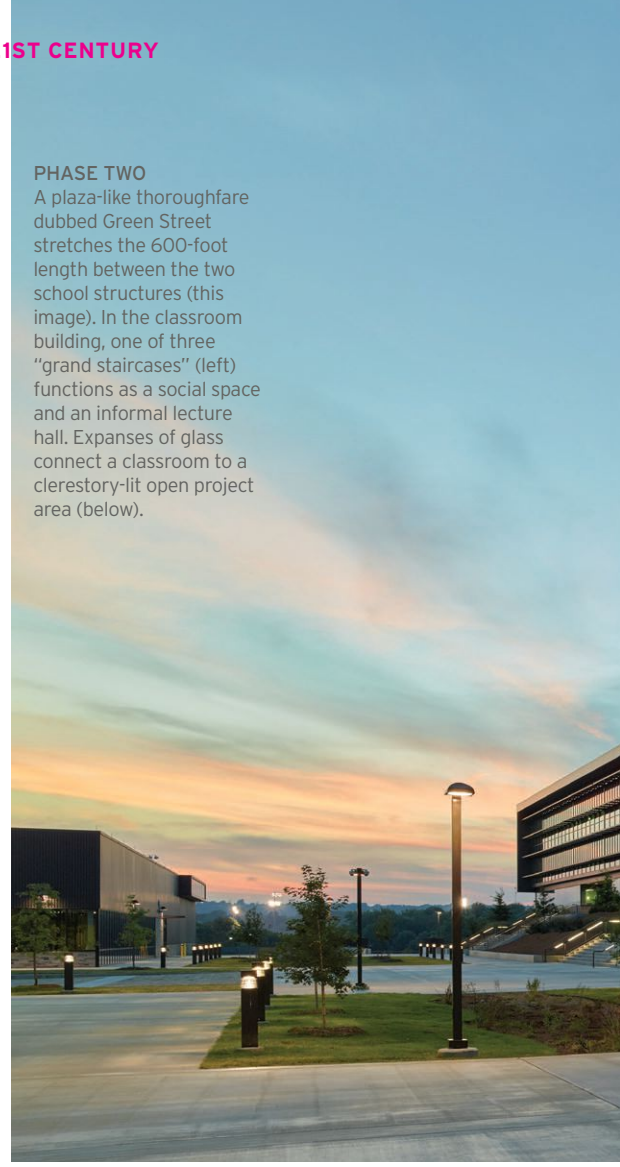
The effect of the massing and materials is a bit austere from the street. But the rich play of spaces on the interior, along with the masterful organization of the major elements, creates dynamic and varied gathering spaces and contributes to Blackwell's aim of making the high school a more "collegiate" experience.

The interior organization highlights an innovative approach to big-school design. Recent research shows that smaller schools often lead to better academic outcomes. A 2007 University of Michigan Study of 789 high schools found that the ideal size is between 600 to 900 students. The study suggests that larger schools could resolve the issue of size by subdividing the student body into "schools-within-a-school."

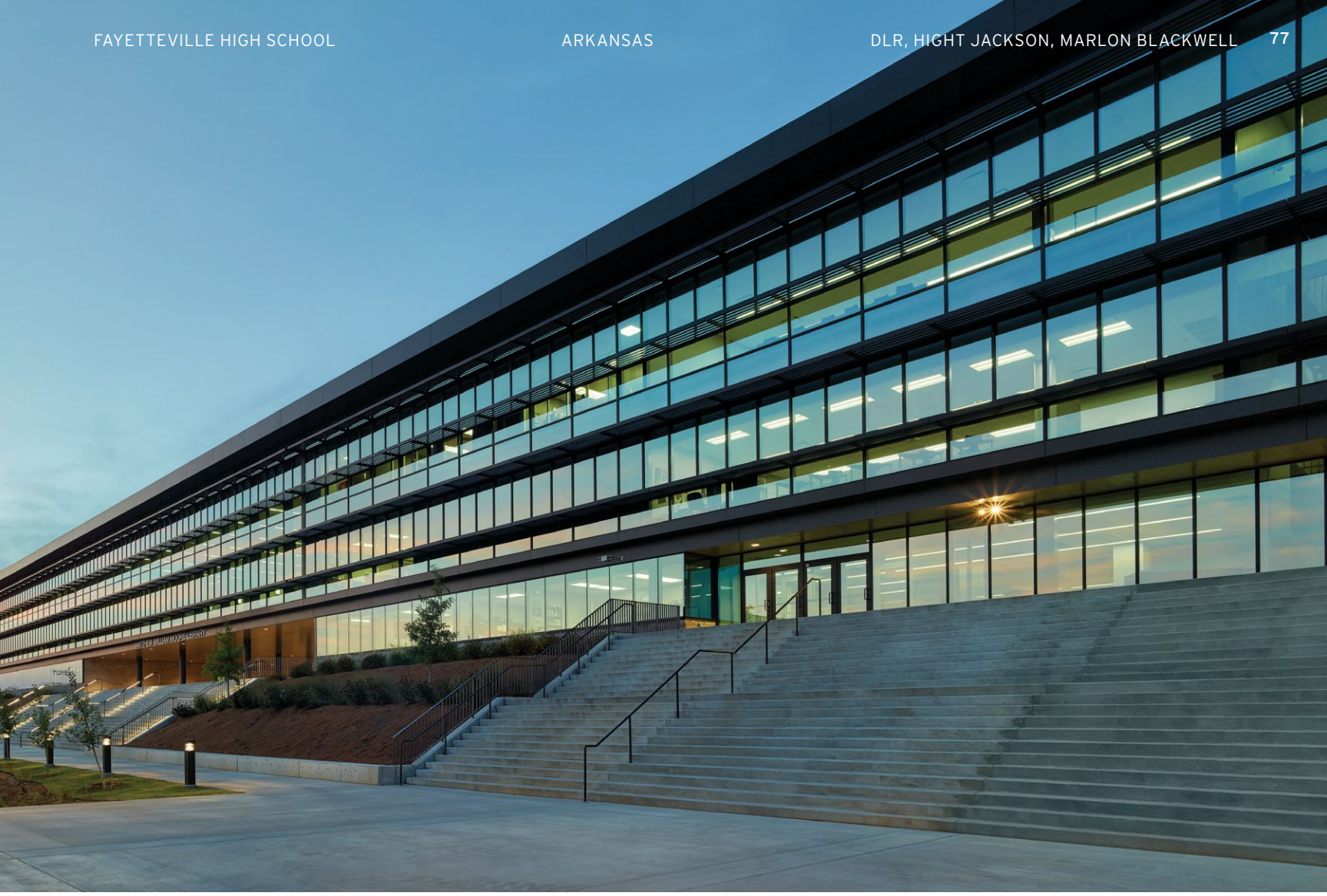
The architects designed Fayetteville High School to accommodate four small learning communities (SLCs), averaging around 700 students each. Although they have yet to be integrated into the school's programming, each SLC will be made up of an autonomous set of students with a core group of teachers who would have access to a variety of rooms such as flexible multimedia labs, maker spaces (woodworking shops, robotics labs, etc.), and bleacher-like grand staircases that transform into mini-auditoriums or places to hang out.

In addition to the generous glazing around the perimeter of the buildings, the architects installed skylights and clerestories at strategic locations within the deep floor plates, introducing natural light throughout the windowless internal areas. "Open project labs," for instance, which provide flexible alternatives to the traditional class-

CLIMBING UP
Students ascend the stairs from the entrance (right) to the high school's main gathering space. This central courtyard (below) provides a spacious place to hang out and looks toward the elevated library in the classroom building.



PHASE TWO
A plaza-like thoroughfare dubbed Green Street stretches the 600-foot length between the two school structures (this image). In the classroom building, one of three "grand staircases" (left) functions as a social space and an informal lecture hall. Expanses of glass connect a classroom to a clerestory-lit open project area (below).



rooms within the heart of the second-phase building, are flooded with daylight. Additionally, clerestory windows in the sports arenas and common spaces combine with bands of south-facing glazing to illuminate key public spaces. These and other sustainable features, including the use of recycled building materials and energy-efficient environmental-control systems contributed to LEED Gold certification for the second building and LEED Silver for the first.

Between classes, students pour into the central courtyard and enliven the three grand staircases in the classroom building, where they socialize or get a bite to eat. Sophomores Michael Lynn McNeill and Evie Ritter often have lunch on one of these daylit stairs. Both students found the transition to the large campus from middle school a bit overwhelming. But would they prefer a smaller school? McNeill replies, "No, I like the diversity of people in a big school, and the fact that it has the feel of a college campus." ■

Michael Cockram is a freelance writer and the director of Bowerbird Design in Fayetteville, Arkansas.

credits

ARCHITECTS: DLR Group – Jim French, principal; Hight Jackson Associates – Hight Jackson, principal; Marlon Blackwell Associates – Marlon Blackwell, Meryati Johari Blackwell, principals

ENGINEERS: DLR Group, Tatum-Smith (structural); DLR Group (m/e/p/fp); McClelland Consulting Engineers (civil)

CONSULTANTS: McClelland Consulting Engineers (landscape architect); Viridian (LEED); THEER (acoustical and a/v); Andy Gibbs (theater)

GENERAL CONTRACTOR: Nabholz

CLIENT: Fayetteville Public Schools

SIZE: 535,000 square feet

COST: $84 million

COMPLETION DATE: August 2015

SOURCES

STEEL: Jacksonville Steel (structural system)

CLADDING: Schwartz Stone (masonry); Morin & Firestone (metal panels)

CURTAIN WALL: Kawneer

GLAZING: Tri-Star Glass

CEILINGS AND RESILIENT FLOORS: Armstrong

STUDY IN CONTRAST
Vibrant shades of pink and orange enliven the rustic wood facade of this school building, located at the center of a mixed-income neighborhood.

PHOTOGRAPHY: © EUGENI PONS, EXCEPT AS NOTED

Simone Veil School Complex | Colombes, France | Dominique Coulon & Associés

A Bright Future

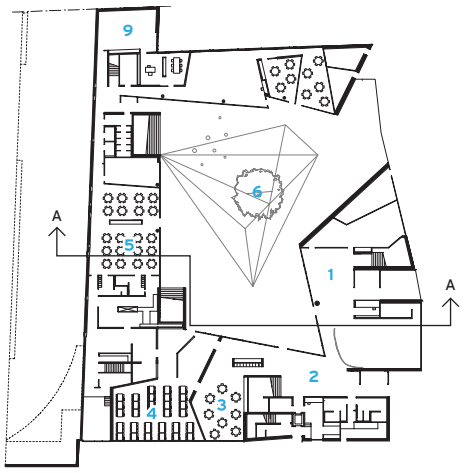
Color and texture create a stimulating environment for the children of a nursery and elementary school complex near Paris.

BY CHRIS FOGES

Clad in rustic, rough-sawn logs and enlivened with jaunty cantilevers and splashes of effervescent color, the Simone Veil School Complex exudes a sense of "joyful chaos," as architect Dominique Coulon puts it. Though the expression of joy is a deliberate reproach to the building's drab environs in the Paris suburb of Colombes, any impression of chaos is misleading: its jumbled form and bold palette are precise, ordered responses to a demanding program and challenging situation.

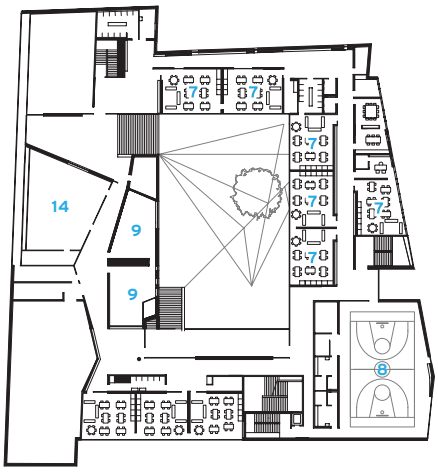
The compact, almost-square plot accommodates two separate schools—preschool and elementary—serving 500 children aged 3 to 11. Each school required its own entrance, internal circulation, and outdoor play areas. Space also had to be made for an after-hours study center and a gym that can operate independently. Options for access were limited, as the site overlooks a park to the north but adjoins housing to the west and a busy tram depot to the south. A complicated social context imposed additional demands. The school aims to draw children from both the new private apartment buildings around it and decayed public housing projects to the east; it acts as a meeting point for two communities whose lives rarely intersect. "Transparency was important, to show that this is a public building, open to all," says Coulon.

This tangle of constraints was tackled by roughing out the building's organization with a few moves of diagrammatic clarity before refining it through pragmatic responses to particular functional requirements. Beginning with a four-story block that fully covers the site and oversails tram tracks to the south, Coulon carved out an angular central void to make a yard for the preschool. One story was removed from the structure's west side, and two from the south to make a terraced yard for older children on top of the building, enclosed by high walls but open to the sky. Deep niches in the north facade shelter entrances and link the courtyard to the park, while over-

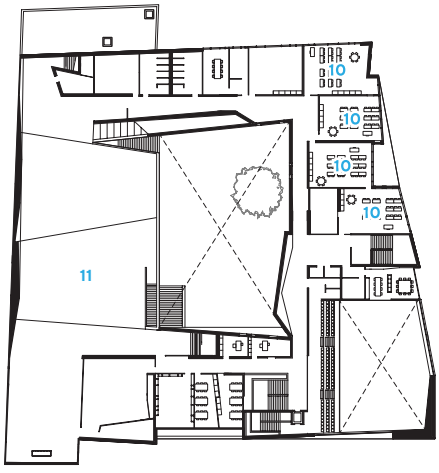


GROUND-FLOOR PLAN

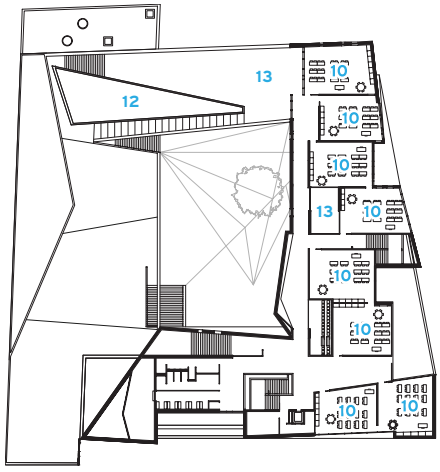
0 30 FT.
10 M.



LEVEL-TWO PLAN

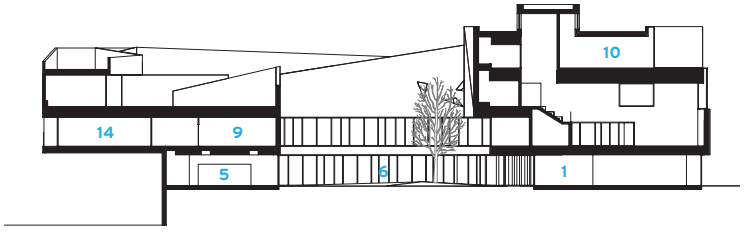


LEVEL-THREE PLAN



LEVEL-FOUR PLAN

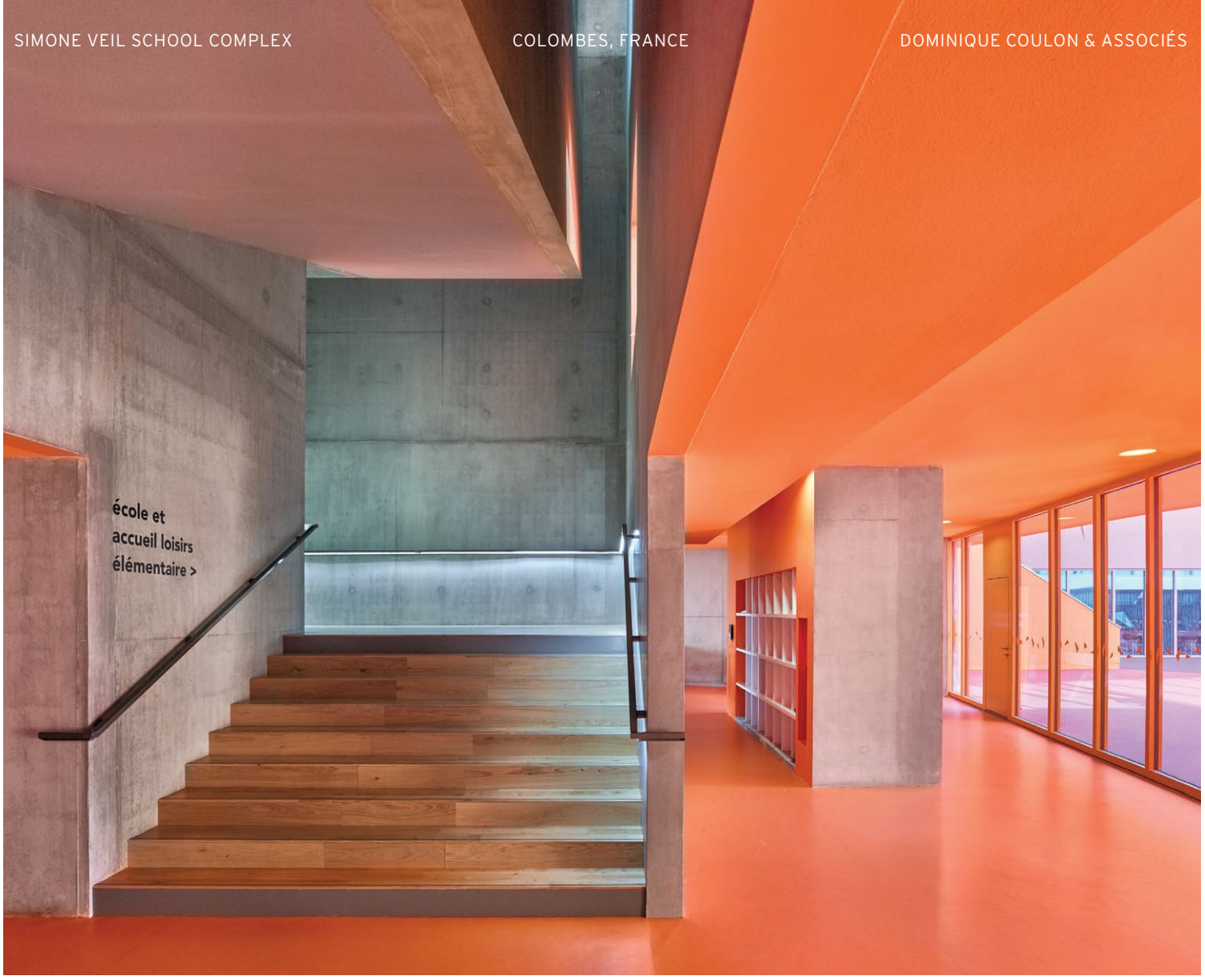
SMART MOVES To minimize disruption from an adjacent tramway depot, teaching space is concentrated in the northern part of the building, and a two-tiered elementary school yard occupies the upper floors to the south. Walls enclosing the yard are angled to maximize daylight penetration into the central courtyard.



SECTION A - A

0 30 FT.
10 M.

1 PRESCHOOL LOBBY
2 ELEMENTARY SCHOOL LOBBY
3 RECEPTION/COMMON ROOM
4 ELEMENTARY SCHOOL CAFETERIA
5 PRESCHOOL CAFETERIA
6 PRESCHOOL YARD
7 PRESCHOOL CLASSROOM
8 GYM
9 NAP ROOM
10 ELEMENTARY SCHOOL CLASSROOM
11 ELEMENTARY SCHOOL YARD
12 LEARNING GARDEN
13 PATIO
14 PHYSICAL EDUCATION ROOM



hangs shade south-facing glazing. Indentations to the upper stories carry daylight deep into the interior and add further articulation.

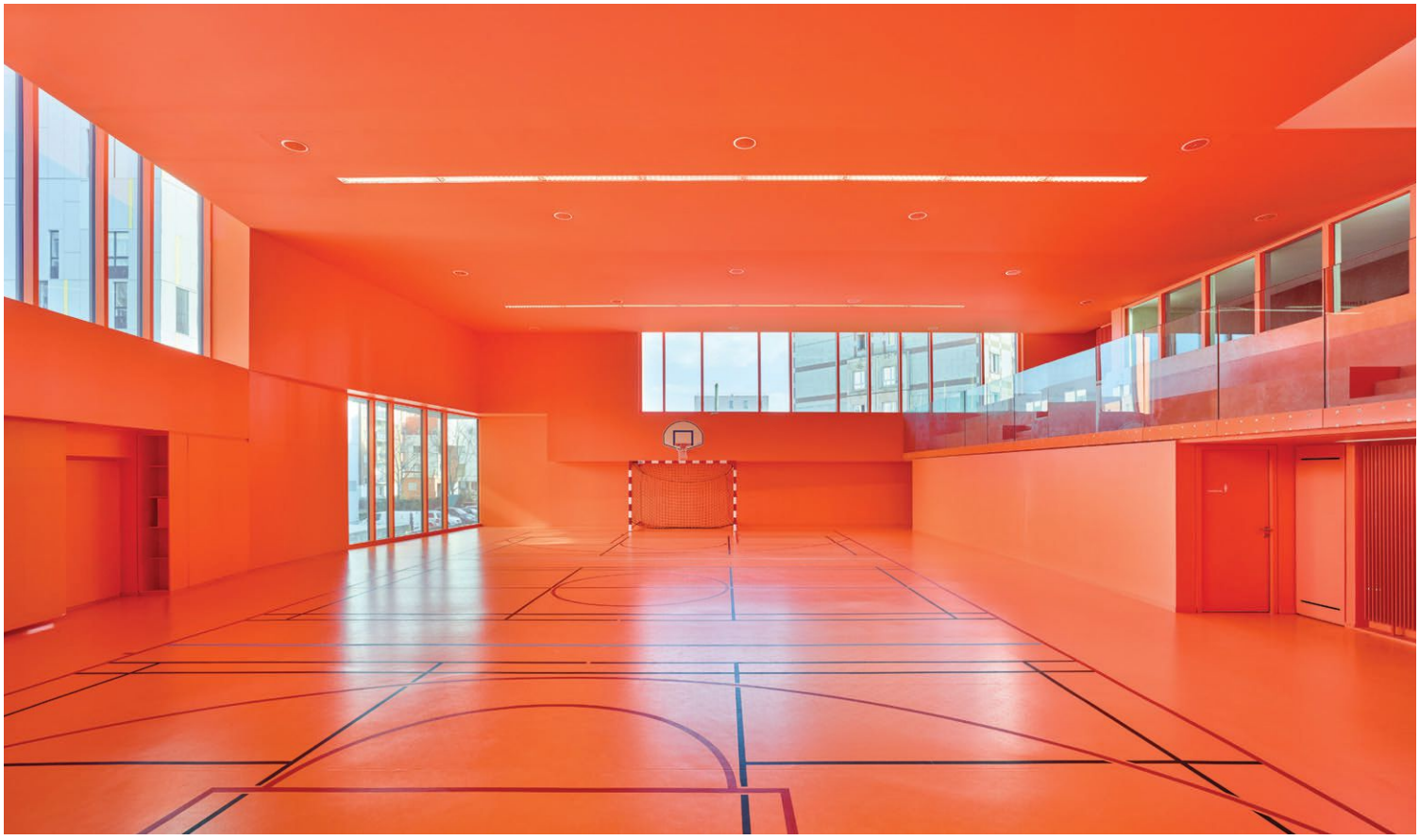
Entrance foyers, offices, and cafeterias occupy the ground level, with the preschool on the second floor and the elementary school on the two floors above. For small children, it's a big institution—"it can take five or 10 minutes to get them from the top floor to the outside, depending on their mood," says the principal—but varied interior treatments give each school a distinct identity within a cohesive whole. Preschool classrooms are a calming white, but all surfaces in the circulation areas and the yard are hot pink and zesty orange. Details are subtler: asymmetric windows are set at child's-eye height; coat hooks are metal butterflies. For the older children, meanwhile, a cooler palette of exposed concrete and blond wood creates an atmosphere that is "more serious," says Coulon. Color appears as an occasional accent: windows look into pink-walled light wells, and the rooftop recreation space, drenched in orange, has an almost hallucinatory impact.

Blocks of vivid color are a hallmark of Coulon's work, and though he maintains that its use does not always require justification, here it has a purpose. "The idea is to make a playful space, with energy," he says, as play encourages learning and discovery.

This ethos also drove the configuration of corridors, which are mostly internal, with windows onto teaching spaces on either side. Gently sloping floors follow the topography of the site, and angled

COLOR CODED Two material palettes meet in the entrance of the elementary school (top). Concrete and wood identify its circulation route, while vivid color characterizes the building's nonteaching areas, outdoor play spaces, and the corridors of the preschool (above).

PHOTOGRAPHY: © DAVID ROMERO-UZEDA (OPPOSITE)



walls create unfolding sequences of compression and release along the routes. The plan varies from floor to floor, so the poured-in-place concrete walls do not vertically align, and loads are transferred through the slabs. Such irregularity is typically expensive, but the building was relatively economical at $200 per square foot.

Variety also characterizes the teaching spaces. “Repetition is not my obsession,” says Coulon. “I prefer that all spaces are slightly different, with unique views or features.” Classrooms are subtly differentiated, but other study areas are given more overtly individual identities: within the elementary school, a library is lined in chunky engineered wood, while a multipurpose studio is distinguished by a deep, black triangular ceiling vault. These memorable quirks aid orientation

PHOTOGRAPHY: © GUILLAUME WITTMANN (BOTTOM, LEFT); DAVID ROMERO-UZEDA (BOTTOM, RIGHT AND OPPOSITE)

MIX NOT MATCH Older children play in the brightly hued rooftop yard (right). The vivid orange gym on the second level (opposite, top) is visible from the street. The elementary school hall ceilings are made of the same bark-covered logs that clad the facades (opposite, bottom left). The elementary school classrooms are concrete and wood (opposite, bottom right).

through the labyrinthine complex.

Though Coulon's design process began with intense work on the plan—both to meet functional requirements and to find the "graphical balance" in two dimensions that generates interesting spaces in three—the section is also pushed hard to exploit all opportunities for distinctiveness and daylight. Roof windows illuminate the second-floor gym via internal voids, for example, and carefully positioned openings allow long views through the deep floor plates and out to the schoolyards and streets.

Looking to the east, the view tells a tale of two cities: the glass towers of the business district at La Défense are not far away "but another world," says Coulon, while closer in are the decayed housing projects in which many pupils live. In conditions of social and economic disadvantage, he suggests, school buildings that stimulate imagination and foster confidence can be transformational, so the architect must "try harder, be more generous, be better." At the Simone Veil schools, that care is as evident in the building's intelligence as in its exuberance. ■

credits

ARCHITECT: Dominique Coulon & Associés – Dominique Coulon, principal; Olivier Nicollas, project architect; Guillaume Wittmann, Emilie Brichard, Jean Scherer, David Romero-Uzeda, design team

ENGINEERS: Batiserf Ingénierie (structural); BET G.Jost (electrical); Solares Bauen (m/p)

CONSULTANTS: Euro Sound Project (acoustics); Defacto (ergonomics); Ecotral (kitchen); Bruno Kubler (landscape); E3 économie (cost estimator)

CLIENT: City of Colombes

SIZE: 82,000 square feet

COST: $17 million

COMPLETION DATE: August 2015

SOURCES

FACADE: Saint-Gobain (glass); Alsecco (insulation and stucco)

DRYWALL: Knauf, Siniat

ACOUSTIC INSULATION: Isover, Rockfon

LIGHTING: Turbo, Bega, Asteri, Trilux, Targetti, Modular, Zumtobel, iGuzzini, Panzeri, Aric, Sermes, Lamdalux, SFEL

PLUMBING: Duravit, Franke, Delabie, Grohe

Indian Springs School | Birmingham, Alabama
Lake|Flato Architects

Out of the Woods

A cluster of new buildings captures the rugged, free spirit of a rural boarding school.

BY ANNA FIXSEN

PHOTOGRAPHY BY CASEY DUNN

When Harvey G. Woodward—an eccentric heir to a sizable iron fortune—envisioned a new boys school for Birmingham, Alabama, in the 1930s, he sought to create an educational institution that was on a par with its Yankee counterparts, with a progressive agenda that embraced nature and shunned two of the South's most sacred pursuits: church and football. "The basic idea of the school is to make [a] boy of sound mind and body," Woodward noted in his will. "It is self-evident that the best superstructure on a weak foundation must eventually show the poor foundation."

As hoped, Woodward's school, called Indian Springs, has provided its students with sturdy academic underpinnings: since opening in 1952 (Woodward's estate was mired in court for decades), it has produced a long roster of accomplished alumni and gained a reputation for its rigorous programming. But in recent years, the campus's aging cinder-block classrooms and deteriorating infrastructure were hindering it from staying on course. "Nothing about the physical campus suggested

LAWN ORNAMENT
The architects oriented three new classroom buildings and a revamped library around a large open space for classes, performances, and socializing. East of these buildings, a new administration building serves as a campus gateway (opposite, bottom).

LIVE AND LEARN A primary design objective was to connect students with nature. Floor-to-ceiling glazing in seminar rooms (left) and clerestory windows in classrooms (above) bring in light, while the library porch (opposite, top) and outdoor circulation (opposite, bottom) allow students to get plenty of fresh air.

that something exceptional or worth the private school price was happening here," says Claire Cassady, the school's director of admissions.

Four years ago, the school turned to San Antonio firm Lake|Flato to design a master plan that would realign the school with its motto, "learning through living." Phase One, completed in August 2015, has recaptured the school's spirit with four new single-story, cypress-clad buildings and a refurbished library that respect the original structures' simple forms and materials while opening the buildings to nature.

"Our notion was that 21st-century schools should actually be more like 19th-century schools," says Greg Papay, Lake|Flato's partner in charge, referring to the firm's back-to-basics approach.

Today, Indian Springs School is a coeducational independent day and boarding school for grades eight through 12. The idyllic 365-acre campus is nestled at the base of Oak Mountain State Park, 20 minutes south of downtown Birmingham. "Because it's such a large campus, creating definition for the master plan was important," says project manager Brandi Rickels.

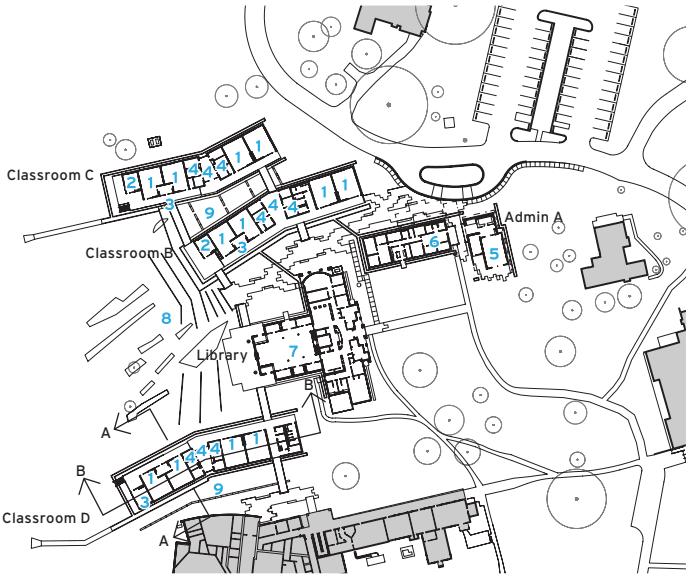
It became clear to the architects—whose research included a community charrette and an overnight stay in the dorms—that the adjacent lake would become the new focal point. On a recent visit, the rolling Alabama countryside was a blaze of autumn foliage. Along a curved drive, glimpses of the buildings' low-pitched roofs come into view through gaps in the trees. The architects clustered the new buildings—three for classes and one for administration—around the existing library, facing the water.

At the administration building, a generous overhang frames a glazed passageway that cuts through the building and leads to the main campus green beyond. As a twist on the original cinderblock buildings, the steel-framed building has textured board-formed concrete exteriors, with some walls warmed up by cypress cladding.

From the administration building, paths lead to the classroom facilities to the north and south. Overhangs protect exterior circulation, which runs the length of the buildings, from sun and rain. Because the campus was built on wetlands, Baton Rouge–based firm CARBO Landscape Architecture devised a system of rain gardens to filter water and then channel it into the lake. A network of gangways bridges these recessed gardens and connects the classroom buildings, which each include four large lecture rooms, six faculty offices, and a tiny (150 square feet) breakout space for pre-exam cramming or office hours. "My favorite part is the open layout, because you get to see everyone when walking between classes," says senior Emma Turner. "You feel like a community." The architects also situated a single midsize seminar room at the end of each of these bars, oriented toward the lake, like the prow of a ship.

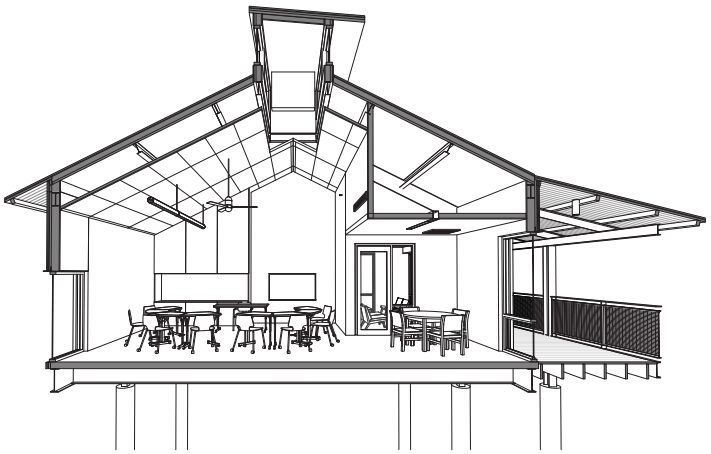
Inside, daylight pours in from monitors, clerestories, and floor-to-

TEEN SPIRIT Landscaped rain gardens channel water into the lake and also serve as an ad hoc hangout spot for students.



SITE PLAN

0 100 FT.
30 M.



SECTION PERSPECTIVE A - A

1 CLASSROOM
2 SEMINAR ROOM
3 BREAKOUT ROOM
4 FACULTY
5 BOARD ROOM
6 ADMINISTRATION
7 LIBRARY
8 OUTDOOR LEARNING
9 RAIN GARDEN

SECTION B - B

0 16 FT.
5 M.

ceiling windows, which also frame views of the lake and the surrounding forest. To make the classrooms as flexible as possible, there is no fixed furniture. Gone are chalkboards or whiteboards: instructors lecture using movable interactive panels. "Learning is a network now," says Papay, recalling how his own high school children do their homework on apps. "So the buildings need to be set up to catalyze that."

Lake|Flato also employed simple solutions to elevate the existing '80s-era library, adding a new standing-seam roof—the same as those on the ground-up buildings—as well as a large front porch. This outdoor room faces a sloped lawn that, when not used for classes, hosts outdoor film screenings and performances.

There is still work to be done at Indian Springs—once funds are raised, Lake|Flato will begin work on an arts building and a replacement dining hall—but the school is already reaping the benefits of its new facilities. The admissions office has seen a 25 percent increase in applications. And, say the architects, the new buildings—on track to achieve LEED Silver certification—are 60 percent more efficient per square foot than the old ones.

Perhaps the most meaningful feedback has come from Indian Springs' former students, who have fond memories of trekking the school's rugged trails or paddling the lake. "We were concerned about messing this place up, because it has a soul," says Libby Pantazis, a school board member. "But alums come back and say, 'This is what the school has always meant to me. You got it.'" ■

LAKE EFFECT
The architects trimmed back overgrown foliage surrounding the water to open up picturesque views to campus.

credits

ARCHITECT: Lake|Flato Architects – Greg Papay, partner in charge; Brandi Rickels, project manager; Ashley Hereen, project designer; Megan Toma, designer

ARCHITECT OF RECORD: ArchitectureWorks

LANDSCAPE ARCHITECT: CARBO Landscape Architecture

ENGINEERS: MBA Engineers (structural); Walter Schoel Engineering (civil); BBG&S Engineering Consultants (m/e/p)

GENERAL CONTRACTOR: BL Harbert International

CLIENT: Indian Springs School

SIZE: 26,900 square feet

COST: $11.5 million

COMPLETION DATE: August 2015

SOURCES

METAL ROOFING: Pac-Clad

WINDOWS: Kawneer

GLAZING: Guardian

ACOUSTICAL CEILINGS: Armstrong

PAINTS AND STAINS: Sherwin-Williams


UPPER LEARNING BUILD

COOL TOUCH The zinc-and-precast-concrete-paneled Upper Learning Building connects one end of the lower campus to the other (this page). A daylit, double-height cafeteria features bands of blue paint (right), a nod to the Hudson River to the west.

Riverdale Country School | Bronx, New York | Architecture Research Office

Building Confidence

A new facility provides a stimulating place to learn, socialize, and engage with nature.

BY LAURA RASKIN

PHOTOGRAPHY BY JAMES EWING

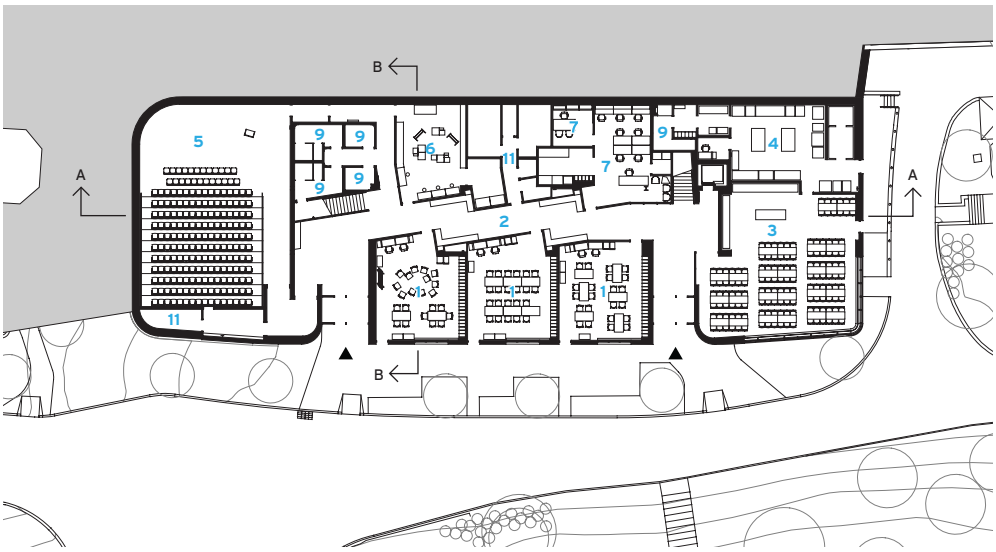
If it weren't for the pint-size stature of its third-, fourth-, and fifth-grade occupants—and the telltale sounds of recess—one would think the new classroom building at the Riverdale Country School in the Bronx, New York, was the custom headquarters of a startup. Like a startup, the new Upper Learning Building by the New York–based firm Architecture Research Office (ARO) was designed with an entrepreneurial spirit, each detail meant to incubate ideas and foster innovative teaching and learning, with spaces scaled to the comfort and optimum productivity of its inhabitants.

Located on the progressive private school's lower-school River Campus, which is nestled between the Hudson River and the 28-acre public garden called Wave Hill, ARO's new structure for Riverdale's older elementary school students is a low-slung, two-story rectangular volume that hugs a hill on both its eastern and northern elevations.

SECTION B - B

0 50 FT.
15 M.

SECTION A - A



LEVEL-ONE PLAN

LEVEL-TWO PLAN

0 20 FT.
6 M.

1 CLASSROOM
2 COMMONS
3 STUDENT CENTER/CAFETERIA
4 KITCHEN
5 THEATER
6 GREENROOM
7 OFFICE
8 MULTIPURPOSE
9 RESTROOM
10 MEETING
11 MECHANICALS
12 CONTROL BOOTH

(The Hill Campus, to the northeast, accommodates the middle and high schools.) A skirt of vertical zinc panels drapes the building's northern end and the second story. The first floor is clad in lightweight, ultra-high-performance blue concrete panels of varying textures. The muted colors are a nod to the river and the sky.

Floor-to-ceiling windows and glazed entrances in the west-facing ground floor classrooms allow students to catch glimpses of the river, while deeply set openings on the second floor maximize light and views. "We liked the idea of students hanging out in the windows," says ARO principal Stephen Cassell, who led the project with principal Kim Yao. At Riverdale, the outdoors is an important part of the curriculum, so the architects created a patio and path beside a grassy slope to the east. Classrooms there have doors that lead directly outside as well. (The architects worked with Matthews Nielsen Landscape Architects.)

The 23,000-square-foot building replaces an impermeable 1967 structure in the same site, which was universally disliked. Originally built for high school students, it had enfilade classrooms and expressed "sixties teaching values," says headmaster Dominic A. A. Randolph. More recently, the old building housed an unwieldy library and a mix of pre-kindergarten, fourth-, and fifth-graders. The lower school's cafeteria was housed in a low-ceilinged room in one of two mid-to-late 19th-century houses—originally part of the Wave Hill estate—that now flank the new building and contain offices and other programs. Even so, Randolph asked the architects to explore saving and adapting the existing building. In the end, "it still wouldn't meet our baseline, with right-sized classrooms near each other," says Cassell. So the existing structure was razed, and, to house the students in the interim, ARO collaborated with the Rockwell Group to create a playful temporary campus by customizing 13 trailers (RECORD, January 2016, page 53).

As part of its scope, ARO was asked to help Riverdale with its master plan and program-

HIGHER ROAD
At Riverdale, the outdoors is considered important for creativity and learning. Architecture Research Office designed a path and patio behind the second story, east-facing classrooms (right). Each of three skylights has a different design and sends daylight into the circulation spaces (below). Hallways double as breakout spaces for small groups (bottom, right).

OBSERVATION DECK The architects kept ceilings exposed to maximize classroom height and added millwork for storage and display (above). Permeability was key: generous fenestration emphasizes the building's connection to its surroundings (opposite). On the second floor, tall windows are aligned with doors for clear views to the outside (left).

ming, and to spiff up spaces in other lower-school buildings. Like many school campuses, Riverdale is a hodgepodge of styles and eras. The new building is "low and respectful of the two houses," says Yao, and shows deference to the surrounding landscape.

In contrast to its predecessor, the new Upper Learning Building is "like a learning organism that you wander around in," says Cassell. He and Yao situated a multipurpose space at each end of the building—a glass-walled cafeteria to the south and a theater (still under construction at the time of publication) with retractable seating to the north—using them as a framework. The classrooms in between are connected by hallways that double as places for serendipitous moments of connection and teaching, with

writable and tackable walls. A large multipurpose room on the second floor is also a work in progress.

Throughout the building, ARO kept materials unfussy and durable, adding pops of blue in keeping with the sky and river theme. The architects worked with graphic design firm Open to inject otherwise blank surfaces with layers of learning opportunities. Four skylights on the second floor are made into teachable moments with graphics about the sun's movement, while other bold visuals, such as the names of cities and countries, and even directionals, are spelled out in blue decals on the concrete hallway floors.

Design is very much at the heart of Riverdale's philosophy. Randolph has been a vocal proponent of "design thinking" in schools and has forged an ongoing partnership between Riverdale and the global design firm IDEO, resulting in a downloadable Design Thinking Toolkit for Educators. The tool kit helps teachers through a process of research, ideation, and experimentation to solve challenges in classrooms—much the way a designer might in creating a better pair of scissors or a chair. In many ways, the new Upper Learning Building is design thinking writ large. It is a building born of exploration, deep discussions with educators about their needs and desires, and a willingness to tweak on the fly. "I've always believed that human-centered design is important and feeling is essential," says Randolph, "but this is the first time I've seen these ideas realized to such an extent." ■

Laura Raskin, a former RECORD *editor, is a Brooklyn, NY–based freelance writer.*

credits

ARCHITECT: Architecture Research Office – Kim Yao, Stephen Cassell, principals in charge; Jejon Yeung, project architect; Yannik Neufang, Drew Powers, Jenny Hong, Nicholas Desbiens, Nora Yoo, David Sobol, project team

ENGINEERS: Robert Silman Associates (structural); AKRF (civil); Buro Happold (m/e/p/fp/it/security)

CONSULTANTS: Mathews Nielsen (landscape architect); Open (graphics/wayfinding); Lighting Workshop (lighting designer); Threshold (acoustics/av); Stages Consultants (theater); Simpson Gumpertz & Heger (envelope consultant)

CLIENT: Riverdale Country School

SIZE: 23,000 square feet

COST: $20.4 million

COMPLETION DATE: September 2016

SOURCES

RAINSCREEN: Imetco (zinc panels), Taktl (precast concrete panels)

CURTAIN WALL & WINDOWS: Kawneer

GLAZING: PPG (glass); U.S. Bullet Proofing (ballistic glazing); SaftiFirst (fire-resistant glazing); Velux (skylights)

PAINT: Sherwin-Williams; IdeaPaint

PLASTIC LAMINATE: Pionite

SOLID SURFACING: Corian

TILE: Nemo Tile (floor, wall)

FLOORING: Forbo (linoleum); Tarkett (resilient); Tandus (carpet); Dur-A-Flex (non-slip)

FURNISHINGS: Steelcase; Knoll; Irwin Seating; KI; Coalesse

LIGHTING: Tech Lighting, Philips, Delray Lighting, USAI, Selux, Focal Point, Prudential (interior ambient), Bega (exterior); Electronic Theater Controls (controls)

ELEVATOR: Schindler

PLUMBING: American Standard, Chicago Faucets, Duravit, Elkay, Kohler, Sloan

BUILDING AUTOMATION: Alerton

Lycée Schorge | Koudougou, Burkina Faso | Kéré Architecture

Raising the Grade

An innovative use of local materials engenders an inspiring setting for learning.

BY JENNA M. MCKNIGHT

PHOTOGRAPHY BY IWAN BAAN

When Susanne Pertl, a board member at the Stern Stewart Institute in Munich, first saw the work of Diébédo Francis Kéré, she knew he would be the ideal architect for an organization that promotes education and entrepreneurship in West Africa. Kéré had grown up in a remote village in Burkina Faso before earning his architecture degree in Germany and opening an office in Berlin. Today, Kéré remains committed to his home country, where he has completed such projects as the Center for Health Care and Social Promotion in Laongo (RECORD, August 2015, page 60) and a high school in Dano (RECORD, January 2011, page 118).

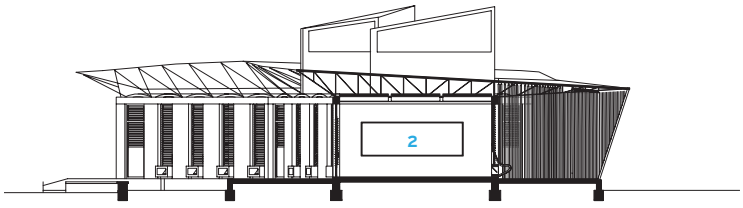
"I found Kéré's architecture to be extraordinary," says Pertl. "The buildings are not 'monuments,' but look special and work well for their inhabitants." The organization ultimately commissioned Kéré to design Lycée Schorge (named for a Pertl family member), a secondary school encompassing 17,900 square feet—the architect's largest completed building to date.

The school opened last February, on the fringe of Koudougou, a city in Burkina Faso with 132,000 residents. Featuring local materials, natural ventilation, a modern design vocabulary—and constructed by workers who live in the area—the building embodies the qualities found in Kéré's other Burkinabe projects. It also introduces new stylistic yet functional elements: "I'm constantly experimenting with local building materials in innovative and modern ways," the architect explains.

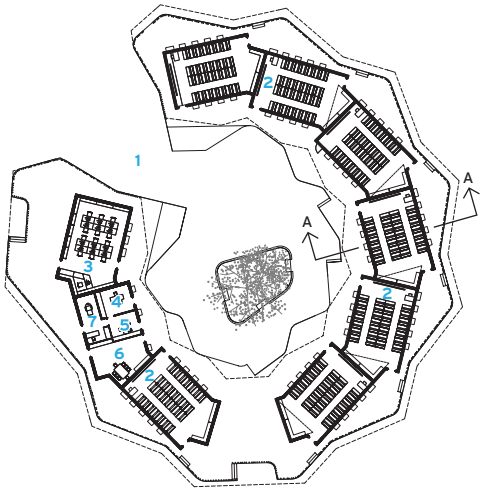
Given its rampant poverty, meager resources, and brutal heat, Burkina Faso is a challenging canvas for any designer. The architecture of the mostly undeveloped, landlocked nation is dominated by simple concrete structures and mud huts. Kéré's first project there, a primary school in his native village completed in 2001, garnered international attention. Since then, he has worked tirelessly across the country to create dignified and low-cost architecture that responds to its context.

Lycée Schorge does just that. Situated on a flat swath of semi-arid land, the school consists of nine distinct rectangular volumes arranged radially around a courtyard. Taking cues from traditional villages, the plan protects the outdoor gathering space from wind and dust while

IN THE ROUND Architect Diébédo Francis Kéré designed the Lycée Schorge with an inward-looking circular plan that bears a similarity to clustered settlements nearby (above). He wrapped the school's exterior walls in a screen of eucalyptus (left). Concrete window towers poke up above the complex's roof of corrugated steel (top, left).



SECTION A - A



FLOOR PLAN

1 ENTRANCE
2 CLASSROOM
3 LIBRARY
4 DIRECTOR'S OFFICE
5 SECRETARY'S OFFICE
6 TEACHERS' OFFICE
7 DENTAL OFFICE

also providing a sense of privacy. The modules, each 900 square feet, contain classrooms and offices, along with a dental clinic.

To construct the school's walls, Kéré used red-hued bricks made of laterite, a subterranean soil that hardens when exposed to air. "It has a high thermal mass, plus a beautiful color and a porous, textured surface," he says. The masonry facades are punctuated with tall, unglazed windows covered with colorful metal shutters, which bring light and air into the building. Curved seating units made of thin wood members are affixed to the window casings and appear to merge with the shutters.

The school's exterior is wrapped by a distinctive screen made of eucalyptus, a fast-growing tree that is typically used for scaffolding and firewood. Here it is used for a brise-soleil. "I wanted to give this material a more powerful and sustainable purpose," says Kéré about the enclosure, which shades patios and walkways.

When it came to designing the corrugated steel roof, the architect employed one of his signature strategies. Using trusses of rebar, he raised the roof high above the building envelope, enabling hot air to easily escape the interior. Its deep overhangs also mitigate solar heat gain. To further enhance the indoor climate, Kéré added a series of angular, 8-foot-high concrete wind towers that capture fresh air and funnel it downward. The undulating ceilings are made of gypsum fiberboard, straw, and cement mortar. Long slits in the cream-colored surfaces allow the classrooms to breathe and expel heat while ushering in diffused daylight.

Kéré also designed the furniture, with local craftsmen making hundreds of chairs and desks using salvaged construction material, such as plywood and rebar. The Philadelphia Museum of Art, which staged a solo exhibition of Kéré's work in 2016, recently added one such chair to its permanent collection.

By all accounts, the school has made a powerful impact. "I cried when I saw it," says Pertl, noting that a building of lower quality wouldn't

have been as effective. "This landmark shows our students that we want them to work hard, dream big, and achieve great goals." The facility is also beloved by its pupils, who tend to linger long after classes have ended for the day. "The students are happy to see that the design is different from other schools," says Baslayi Tindano, a biology and gardening teacher. "It inspires them to excel and make a difference." Kéré, who vividly recalls sitting in cramped, dark, and sweltering classrooms as a child, credits the client for the school's success.

"If you have a client who is open to innovation," he says, "you are able to do great things." ■

Jenna McKnight is a former editor of RECORD *who writes frequently on architecture.*

credits

ARCHITECT: Kéré Architecture – Diébédo Francis Kéré, lead architect; Dominique Mayer, Jin-gul David-Jun, Marta Migliorini, Diego Sologuren Martin, Jaime Herraiz Martinez, Blake Villwock, Adriana Arteaga, Johanna Lehmann, design team

GENERAL CONTRACTOR: Association Dolai

CLIENT: Stern Stewart Institute & Friends

SIZE: 17,900 square feet

COST: $478,000

COMPLETION DATE: August 2016

INTERIOR WORLDS Between the eucalyptus-wood screen and the brick walls of the school's rectangular modules (opposite, left) is a sheltered space where students can socialize. At one end of the courtyard, meals from a separate kitchen pavilion can be assembled (top). Undulating classroom ceilings (above) are made of gypsum fiberboard, straw, and cement. Slits in these surfaces admit diffuse daylight.

Common Ground High School | New Haven, Connecticut | Gray Organschi Architecture

A Study in Materials

An environmental charter school gets a new building with an unusual wood structure.

BY JOANN GONCHAR, AIA

PHOTOGRAPHY BY DAVID SUNDBERG

Few high schools, let alone those in cities, have hens, pigs, and sheep, a one-acre vegetable garden, or an extensive network of hiking trails. But Common Ground, in New Haven, Connecticut, is far from ordinary. The mission of this 200-student charter high school, which sits at the edge of a wooded, 1,800-acre state park, "is to instill environmental literacy in urban kids," says Melissa Spear, executive director.

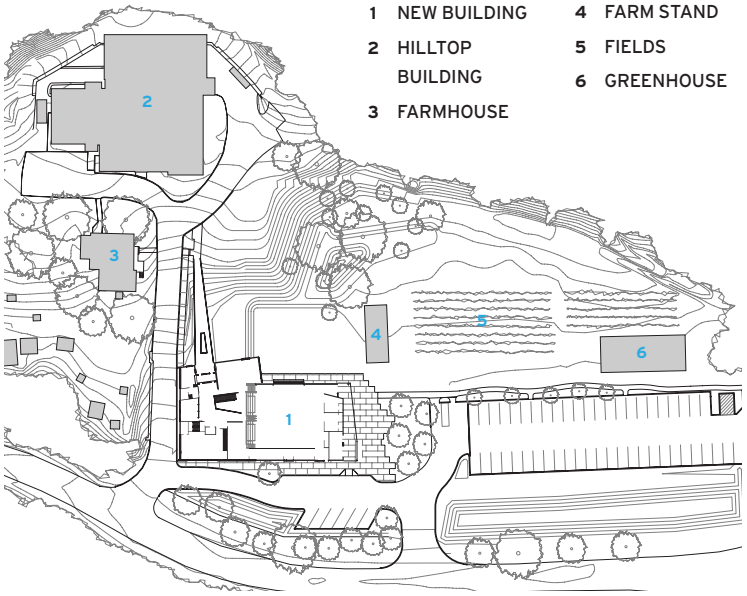
Since 1997, when the school was founded, Common Ground has expanded several times, always by adding onto its base of operations—a barnlike, wood clapboard structure referred to as the hilltop building because of its location on the steeply sloping campus. But about eight years ago, with its student body still growing, and with more summer, after-school, and community programs run by its parent nonprofit, Common Ground's management team and board began to consider another expansion, issuing a request for proposals in 2011.

Gray Organschi Architecture, a New Haven–based firm known for its attention to craft, decided to compete for the project because of an affinity for the school's educational vision. "Common Ground's values were close to home," says principal Alan Organschi. Although several firms that specialize in K–12 construction were also in the running, the selection committee chose Gray Organschi, in large part because of its encompassing view of environmentally responsible design. "Their interest in sustainability goes beyond merely reducing operational energy," says Spear. "They also consider the materials and where they come from."

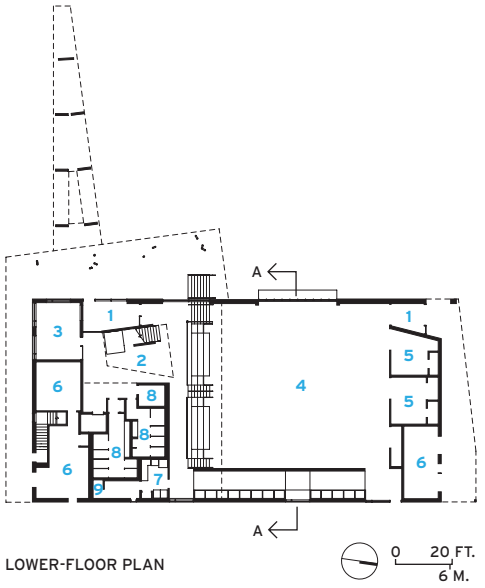
These ideas are manifest in the rustic, almost 15,000-square-foot, two-story building, completed last April. Behind its cedar rainscreen skin and below its irregular sawtooth roof, the new $9.3 million structure houses a small gym that also serves as an event space, classrooms for science and art, and offices. The new facility is positioned near the base of the school's site, with its second floor connected to the upper part of campus and the hilltop building by a pedestrian bridge.

Arguably the new building's most remarkable feature is its structure, which consists primarily of exposed black spruce, with glulam trusses and beams, and cross-laminated timber (CLT) used for bearing and shear walls and a stressed-skin roof system. CLT, which is not yet common in the U.S., is made of multiple layers

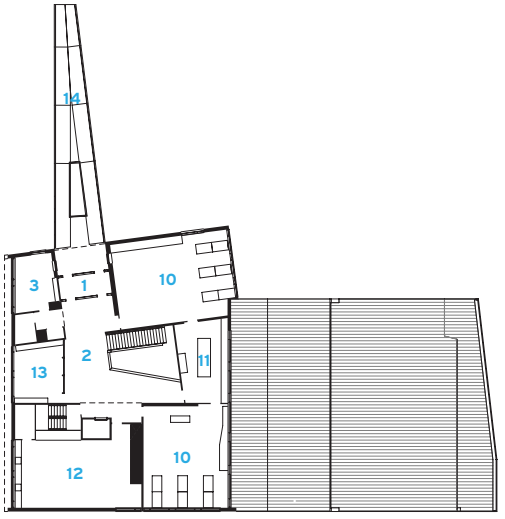
BARN RAISING Cedar rainscreen cladding and a standing-seam metal roof recall agricultural buildings and make Common Ground's new structure at home on the bucolic campus, which includes farm animals and a one-acre vegetable garden.



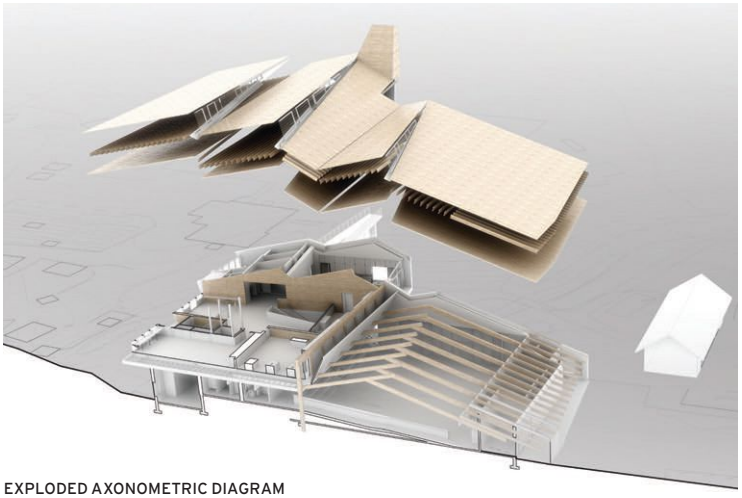
SITE PLAN



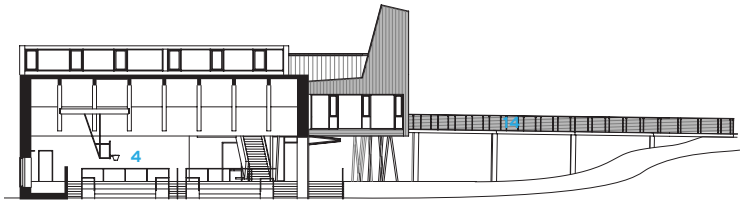
LOWER-FLOOR PLAN



UPPER-FLOOR PLAN



EXPLODED AXONOMETRIC DIAGRAM



SECTION A - A

1 ENTRY
2 FOYER
3 OFFICE
4 GYM
5 STORAGE
6 MECHANICAL
7 KITCHEN
8 TOILETS
9 SHOWER
10 SCIENCE CLASSROOM
11 PREP SPACE
12 ART CLASSROOM
13 BREAKOUT ROOM
14 BRIDGE

of dimensional lumber to form large, slablike panels. A sturdy-looking but sleek central stair is also constructed of this material.

Although these wood components are highly engineered, they retain the evidence of their natural origins. With knots, the direction of the grain, and the individual pieces of lumber easily discernible, they lend the interior a tough, vaguely Scandinavian feel. And from an environmental standpoint, this use of mass timber, instead of steel or concrete, means that the building sequesters, rather than emits, carbon. According to Gray Organschi's estimates, it offsets 447 metric tons of carbon dioxide, the equivalent of the annual emissions of 95 cars.

The method of construction was also environmentally sound, with the wood manufactured into CLT and glulam in northern Quebec, near where it was harvested. The glulam and CLT material was then fabricated into elements, including trusses, stair components, and insulated roof panels, in a New Hampshire factory. The approach minimized disruption to the site and meant that, once the foundations were poured, the structure could be erected and enclosed by a crew of five workers equipped only with light tools and a mobile crane

NORTHERN LIGHTS
The building's roof ridges and valleys are configured to create an irregular sawtooth and accommodate clerestory windows (above). The roof also includes a chimney-like element that encloses the ventilation system for the science labs. The new classroom structure (right) is connected to the rest of the sloping campus via a pedestrian bridge that leads to an upper-floor foyer.

FAST TRACK The building's structural components, including glulam beams that frame the roof over the gym (above), and the CLT panels used in the ceiling of a science classroom (top) and a central stair (opposite), were shipped to the site already fabricated and cut to size, accelerating construction.

in about five weeks, says Organschi.

In addition to their environmental and construction benefits, the legible structure and its timber components help support the school's educational goals. The students study the materials, devising their own tests to explain their physical and chemical properties. Hector Roman, a junior considering a career as a mechanical engineer, explains that the CLT is stronger than steel because it is made of several layers of wood from fast-growing trees. The pedagogical approach resonates, explains Emily Schmidt, the school's chemistry and physics teacher, because "it introduces the science to the students in a way that is relevant to them."

The students can talk at length about other features of the project, including its system of geothermal wells, the acoustical and thermal properties of the building enclosure, and how the surrounding bioswales and wetlands clean the rainwater that runs off the standing-seam roof. But when the young occupants are asked about their favorite features, they invariably point to experiential aspects rather than environmentally beneficial or functional attributes. Hope Dymond, a high school junior, points to the quality of the light that comes in through the north-facing clerestory windows and the glimpses of the sky they afford.

Such comments point to the real triumph of the project. The building is a genuinely handsome expression of the values of the school in built form, as well as an instructional tool. But it is also a great environment for teaching and learning—and for contemplating the clouds. ■

credits

ARCHITECT: Gray Organschi Architecture – Elizabeth Gray, Alan Organschi, Karen Scott, Eero Puurunen

CONSULTANTS: Bensonwood (frame structure); Edward Stanley Engineers (foundation structure); Altieri Sebor Wieber (m/e/p/fp); Atelier Ten (lighting); Mark J. Papa (landscape)

CONSTRUCTION MANAGER: Newfield Construction

CLIENT: Common Ground High School, Urban Farm, and Environmental Education Center

SIZE: 14,800 square feet

COST: $9.3 million

COMPLETION DATE: April 2016

SOURCES

CLT AND GLULAM COMPONENTS: Nordic Wood, Bensonwood

SIDING: Inland Port Orford Cedar

METAL ROOF: Firestone

GLASS: Oldcastle BuildingEnvelope, TGP

WINDOW FRAMES: EFCO

SKYLIGHTS: Co-Ex

Campus Moos | Rüschlikon, Switzerland | E2A

Hip to be Square

A compact concrete box with a rational floor plan hosts a forward-looking middle school.

BY MARY PEPCHINSKI

In 2011, two Swiss towns on the western shore of Lake Zurich, Rüschlikon and Kilchberg, decided to construct a shared public school for grades seven through nine. Rather than building separate facilities, they pooled their resources in hopes of increasing staff and creating a single building at an elevated level of design that would enhance the learning experience with flexible spaces. "When institutions merge, the usual motivation is to save money," says Lorenz Felder, a parent and president of the association overseeing the new facility, "but we wanted to improve the quality of the education—this was the driving force."

Situated among single- and multifamily residences in Rüschlikon, the school, named Campus Moos, opened in September 2016. It occupies a site planned by Zurich-based architects Jakob Zweifel and Heinrich Strickler with landscape architect Ernst Cramer in the late 1960s. The team had proposed shops, a residential tower, a primary school, and a row of plane trees along the site's northern and western boundary, yet only the school was built and the trees planted. Taking part in a limited competition in 2012, E2A architects, also Zurich-based, returned to this scheme and placed a compact six-story middle school for 164 pupils next to the primary school, where the residential tower had been envisioned, thus preserving the mature trees and the neighboring play area.

To educate a diverse student body (half the children are foreign-born), Campus Moos emphasizes sports and performing arts. Skill-building through personalized assignments, collective projects, and differentiated instruction according to ability are offered across disciplines. Addressing these various approaches required a range of spaces whose uses might shift over the course of the day.

The architects rejected the typical rigid, classroom-based Swiss school layout, opting instead for a design with fewer predetermined spaces. "Children learn a lot from one another, and this school needed to help students engage with their peers," says E2A partner Wim Eckert. The architects' scheme developed as a large cube constructed of reinforced concrete.

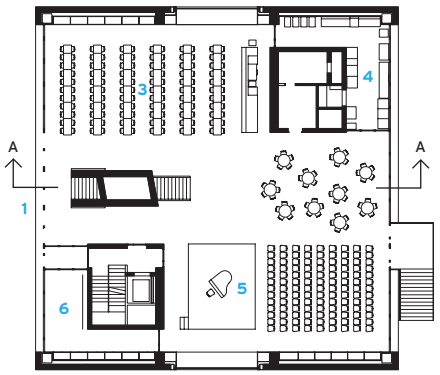
Seven floors are stacked to a height of 82 feet. Fenestration alternates from level to level, between long ribbons of floor-to-ceiling triple glazing and a single large window, creating a rhythm on the facades and varying the light levels and views for occupants. The opaque sides

CUBE SMART The school's modest footprint enabled preservation of mature plane trees (right) and a schoolyard, which is shared with the adjacent primary school. A gently sloping surface (opposite) provides barrier-free access to the open-plan ground floor.

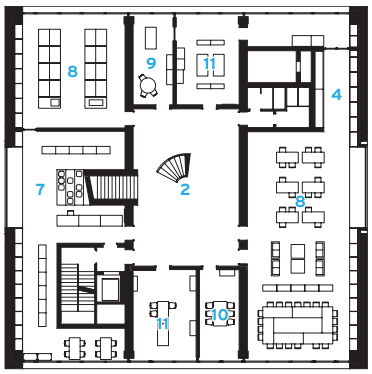
PHOTOGRAPHY: © RASMUS NORLANDER

SECTION A - A

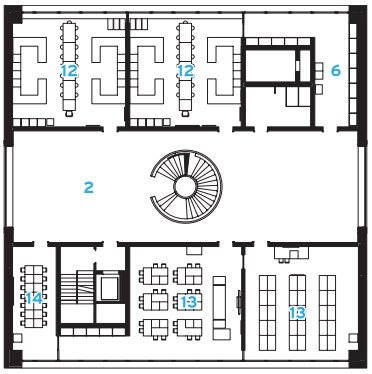
1 ENTRANCE
2 CIRCULATION
3 CAFETERIA
4 KITCHEN
5 MULTIPURPOSE
6 STORAGE
7 LIBRARY
8 TEACHERS' ROOM
9 SOCIAL WORK
10 CONFERENCE
11 ADMINISTRATION
12 TEACHING KITCHEN
13 NATURE STUDIES
14 CONFERENCE
15 CLASSROOM
16 MUSIC
17 DELIVERY
18 MECHANICAL



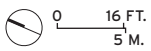
GROUND-FLOOR PLAN



SECOND-FLOOR PLAN



FIFTH-FLOOR PLAN



credits

ARCHITECT: E2A – Wim Eckert, Piet Eckert, founding partners; Nils Döring, Eric Rudolph, Oke Hauser, Andrea Kovács, Kirstyn Lindsay, Valentino Sandri, Tobias Weise, team

CONSULTANTS: Dr. Lüchinger+Meyer Bauingenieure (civil); Buri, Müller Partner (facade); Todt & Gmür Partner (intelligent building technology); R+B engineering (electrical and building systems); Neukom Engineering (sanitary) raderschallpartner (landscape); BB&A Buri Bauphysik & Akustik (acoustical); Rametall Ramseier + Ammann (kitchen)

GENERAL CONTRACTOR: E2A

CLIENT: Joint Board Secondary School Kilchberg-Rüschlikon

SIZE: 57,000 square feet

PROJECT COST: $21.8 million

CONSTRUCTION COST: $15.4 million

COMPLETION DATE: July 2016

SOURCES

WINDOWS & DOORS: Diralsa

ELEVATOR: Schindler

WOOD & METAL CEILINGS: Rööslı

GLASS PARTITION WALLS: Jegen

LOCKING SYSTEM: Evex

KITCHEN: Simeta

STAGE EQUIPMENT: Schelling

FURNISHINGS: Embru-Werke

VENTILATION: Rokitzky

are structural, and the building's corners carry point loads. Circulation and sanitary cores occupy the plan's northwest and southeast corners, leaving a largely unencumbered interior.

Although the ground floor, holding the cafeteria and a performance area, has an open plan (it can be divided by deploying a sliding wall), more conventional spaces are found in the half-sunken basement, containing music rooms and workshops, and on the second level, where administrative offices and the library are located. On levels three to six, plans are organized into three parallel bars, providing the greatest flexibility. A concrete spiral stair sits at the center of the middle bar, with the spaces to either side accommodating informal learning activities. The other two bar-shaped spaces hold classrooms and a larger "learning atelier," which can be split into two smaller classrooms with sliding partitions. Level five, with the same layout, contains kitchens, laboratories, and therapy rooms.

Exposed concrete interiors might seem inappropriate for a school. "Some people would like it to be more colorful," says Felder. Yet the advantages of the material are experiential and atmospheric. From within, the fine-grained concrete gently reflects both natural and electric illumination and suggests a place "like a museum or an artist's studio," says school principal Conny Christen. In addition to concrete, the architects specified neutral finishes, such as matte

UP AND AWAY
A concrete spiral stair (above) connects the top four floors and animates a generous circulation/ gathering area that connects to classrooms. On the ground-floor level (right), a cafeteria linking to performance and recreation spaces buzzes with activity.

BRIGHT SPOTS Floor-to-ceiling glazing (top and above) allows daylight to flow into learning spaces and from classrooms into the central circulation zone. Emerald green highlights, such as drapes and sealed-polyurethane flooring in laboratories, provide a counterpoint to the otherwise muted finishes, like concrete, anodized aluminum, and gray terrazzo floor tile.

white fiberboard for sliding walls and storage units, pearl gray terrazzo flooring in the public areas, and oak floors in the classrooms. The muted colors of the walls and floors cause these surfaces to fade into the background, instead highlighting occupants and their activity. With a similarly deft hand, the team tucked acoustic panels, ducts, and LEDs between the ribbed ceiling's exposed concrete beams to create a clean plane.

Selecting concrete for the principal material had other advantages—its thermal mass allowed for reduced heating. Other sustainable strategies include operable fenestration (which eliminates the need for air-conditioning) and a geothermal heat-recycling system that Campus Moos shares with the primary school.

One might not expect such a rationally planned building to enliven the daily experience at a small, suburban school. Yet Campus Moos's concrete form and extensive glazing feels surprisingly inviting, while its generous multipurpose spaces provide ample opportunities for pupils to engage one another. Although students and staff are still testing the waters, architecture's ability to enrich school life is already in evidence here. "The 40 ninth graders like working together in the sixth-floor learning atelier," says Christen. "They are quiet and listen to one another; the space gives them the sense of community." ■

Mary Pepchinski is a writer and educator based in Berlin and Dresden, Germany.

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Safe Havens

Three new schools provide an alternative to the fortress approach to security.

By Katharine Logan

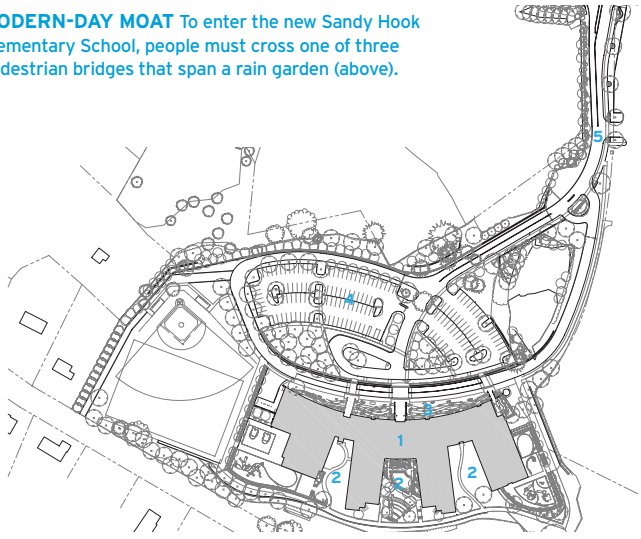
DECEMBER 14 was the fourth anniversary of the Sandy Hook Elementary School massacre in Newtown, Connecticut, the most lethal in America's sad history of mass shootings of schoolchildren. That history is now unfolding at an average of about two shootings at K–12 schools per month: more rare than death by lightning, but still too frequent. More commonplace threats are fights and bullying. And even on an ordinary day, with no immediate or looming danger, the fundamental challenge of being a school kid navigating the ups and downs of life in a sea of other school kids can feel more fraught than it needs to be.

Design can't solve all that, but it can make a difference. Here we look at three schools—an elementary school and two high schools—that address multiple aspects of safety and security, and illustrate how architects can improve the chances that children do not become victims at school.

No matter how intense the concern for security, a bunker is not the answer. This was the message that emerged from a community consultation process that informed the design for the new Sandy Hook Elementary School by New Haven, Connecticut–based Svigals + Partners (RECORD, September 2016, page 27). The school, now in its first year of operation, replaces the one demolished following the 2012 shooting tragedy in which 20 children and 6 staff members died. "The priority is making a nurturing environment for the future generations of this town. You can't let it all be colored by this horrific, terrible incident," says Jay Brotman, managing partner at Svigals. "We didn't have to say that; the community said it."

The new 87,000-square-foot, $50 million school translates the town's priorities of vitality, community, and connection to nature into a building that feels bright, open, and playful. A curving plan extends a seeming embrace as students approach. Gables emerge from behind the facade's undulating roofline: this is intended to recall views of the town, in which

MODERN-DAY MOAT To enter the new Sandy Hook Elementary School, people must cross one of three pedestrian bridges that span a rain garden (above).



1 SCHOOL BUILDING
2 COURTYARD
3 RAIN GARDEN
4 PARKING
5 VEHICULAR APPROACH

SANDY HOOK ELEMENTARY SCHOOL SITE PLAN

0 200 FT. 60 M.

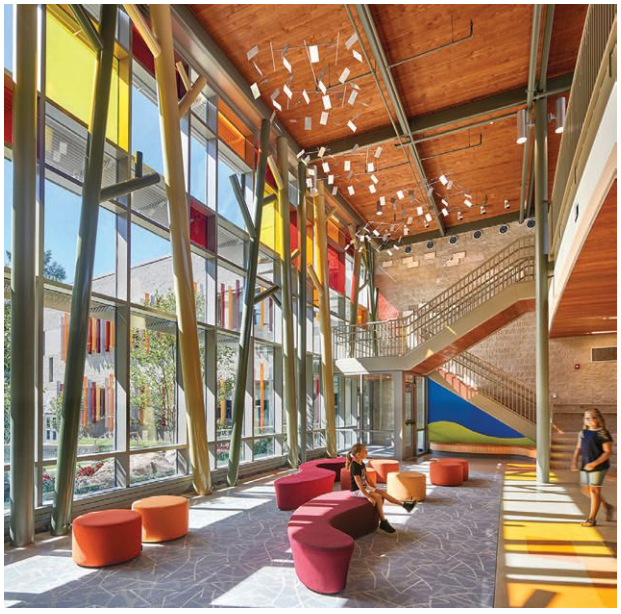
PHOTOGRAPHY: © ROBERT BENSON

buildings and spires extend above the trees. A daylit, art-filled interior provides a cheerful, engaging environment, and ample windows look out to an adjacent forest.

The security strategies are incorporated so unobtrusively that visitors touring the school have commented that they don't see them. "That's high praise, when in fact security has been designed into almost every aspect," says Brian Coulombe, a principal with Hamden, Connecticut–based security consultant DVS, a division of Ross & Baruzzini. The key, he says, is establishing security as a design priority from the outset. "When we're brought in late in the game, the tools left in our toolbox dwindle" and projects have to resort to more add-on electronic devices, staffing, and physical barriers to compensate, he says.

In achieving its inconspicuous security, Sandy Hook's designers drew on the principles of Crime Prevention Through Environmental Design (CPTED), a multidisciplinary approach to deterring criminal behavior. CPTED builds on the work of 20th-century thinkers such as Jane Jacobs, Oscar Newman, and C. Ray Jeffery, and relies on architectural design, landscape planning, security systems, and visual surveillance. CPTED's main principles include "natural surveillance," which gives legitimate users opportunities in the course of their ordinary activities to keep an eye on the place and the people around them; "natural access control," which directs users to enter through observable areas and prevents access to unobservable areas; and "territorial reinforcement," which encompasses a variety of strategies for signaling that a place is occupied and cared for. Together, CPTED strategies generate psychological and physical deterrents.

The Sandy Hook design team's first step in providing for natural surveillance was to set the building toward the rear of its site, so that anyone approaching the school can be observed from a distance. Windows, which in a fortress mentality would be considered a vulnerability, become an asset. Inside, a two-story glazed entrance lobby provides views into one of three semi-enclosed courtyards where children play and learn outdoors. Inverting the concept of natural surveillance in order to deprive an intruder of an advantage, classroom windows and doors are located so that occupants can shelter unseen by someone in the corridor.



NATURAL PLAYSCAPE At Sandy Hook, two-story glazed entry lobbies (left) look out onto semi-enclosed courtyards where children can play and learn outdoors (above).

The siting of the school was also the first step in natural access control. Wetlands and forest provide physical barriers to the sides and rear of the building, and anyone approaching from these directions draws suspicion. The main route brings all users toward the front, where staff, visitors, parent drivers, and school buses are funneled to dedicated approaches. Along the main facade, a rain garden reinforces natural access control: in addition to managing stormwater runoff and providing a teaching opportunity, it serves as a modern-day moat, directing people to enter by one of three pedestrian bridges and making it difficult to approach the building's windows unobserved. Supplementing the site's natural barriers are territorial-reinforcement devices including fencing and security gates.

Once the passive design for security is maximized, says Brotman, "you look to technology to reinforce or fill in the gaps." So Sandy Hook's entry vestibule complies with the State of Connecticut's new school-security guidelines' requirement for bullet-resistant glass, while other strategic locations throughout the school, such as corridor walls, have been hardened against attack. Cameras enhance the control of the courtyards, classroom doors have automatic locks, and an alert sounds if an exit stair door is left ajar. Most security incidents are over in less than five minutes, "so the real issue is to delay a perpetrator until the first responder arrives," says Brotman.

Security is more than an absence of violence. In Joplin, Missouri, pre-design consultations for a new high school to replace one destroyed in a 2011 tornado made it clear that, although the disaster struck outside school hours, the devastation had left the students shaken. "They wanted to have a psychological sense that they were safe," says Kevin Greischar, a principal at the Kansas City office of DLR Group, who designed the new school with local firm CGA Architects. As at Sandy Hook, security for the Joplin students didn't mean a bunker. They wanted daylight, views, connections to the outdoors, and a school they felt proud to belong to.

The new 500,000-square-feet, 3,000-student high school maximizes light and transparency with generously sized windows, interior glazing, open spaces, and overlooks. In addition to the sense of uplift and security the light and openness provide, wood accents throughout the building contribute a sense of dignity, tactility, and warmth. Two iconic elements salvaged from the old school—stones from a rose garden and a bas relief brick eagle from the gym wall—provide a comforting continuity with the school's pre-disaster days. As for future tornadoes, the $120 million school's ground floor is bermed into the slope of the site, and program elements requiring solidity—such as a broadcasting studio, choral space, and counseling area—are designated to double as emergency shelters.

More common than the threat of either intruders or tornadoes, however, is conflict among students themselves. Children can be unkind to one another at any age, but by adolescence the hormone soup coursing through their veins, combined with high schools' larger number of students and reduced levels of supervision, means that the most common source of security incidents is the kids themselves. A 2015 survey conducted by the Centers for Disease Control and Prevention on violence in high schools in the previous 12 months found that 8 percent of students had been in a fight at school, 6 percent had been threatened or injured with a weapon at school, and 20 percent had been bullied.

As evidence of the difference design can make, disciplinary incidents among students at Joplin's new school, which opened in September 2014, dropped by more than 50 percent in its first year of operation, dropout rates fell by 25 percent, and the four-year graduation rate rose from 74 to 84 percent, as compared to the old school.

It was while the school was being accommodated in a temporary, post-tornado facility, also designed by DLR and CGA, that disciplinary incidents first began to drop. Staff realized that the old school's attempt to control students by concentrating them in just a couple of common areas, including lunch in a single big cafeteria, had actually exacerbated conflict.

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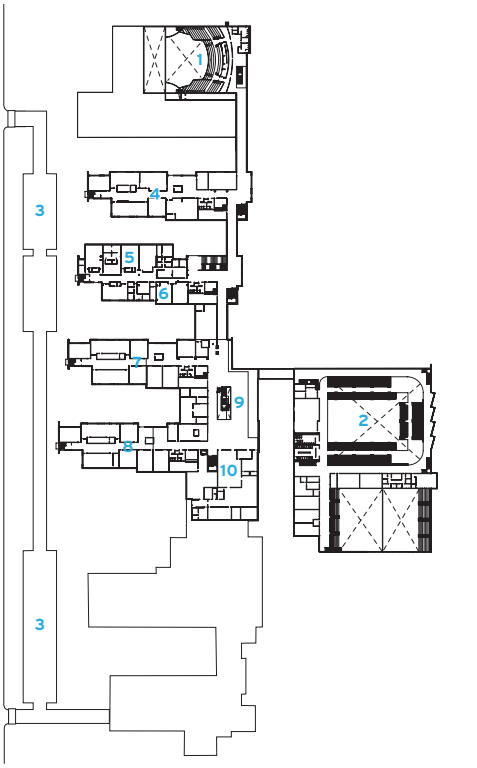

JOPLIN HIGH SCHOOL
SECOND-FLOOR PLAN

0 100 FT.
30 M.

1 PERFORMING ARTS
2 ATHLETICS
3 PARKING
4 ARTS AND COMMUNICATION
5 ADMINISTRATION
6 TECHNICAL SCIENCES
7 HUMAN SERVICES
8 HEALTH SCIENCES
9 STUDENT COMMONS
10 KITCHEN

NEIGHBORHOOD FEEL To make Joplin, Missouri's new 3,000-student high school (top) feel smaller, the architects organized the building into four three-story wings. These include classrooms clustered around adaptable break-out areas (above).

And so they were open to a configuration at the new school that would distribute the students and reduce the apparent size of the school population in students' day-to-day experience.

The new school is organized into four three-story wings (plus performance and athletics spaces) opening off a central circulation spine, with each wing corresponding to a career pathway: Technical Sciences, Human Services, Arts and Communication, and Health Sciences. Classroom clusters on the upper floor of each wing group the students into small integrated-learning communities, each with their own break-out areas and social spaces, where students are free to eat lunch if they choose.

A similar risk triad of natural disaster, stranger danger, and student conflict influenced the design for Snoqualmie, Washington's new Mount Si High School, located in a long, narrow river valley east of Seattle—except here the risk of tornadoes is replaced with that of earthquakes and floods.

The site for the 350,000-square-foot replacement school, scheduled to open in 2019, will undergo major remediation to reduce the chances of liquefaction of its alluvial soil in a quake. The school itself will sit on a platform elevated 3 feet above the 100-year-flood level. As well as making for a more resilient school building, the raised platform improves security

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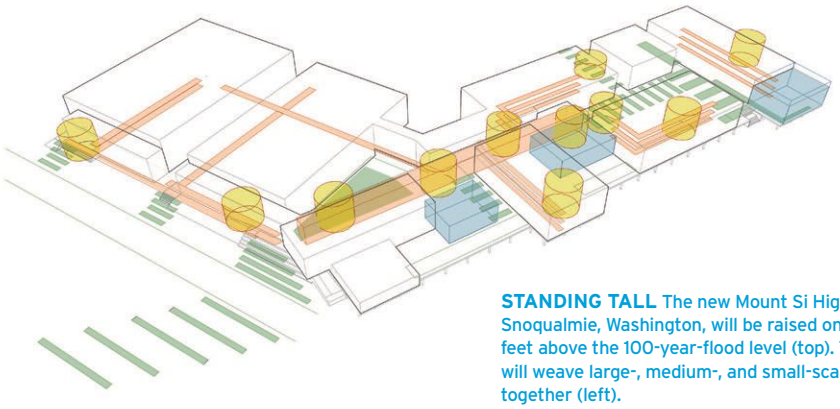

STANDING TALL The new Mount Si High School in Snoqualmie, Washington, will be raised on a platform 3 feet above the 100-year-flood level (top). The building will weave large-, medium-, and small-scale spaces together (left).

more narrowly defined, forming the first of four complementary strategies to foster security at the school. In CPTED terms, the raised platform clearly demarcates territory, presenting a psychological deterrent to potential offenders, and provides a view from the administrative area of anyone approaching the school.

Designed to accommodate 2,300 students, with the capacity to expand to 2,800, Mount Si will be one of the largest high schools in Washington State. So the second strategy in the school's design for security, as at Joplin, is to divide this population into smaller communities, including a separate building for first-year students. "They will know most, if not all, of the students inhabiting their home base," says Boris Srdar—a principal in the Seattle office of NAC Architecture, designers of the school—"which automatically increases the perception of safety." Breaking down the scale of the school into smaller, lockable buildings can also serve to delay a potential offender. And to alert staff and students to a security issue, a public address system with colored lights signaling different degrees of emergency enables communication with each classroom.

In the third strategy, large social spaces are also broken down and designed to invite gathering in smaller groups. The social spaces are configured as larger open areas complemented by a variety of smaller seating spaces along the perimeter, and this pattern is repeated on every floor in each of the academic buildings, to form an experiential fabric of large-, medium-, and small-scale spaces that weave the school together. "As students develop their own favorite places with their peers and friends," says Srdar, "that contributes to their having a sense of choice and familiarity, and ultimately to feeling safer."

For its fourth security strategy, the school's design draws on biophilic principles, which account for humankind's innate need for connection to nature. In particular, the design incorporates the biophilic patterns, or concepts, of prospect and refuge. The term prospect refers to the long views that humans instinctively enjoy and find reassuring, especially from an elevated position; while *refuge* refers to the sense of shelter or withdrawal, either from the elements or from action. Both patterns appeal to a basic instinct for what a safe place feels like, and multiple studies suggest they reduce stress. All of Mount Si's social spaces enjoy views to the mountain for which the school is named, with a sense of refuge deriving from the cozy, protected character of the interior spaces.

At Mount Si, as at Sandy Hook and Joplin, the priorities for security and the values with which it needed to be integrated emerged from extensive community consultation and a careful consideration of the specifics of the site. Rather than handing security design over to security consultants, architects can play a pivotal role. "You have to translate these strict security requirements into a wonderful, nurturing environment for children to live and learn in," says Brotman. "And if you keep everybody going back to the priorities, you'll come to the best solution." ■

Katharine Logan is an architectural designer and a writer focusing on design, sustainability, and well-being.

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Learning Objectives

1 Outline the crime-deterrent principles of CPTED.

2 Explain how the designers of the new Sandy Hook Elementary School made its security features inconspicuous.

3 Discuss how schools can be designed to mitigate the impact of natural disasters, including tornadoes and floods.

4 Describe the role that biophilic design can play in making schools feel safer for students.

AIA/CES Course #K1701A

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p120

Student Performance in 21st Century Schools

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BE | EM | PM

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Photo: Bethel School District

p141

Designing Modern Wood Schools

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LS | PM | ST

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p146

Capturing Timeless Values with Contemporary Design

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PM | RE | SU

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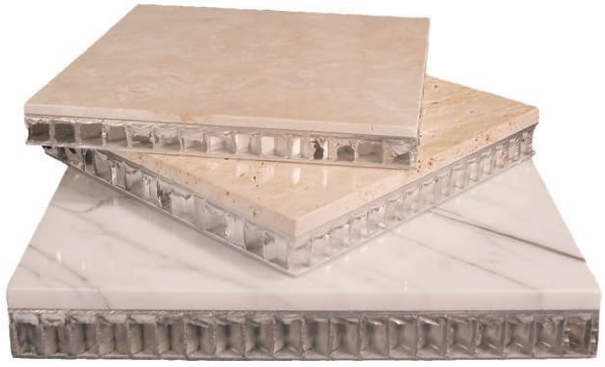

p150

Enhancing the Stone

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CATEGORIES

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EM ELECTRICAL AND MECHANICAL
IN INTERIORS
LS LIFE SAFETY AND CODES
PM PRODUCTS AND MATERIALS
RE RESIDENTIAL
ST STRUCTURAL
SU SUSTAINABILITY

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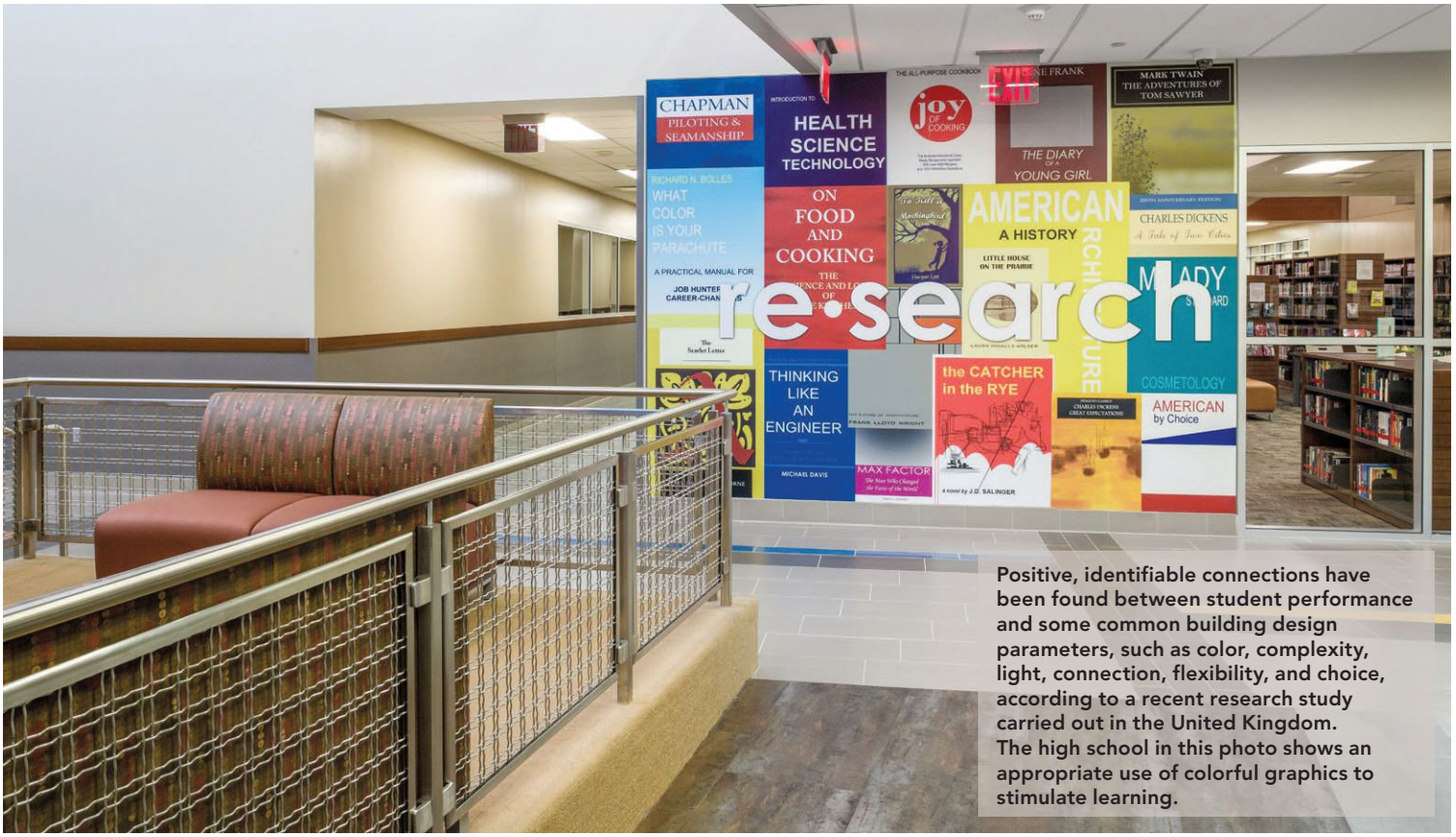

Positive, identifiable connections have been found between student performance and some common building design parameters, such as color, complexity, light, connection, flexibility, and choice, according to a recent research study carried out in the United Kingdom. The high school in this photo shows an appropriate use of colorful graphics to stimulate learning.

Student Performance in 21st Century Schools

Research identifies ways to create positive impacts on student learning through building design

Sponsored by AMBICO Limited, ASI Group, Construction Specialties, dormakaba, Glen-Gery, Guardian Glass, Mitsubishi Electric Cooling & Heating, and NanaWall Systems | *By Peter J. Arsenault, FAIA, NCARB, LEED AP*

Winston Churchill is famously quoted as saying, "We shape our buildings, and in turn they shape us." While that resonates with architects and others in a broad and even philosophical sense, we often need more specific information to justify making design decisions intended to shape people in positive ways. This is particularly true in the world of education and school design, which is paradoxically challenged to promote high student outcomes within very real budget restraints. The question often comes down to priorities and determining where the available funds are able to do the most good.

Toward that end, a recent study of original research published in the journal *Building and Environment* conducted by a team in the United Kingdom headed by Peter Barrett has shed some light on this subject.[1] Titled "A holistic, multi-level analysis identifying the impact of classroom design on pupils' learning," Barrett and his colleagues explored ways to measure impacts of school building design on the learning rates of pupils in primary schools. They developed hypotheses under three design principles: appropriate levels of stimulation for students, naturalness of the environment, and individualization. Under these broad categories, they investigated 10 design parameters within a neuroscience framework. These were tested using data collected on 751 pupils from 34 varied classrooms in seven different schools in the United Kingdom.

Based on their data collection and analysis work over the course of a school year, Barrett and his team found strong connections between

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Learning Objectives

After reading this article, you should be able to:

1. Identify the significance of using independent research as a basis for making design decisions in schools.
2. Assess the health and safety performance aspects of a variety of design characteristics and materials as they relate to durability and sustainability.
3. Explain the importance of working with a collaborative team to make design decisions that have positive impacts on student performance, indoor air quality, and health.
4. Determine ways to incorporate the design principles presented into buildings that are sustainable and high performing, as shown in case studies.

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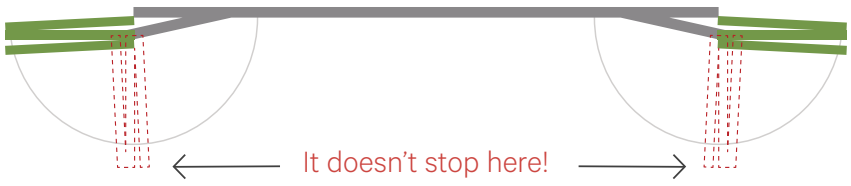

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classroom experiences and six particular building design parameters: color, complexity, light, connection, flexibility, and choice. They also determined that it was possible to estimate how much of an impact these particular design elements played on improved learning. In the case of this study, they found, on average, a 25 percent contribution to better learning due to the classroom design after accounting for other factors. This is strong evidence of the significant impact that design aspects of the built environment can have on pupils' learning progression. Not only are research findings like this important for policy makers, designers, and users to be aware of, they have great value in making and justifying design decisions.

To illustrate how research like this can be used in day-to-day design situations, we will look at some of the theoretical and practical ways to incorporate the three broad categories (stimulation, naturalness, and individualization) and the six referenced design parameters (color, complexity, light, connection, flexibility, and choice) plus others into new and renovated school designs of the 21st century.

STIMULATION AND COLOR

Under the general design principle of appropriate levels of stimulation for students, color was addressed based on the degree to which the "color mood" was appropriate for learning and teaching. While the researchers looked at the color of classrooms, it is the color of all areas of the building that certainly contribute to the overall color mood. In general, they found a tendency for warm colors that may complement the young pupils' extroverted nature, while cool colors seemed to enhance concentration and learning. As a design guideline, they suggest that warm colors are welcomed in senior grade classrooms and cool in junior grades, as long as it is bright. While many things in the building provide color, they found the constructed walls and floors to be the most important.

The pragmatic design challenge with this finding in schools is how to provide appropriate color in a way that is durable and rugged enough for high use areas and still work within budgetary limits. One of the common material selections to provide wall surfaces and even exterior walkway surfaces is brick masonry. Part of its appeal is that a full range of choices are available that are aesthetically diverse and technologically strong, including custom colors, blends, textures, and shapes. Brick manufacturers often collaborate with architects and interior designers on design concepts to provide unique solutions that efficiently bring vision to reality. Brick is a highly versatile solution that is available in a wide spectrum of colors, with a multitude of shapes and textures.

In some cases, an alternative in the form of thin brick veneer is desirable in a school design. Thin brick veneer expands design potential by reducing the space requirements of brick, creating real space savings throughout a building, while still maintaining a robust choice of colors. This approach can be used in tilt-wall/tilt-up, precast, and adhered veneer installations. Structurally, the reduced depth and lighter weight provides less impact on the supporting structure, with fewer seismic concerns than full brick. Further, less material often means less cost overall as well, with reduced wall costs through the elimination of shelf angles, lintels, and other miscellaneous items. Thin brick installation often reduces man hours 15–20 percent relative to conventional brick installations. And, depending on the substrate, thin brick veneer may be a more sustainable choice since it consumes fewer raw materials and requires less energy for manufacturing and transport.

According to members of the Schenkel/Shultz Architecture firm, "The long-standing reputation for quality products and the ability to manufacture matching thin and full-size brick units that met the design criteria for this project solidified our selection." This combination of student-enhancing color availability and technical capability give brick and thin brick veneer attributes worth considering in school designs.

STIMULATION AND COMPLEXITY

An interesting aspect of the study by Barret and colleagues is the role that the complexity of the environment plays in the process of creating appropriate stimulation for learning. Specifically, they raised the question about the degree to which the school provides appropriate diversity and novelty. Some of this is related to the size and area of the building in providing more potential opportunities for alternative forms of learning. But they also found high ratings of improved learning in areas where interior décor caught the pupils' attention and arousal. Displays that were stimulating, well-designed, and organized without clutter were good. In a related characteristic, corridors in schools that included large and visible pictures as well as visual landmarks enriched the stimulation and helped with wayfinding.

Architects, designers, and school officials have often sought to add such color and visual characteristics into school settings with an interest in using imaging for mascots, logos, and other creative graphics. Everyone recognizes, however, that such graphics need to be durable

Photos courtesy of Glen-Gery

Wall and floor materials of a school building can contribute to the overall color mood, which has been shown to have an effect on student learning.

Children's Hospital of Michigan, Troy, Michigan
Architect: Harley Ellis Devereaux (HED)

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Adding color and complexity to school environments can be accomplished with wall graphics protected by environmentally preferable PETG clear rigid sheet.

and easy to clean if they are going to continue to be seen as an asset. There are, fortunately, new product offerings that deliver all the functional durability required of walls in schools in addition to being able to provide exceptional graphics. One such offering is made of impact-resistant, environmentally preferable, PETG (polyethylene terephthlate glycol-modified) rigid sheet that is PVC free. It also contains no substances labeled as persistent, bioaccumulative, and toxic (PBTs) and no halogenated or brominated fire retardants, making it very suitable for use in schools concerned about the ingredients in building products. The PETG overlay acts as a wall covering material and protective shield for the graphics to safeguard against damage. The rigid sheet also serves as an impact-resistant, easily cleanable wall protection so walls can look great during use and hold up for years to come.

The graphics capability of these products allow for visual freedom with photos, wayfinding, mascots, logos, and other art to be created and preserved on walls throughout schools. Available in standard-size sheets (such as 4-by-8 or 4-by-10 feet), PETG can protect and enhance any wall space where graphics are introduced, from subtle visual textures and refined patterns to vivid, space-defining imagery. Such graphics can provide the appropriate complexity and stimulation while generating school pride, identify fields of study areas, spark enthusiasm for learning, and stylize wayfinding.

NATURALNESS AND DAYLIGHT

The design principle of naturalness of the environment was taken into account in the Barrett study as a contributor to student learning. Among the classroom features found to be desirable in this regard, natural daylight was seen as significant, preferably from more than one compass orientation. This appears to confirm and reinforce the findings of other studies that have also found daylighting and views to be important to student performance.

Of course, in most buildings, the desire for light and views usually needs to be balanced with the need for energy efficiency and budget. School systems and architects, however, shouldn't necessarily feel that budget limits will impede any efforts to design with energy performance in mind. The range of high-performance, low-e glass products currently available delivers energy performance that helps buildings run efficiently at multiple price points. With that in mind architects often ask glass manufacturers, "What is the best U-factor and solar heat gain coefficient we can get for this project?" In order to determine the proper answer, the location of the project (to identify the proper climate zone) and the orientation of the glass (south facing, west facing, etc.) are paramount. The other significant factor is the choice to use either clear or reflective glass, which directly impacts visible light transmission and solar heat gain.

Beyond addressing these fundamental questions, some glass manufacturers offer online tools to easily calculate the performance and aesthetic differences between different glass options and create reports comparing choices made by architects. Some also offer a comprehensive digital suite of engineering and analytical reports that demonstrate the advantages of high-performance glass in building facades. One manufacturer points out that the most popular clear glass (not tinted) product selected for education projects has a visible light transmission of 68 percent and a solar heat gain coefficient of 0.38, delivering abundant natural light for most regions. When a lower solar heat gain coefficient is needed, a clear glass product with 62 percent visible light transmission is common, while offering an impressive solar heat gain coefficient of 0.27. Improvements in thermal efficiency currently help to boost U-factor performance, bringing some double-glazed insulating glass units closer to the thermal performance of triple-glazed units. Analyzing all of these fac-

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Abundant natural daylight in schools helps with learning outcomes but also needs to be designed to account for proper energy efficiency based on variables such as climate, orientation, and glass properties.

tors and using high-performance, low-e glass products can help deliver glass performance that ensures schools can be optimized for daylight and energy use throughout the year.

Brian Schulz, the commercial product manager for Guardian Glass North America, has seen this play out firsthand. "High-performance glass can play a significant role in helping school districts realize utility cost savings by helping to manage solar heat gain, and these glass products can enhance the learning environment by delivering abundant natural light to classrooms, proven to boost learning rates. The total utility savings can be up to 20 to 40 percent annually for new schools, and 20 to 30 percent for renovated schools, just through high-performance glass design concepts."

NATURAL LIGHT CONTROL

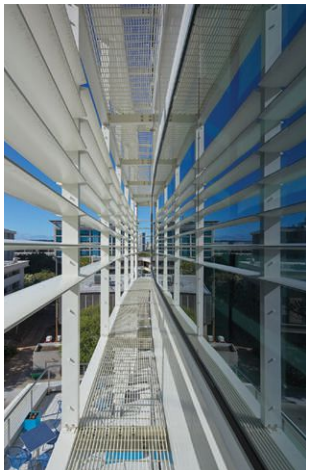
It is one thing to add natural daylight to a building, but it is another thing to control that light. Too much daylight will lead to uncomfortable glare and, depending on the compass orientation, could add more solar heat gain than desired. Interior solutions can help with distribution of light, but interior shades won't keep unwanted heat from penetrating into the building. The most effective way to address these issues is from the exterior by controlling the amount of sunlight that ever reaches a window.

Exterior sunshades have become a common and popular design solution to promote lower energy costs and reduced glare, allowing filtered light to enter interiors while still allowing occupants to see out. Incorporating such exterior sunshades can take on a variety of forms with intricate patterns, sleek textures, and vivid colors—some can even incorporate LED lighting for dramatic or artistic nighttime appearances. Cantilevered and suspended sunshades typically project horizontally outward from the building facade and are well suited for southerly facing facades. The location and angle of the horizontal bands or louvers can be adjusted to suit particular projects based on specific orientation, latitude location, and facade conditions. This type of sunshade is also ideally suited for installations where loads from wind and snow need to be distributed over a larger area and back to the buildings structural support system. Tube shades are a variation on this concept, which use a hollow extruded aluminum profile with a shape that allows longer spans than traditional Z louver blades. A further variation employs a hollow extruded aluminum airfoil profile that maximizes the span between supports.

Instead of cantilevering outward from the building, exterior sunshades can be suspended closer to the facade in either a horizontal or vertical format. This configuration is particularly well suited for east and west elevations, where low sun angles make sun control challenging. In most cases, vertical sunshades will be the most effective for such east and west elevations if they are spaced properly to fully block the low sun angles. For installations where daylight from any direction is intended to offset the use of electric lights, something is needed to help distribute the daylight evenly in the spaces, such as classrooms. Interior lightshelves have been successfully employed to do just that, particularly with upper or transom style windows. These lightshelves intercept the upper light and redirect it deeply into the building. In this way, they reduce heat and glare, allowing students to sit adjacent to windows comfortably and productively.

Manufacturers of exterior sunshades can demonstrate how their particular products can enhance building designs while lowering environmental impact. For some, though, manufacturing the product is just the beginning. When architects are looking for an exterior sun control solution, certain manufacturers can also provide expert guidance and engineering support in the final design and fabrication of products directly suited to individual projects. Architects can work with product engineers to design a custom system that is code compliant and structurally sound, regardless of how complex the final design may seem.

Photos courtesy of Construction Specialties



Controlling glare and heat from sunlight in schools is most effectively done on the exterior with a sunshade system specifically designed to suit the building. Distributing daylight inside the building can be achieved with interior lightshelves.

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Acoustic wood doors in a steel frame all coordinated and supplied by a single manufacturer can be carefully controlled and tested to achieve high performance, such as this door that is verified at STC 51.

NATURALNESS AND SOUND

Although not one of the top six indicators, sound as part of the natural environment of a school was addressed in the research study by Barrett et al. This corroborates with an increasing number of design professionals who have focused on good acoustics, and even more so on acoustic control between spaces, as a key factor connected to learning outcomes in school environments. Independent programs such as LEED for Schools or Collaborative for High-Performance Schools (CHPS) also encourage the use of high-performance acoustic environments in schools. Indeed, the LEED for Schools program now contains both prerequisite and credit options for good acoustics in schools, with a particular emphasis on controlling sound between the spaces where they originate and the spaces where they end up. This is true for many wall assemblies in schools, but one area where this is sometimes overlooked is in the openings in walls, such as windows and doors. Sound energy will move through those openings easily if they are the acoustic weak point of a wall. Certain door companies recognize this and offer the highest-quality specialized door assemblies in both steel and wood that are tested and certified to industry performance standards.

Photos courtesy of Joe Loehle Photography

Variable refrigerant flow (VRF) cooling and heating systems blend easily into classrooms, offering greater design flexibility, more precise comfort control, and quiet operation.

The measure of acoustic performance for doors is found in sound transmission class (STC) ratings based on tests in accordance with ASTM E-330: Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference and ASTM E-413: Classification for Rating Sound Insulation. Fortunately, it is possible to specify doors and frame assemblies with high STC ratings based on these testing standards. However, that is not where things end. The door, frame, and related door components all need to be looked at and addressed together in order to achieve satisfactory results. To do so using individual field-installed products and components is possible in theory, but in practice, it is extremely difficult to achieve. The more direct solution is to specify complete door and window frame systems that are manufactured from a single source such that they are coordinated and independently tested together for sound control. In this way, STC ratings can be achieved in a door that can approach or even match those achieved in the walls where the doors are being installed. If separate doors, frames, seal systems, glazing, and hardware are all supplied from different manufacturers, it is nearly certain that they have not been tested as a system to determine STC ratings, and it is even less likely that they can be installed across a school building to consistently attain the acoustic performance needed.

High-performance door and window products also address safety in schools, particularly in terms of tornado-resistant openings in exterior walls. Many of the same attributes that lead to an acoustically superior door also help with tornado resistance when tested in accordance with FEMA 361 & 320 and ICC-500 standards. The goal is to provide doors that enhance the quality of the learning environment and provide critical

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life safety protection to the occupants. Many schools in certain areas of the country experience the threat of tornados on a more regular basis than they would care for, which has given rise to incorporating tornado safe rooms in schools. Door frame and hardware assemblies along with window frame and glazing assemblies on the perimeter of those rooms need to be capable of resisting the forces imposed on them and protecting the critical life safety of the inhabitants. Properly specified, manufactured, and installed high-performance doors can do exactly that.

NATURALNESS, TEMPERATURE, AND AIR QUALITY

Similar to acoustics, temperature and air quality were looked at in the research study we have been following. Some of the indicators of a successful classroom environment suggested that the degree to which the pupils feel comfortable during different seasons and the degree to which manual adjustments can be made are important. This plays directly into the type of cooling and heating system that is used and the ability for it to be responsive to different needs within a school.

Conventional HVAC systems have served the needs of most buildings for many decades. However, achieving high levels of comfort, versatility, and performance often requires going beyond the conventional. Considerable success has been found in the use of variable refrigerant flow (VRF) systems, which operate in a zoned manner as an energy-efficient method of providing improved comfort control to indoor environments. Zones are defined as single- or multiple-room spaces that are conditioned to a set temperature and are operated independently from other rooms within the same structure.

VRF systems move conditioned refrigerant directly to the zone to be cooled or heated, allowing the temperature of that area to be more precisely controlled. They can simultaneously cool some zones while heating others or just provide conditioning to zones that are in use. VRF systems provide educational buildings with efficient, personalized comfort and can meet the needs of a wide variety of spaces within schools—classrooms, lecture halls, administrative offices, athletic facilities, and more. Further, the quiet operation of VRF systems makes them ideal for environments like libraries and classrooms where students need to focus on their studies. They can also be used with energy recovery ventilators (ERVs) that exhaust outside air to rid school buildings of toxins, odors, bacteria, and other potentially harmful contaminants. ERVs also improve HVAC system efficiency by preheating or cooling incoming outside air with energy recovered from the exhaust air. All of that adds up to a healthier indoor environment for students and staff. For architects, VRF systems with ERVs mean flexibility in design, quiet operation, and the ability to modify the systems as needs change during the design or life cycle of the building.

INDIVIDUALIZATION AND FLEXIBILITY

Barrett and his research team make a case that when students and teachers feel a sense of ownership and control over their surroundings, learning outcomes can improve. This is manifested in several ways, but of particular interest to architects is the notion of creating spaces that can be flexible. In particular, spaces that allow the teacher to reconfigure things within learning spaces or provide different zones all contribute to an environment that offers a variety of learning spaces and activities. This finding seems to support many school client requests for more open and shared use of space. Moreover, with square footage becoming a premium, ways to utilize space efficiently is required.

The design question becomes how to achieve this flexibility in a way that enables multiple room layout configurations within a single space or opens transitional areas within circulation areas. Even more so, how can traditional classrooms transform into learning environments that are agile and adaptable, encouraging collaborative learning and facilitating large group, small group, team, and individual activities. If those spaces provide options for direct and open linkage to outdoor learning spaces too, then that certainly adds to the variety and stimulation potential for students, while providing opportunity for natural daylighting at the same time.

One of the solutions being used increasingly in schools are operable glass walls made of panels that can be easily moved to define smaller spaces when they are closed and larger spaces when they are open. From a learning perspective, this solution allows the creation of defined areas for focused learning or the opening up of larger common areas where multiple students can work together on a range of activities utilizing shared resources. Not only does this approach offer the sought after variety for students, it also means that teachers can share resources and support each other, fostering a better managed classroom environment. From an overall design perspective, creating such a flexible classroom configuration with operable glass walls can optimize or even reduce the needed floor space within a building envelope, which can translate into reduced construction costs.

Architects who have used this approach include John Brown, AIA, partner, Hollis + Miller Architects, who points out, “Connectivity, flexibility, and visibility were all very important concepts in the design of the spaces within our school projects. While we still needed the capability of closing off spaces for more traditional classroom and learning spaces,

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Operable glass walls provide flexibility and connection of student learning spaces to larger, more collaborative spaces or to outdoor learning areas.

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we also needed to open up the walls to accommodate larger groups, which would then allow for collaboration." David T. Esely, AIA, senior project architect of the same firm, adds, "When closed, very little sound penetrates, which allows for diverse learning opportunities on both sides of the panels simultaneously. When the panels are open, the opportunities within the space transform and can then be tailored to specific instructors' needs and requirements. This is all done with ease, with speed, and with frequency."

Among the practical benefits that these design professionals and others have seen by incorporating operable glass walls into schools, a number are worth noting:

- Collaborative learning is fostered through group work activities. At the same time, the movable walls enable the separation of smaller groups for discussion, group projects, quiet zones, advanced or remedial work, test centers, teacher assistant-led groups, etc. Glass-filled space divisions also allow teachers to monitor multiple activities in functionally separated spaces.
- When parents or other visitors volunteer in the classroom, they can use separated areas to work independently with students.
- Classroom management is enhanced through the use of shared resources that offer common storage space for shared books, supplies, and computers, thus reducing redundant purchases.
- Teamwork is encouraged by joining two or more classrooms with a shared space. This allows teachers to configure space to meet their needs quickly and easily.
- Management of students is streamlined since one teacher can temporarily monitor two classes if another teacher has an emergency or needs a break.
- Visual distractions can be minimized through the use of mixed transparent and opaque glazing, thus allowing seated students to be isolated from excessive distraction beyond the operable wall, while a standing teacher can monitor multiple spaces.
- Separated spaces can also become cool off/recovery areas, offering isolated, private space for behavioral and emotional issues or disciplinary actions.
- Health benefits are possible, particularly if the operable walls open directly to the outdoors and provide natural ventilation in the process.
- Exterior operable glass walls can also add an abundance of natural daylight with the same benefits we have already discussed on this topic.

In multiple ways then, flexible learning spaces using movable glass walls provide architects with great design possibilities, teachers with more flexibility in how to configure spaces, students with more variety for improved learning, and school administrators with potentially better budget control.

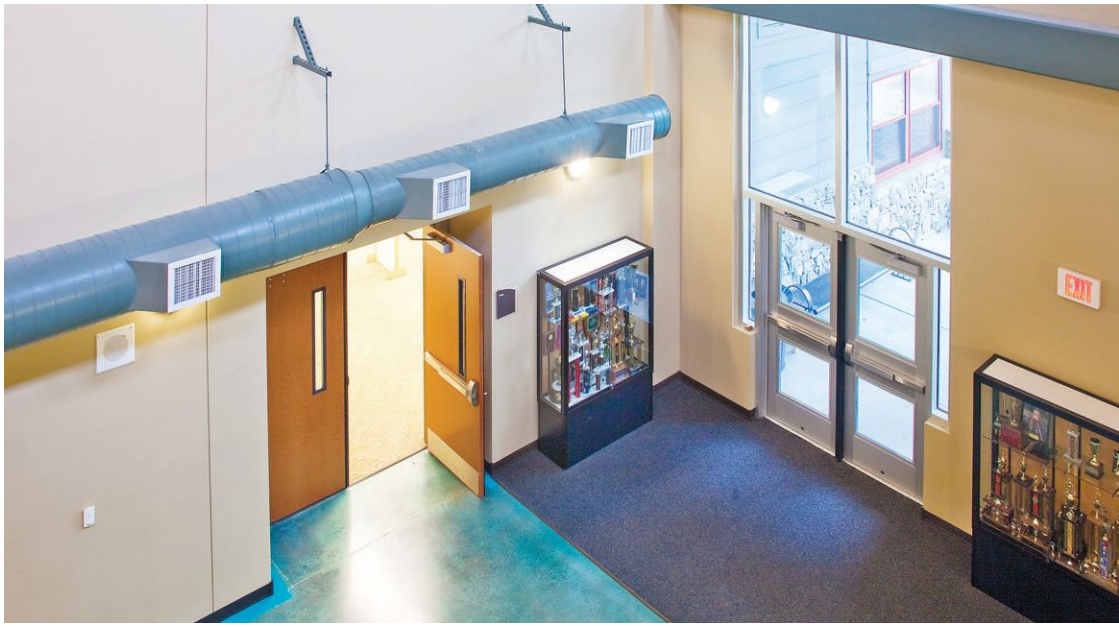
Photos courtesy of NanaWall Systems

Flexible learning spaces that can be closed off for smaller or individual activities or opened up to allow for larger group activities provide benefits to students, teachers, designers, and administrators.

INDIVIDUALIZATION AND CONNECTION

Part of the process of feeling a sense of individual ownership and control within a school building involves having a sense of connection and wayfinding through corridors and public spaces in the building. The Barrett team found significance in having clear and orienting corridors that were wide and used just as cor-

Photos courtesy of dormakaba



School designs that employ wide open corridors that allow students to make connections to different parts of the school are important but they also need to be safely secured with proper access control systems, both manual and electronic.

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CIRCLE 226

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ridors, not for storage or breakout spaces. They also identified safe and quick access to the school facility as important, which is right in line with the needs of many school administrators to assure proper access control and safety in schools. That usually means that it is up to architects to specify electronic and mechanical access control products that match the rigorous performance standards required in the K–12 school building environment. It also means providing a serviceable and secure solution for all openings, utilizing both concealed and surface mounted hardware.

Architects and educational programmers are always conscious of building safety and security. Identifying manufacturers and products that readily address those concerns with both traditional master key systems and the integration of electronic access control is often the task at hand in designing schools. Specifically, finding top-grade locks, closers, and exit devices that have been proven in school environments across the country is often paramount for durability, operability, and functionality. In this age of increasing use of electronic access control products, it is equally important to find a manufacturer that can offer a complete, durable, and flexible control system. That can include a full line of electronic, stand-alone, and wireless cylindrical and mortise locks as well as the electronic access control trim for exit devices. In the spirit of a coordinated system not only for function but for aesthetics too, at least one manufacturer offers door-closer products with a consistent look across different types and series due to the use of matching covers and trim. Lever designs for door handles are also consistent from series to series, be it mortise or cylindrical, and the finish options are complementary for all door hardware products.

It is common practice to work with a particular manufacturer during the design and specification writing stage that offers direct specification and product selection assistance to generate the appropriate safety and security solution. Erich Tolksforf, CSI, CDT, senior specification writer for James W. Buckley and Associates Inc., comments, "As a specification writer for an architectural firm, I am always confident in including the manufacturer in our designs. This way, I know the products are reliable, the lines and associated nomenclature are understood, and everyone can take advantage of their service support system. All of these factors are extremely beneficial to me in the execution of my job as well as providing our clients with a quality access control solution that will last for many years."

INDIVIDUALIZATION AND CHOICE

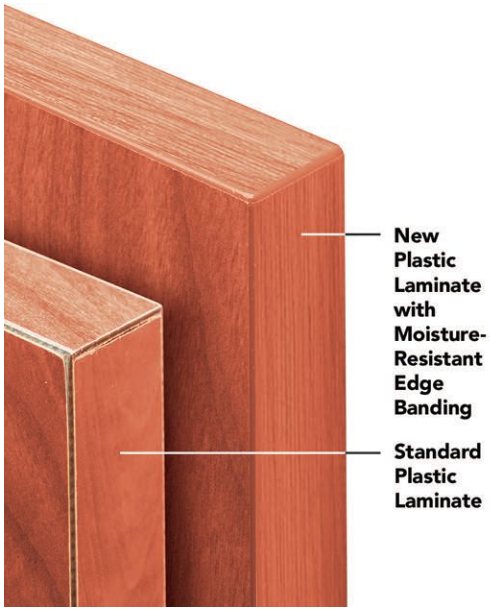
The design parameter of having a choice in the way students interact with things in the building, like furniture, fixtures, and equipment (FF&E), was found by the Barret research team to help reinforce the notion of ownership and identification with the school in a positive way. High-quality and purposeful design in this area helped to reinforce outcomes in the classroom.

Architects and designers may or may not have much say in some of the FF&E choices in typical school building projects, depending on the client, the budgeting, and purchasing protocols. However, those things that are built in, such as lockers, bathroom fixtures, and accessories, are typically under the architect's control and should be considered as fully as any other permanent part of the building. In fact, the proper design of bathrooms in a school can influence user experiences significantly more than the design of other parts of the facility. Since there are a wide variety of different products that meet different needs in bathroom and locker-room designs, product selection is instrumental in achieving not only a successful design but also in creating a long service life.

In developing specifications for these types of products, it is important to be aware of both the salient features and the material qualities of the different products being considered. Partitions in restrooms and locker rooms, for example, need to address appearance, functionality specific to the application, and durability. Given the presence of water and high humidity in some of these rooms, products that can stand up to those conditions, as well as the usual rigors of a school environment, are important. Of course, there is a desire to move away from cold, institutional appearances too, so such partitions need to provide an appropriate aesthetic. Plastic laminate partitions have been used as a cost-effective solution for this type of application, but they need to be properly selected and specified in order to avoid delamination or other problems. Toward that end, at least one manufacturer offers an edge-banding system (often the common weak point in the finish) that fuses with the substrate, creating a seamless beveled profile that eliminates any unsightly black lines that normally appear in standard plastic laminate. ASTM tests on this type of system confirm up to three times greater durability with increased resistance to moisture and humidity than standard plastic laminate. From a design standpoint, the edge banding is available in more than 40 different colors and patterns to match laminate on partition doors, panels, and pilasters.

Looking at other aspects of a bathroom design in schools, attention to the permanent accessories can help with the smooth and long-term operation of restrooms, including the ability to easily maintain them. For example, soap dispensing systems often require a lot of time for maintenance staff to refill them on a regular, even daily basis. Products are now available in top-fill soap dispensing systems that can refill up to six soap dispensers with one pour. That saves time, but it can also mean that all dispensers are full and hands are actually washed at school, thus preventing the spread of germs and disease in school environments.

Photos courtesy of ASI Group



The selection and specification of permanent furnishings and equipment in bathrooms and locker rooms in a school can directly influence the design appearance and functional performance of those rooms such as the toilet partitions shown here.

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Images courtesy of ASI Group

Permanent bathroom accessories, such as multi-fill soap dispensers and high-speed electric hand dryers, as shown here, can provide choices that make a positive impact on the perception of the people who use the school.

Hand drying is critical for good hygiene and hence an important detail in restroom design. The common options are paper towels and hand dryers, and while each have their pros and cons, there is room for both, even in the same washroom. One manufacturer even makes a three-in-one unit that has a paper towel dispenser, waste receptacle, and a built-in high-speed hand dryer.

While paper towels can generate waste and may be more expensive in the long run (since they are a consumable), there are instances where they are needed for uses besides hand drying, like cleaning up a mess in a washroom or even using them to avoid touching surfaces that people don't want direct contact with.

As far as hand dryers go, high-speed hand dryers are more energy efficient and quicker (less than 12 seconds drying time). However, with high speed comes noise, which is not great for schools—consider hand dryers with lower decibel levels as well as ones that have the ability to adjust airflow and heat to meet specific needs. Hygiene is most critical in washrooms, and some hand dryers collect water in a trough—a breeding ground for bacteria—and often that water can overflow and spill onto the floor, creating a safety hazard. It is best to investigate hand dryers that have moisture management systems that in effect help eliminate bacteria and other hazards. Dryers that have triple filters (HEPA, odor-fighting, and anti-microbial layers) add a level of hygiene as well. In summary, the key in hand dryer selection is to find dryers that have high-performance parts so that they manage moisture, eliminate bacteria, keep decibel levels low, save energy, and also have the flexibility of adjusting air flow and heat to suit a school's specific needs.

Cyrus Boatwalla, director of marketing, ASI Group, has a good bit of experience in this area, and architects he has spoken with agree with his observation that "a well-designed bathroom and locker room in an educational facility can be the deciding factor in elevating a building from 'good to great'. Bathrooms and lockers rooms are more private and personal and are used much more frequently than entryways and building facades. If given the requisite attention to detail, a well thought out bathroom can make a much greater positive impact on the user experience of a building—thus influencing their opinion of the school, the town, and the architects who designed the building."

CONCLUSION

Architects, designers, education planners, and school administrators all need to make decisions about the design and construction of school buildings. Some of those decisions are appropriately based on individual experience and professional training. They can also benefit by being based on the work of researchers who seek to measure design variables in buildings and investigate the impact of those variables on students and other occupants, particularly in terms of how they influence learning. Basing designs on the findings and evidence found in such research (referred to as evidence-based design) allows everyone involved to make informed, up-to-date decisions. In that way, the design can truly make a more positive impact on the people who spend many hours each day inside schools and other buildings.

Continues at ce.architecturalrecord.com

Peter J. Arsenault, FAIA, NCARB, LEED AP, *is a practicing architect, green building consultant, continuing education presenter, and prolific author engaged nationwide in advancing building performance through better design.* ***www.linkedin.com/in/pjaarch***

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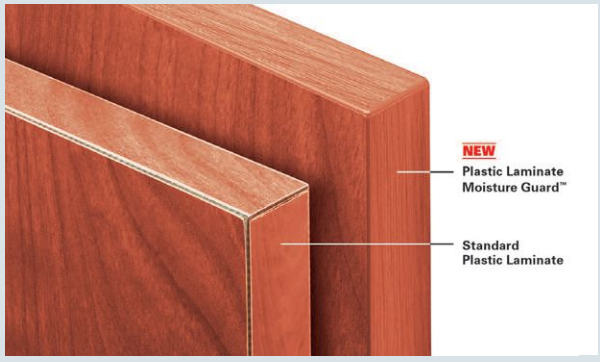

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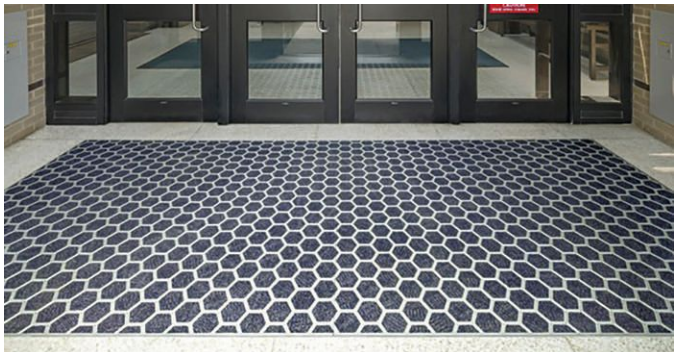

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Construction Specialties

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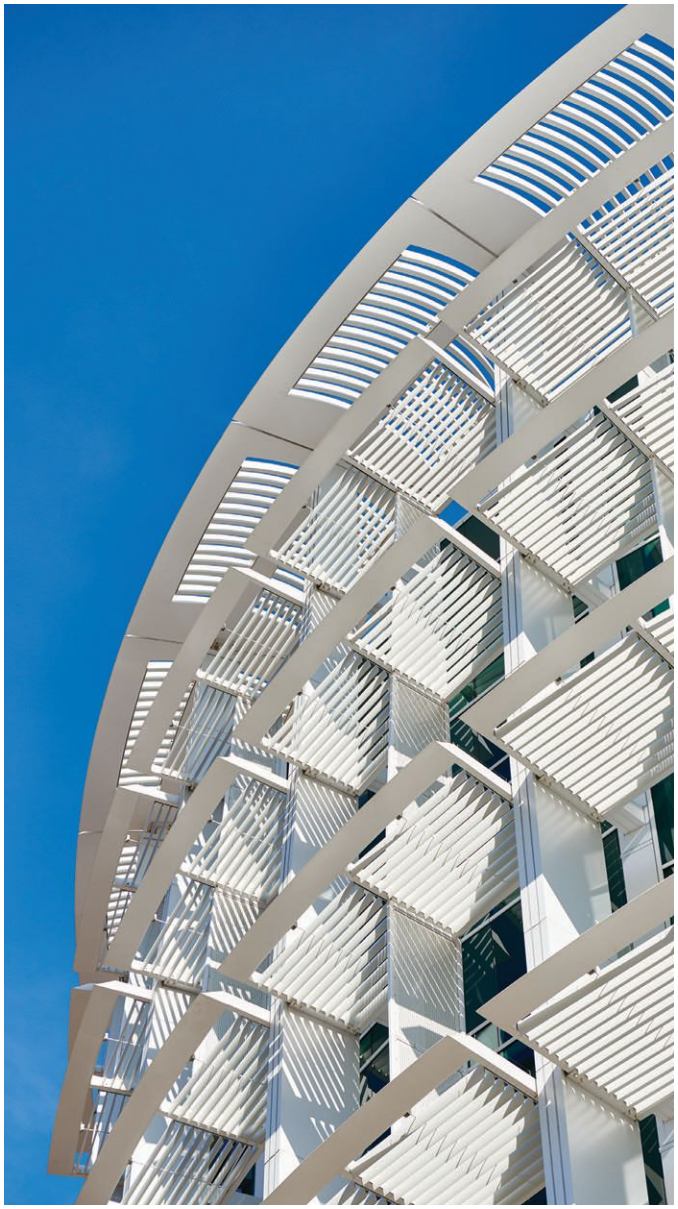

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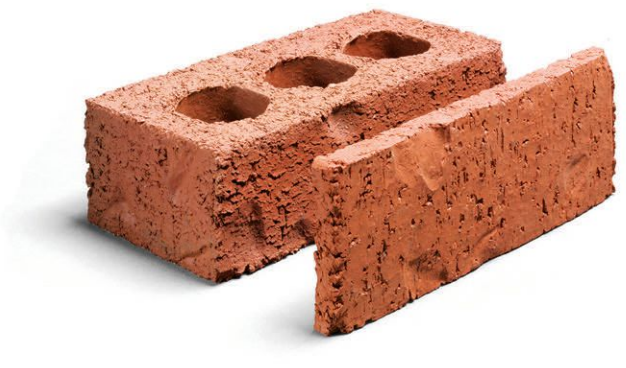

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Designing Modern Wood Schools

How to create high-performance structures that are also cost effective

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There is a strong case to be made for using wood in school construction, both to accommodate a growing number of students with structures that are cost effective, and to do so while creating high-performance buildings that are safe, resilient, and appealing.

Across the United States, there is high demand for new schools. In 2015, an estimated $6.1 billion was spent on new school construction, and educational facilities accounted for about 88 million square feet of the nonresidential market.[1] Since, by 2024, U.S. schools will be required to accommodate an estimated 2.8 million more students than they do today, these numbers can only increase.[2]

Cost and construction speed are often cited as the main reasons to design a school in wood. Wood building systems typically cost less than alternatives, and wood construction is fast, even more so with the trend toward panelized products, such as cross-laminated timber (CLT) and prefabrication. This is espe-

CLOVER CREEK ELEMENTARY SCHOOL
Location: Tacoma, Washington
Architect: Erickson McGovern Architects
Structural Engineer: PCS Structural Solutions

Bethel School District uses Type VB Construction to save upfront construction costs and super insulates to reduce utility costs. It uses the savings from both to buy more energy-efficient but expensive mechanical and lighting systems, which further add to the savings. Director of Construction and Planning Emeritus Jim Hansen, says, "We need people to believe we do a good job, not only educating their children but managing their money."

Photo: Bethel School District

CONTINUING EDUCATION

1.5 AIA LU/HSW

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Learning Objectives

After reading this article, you should be able to:

1. Review provisions of the International Building Code specific to school buildings and discuss opportunities to achieve cost savings through the use of wood.
2. Explore design and detailing best practices used to achieve performance objectives in school assembly design.
3. Discuss structural design considerations unique to school buildings, as well as framing options for floors, walls, and roofs.
4. Consider how wood has been used in modern wood-frame and mass timber schools across the United States.

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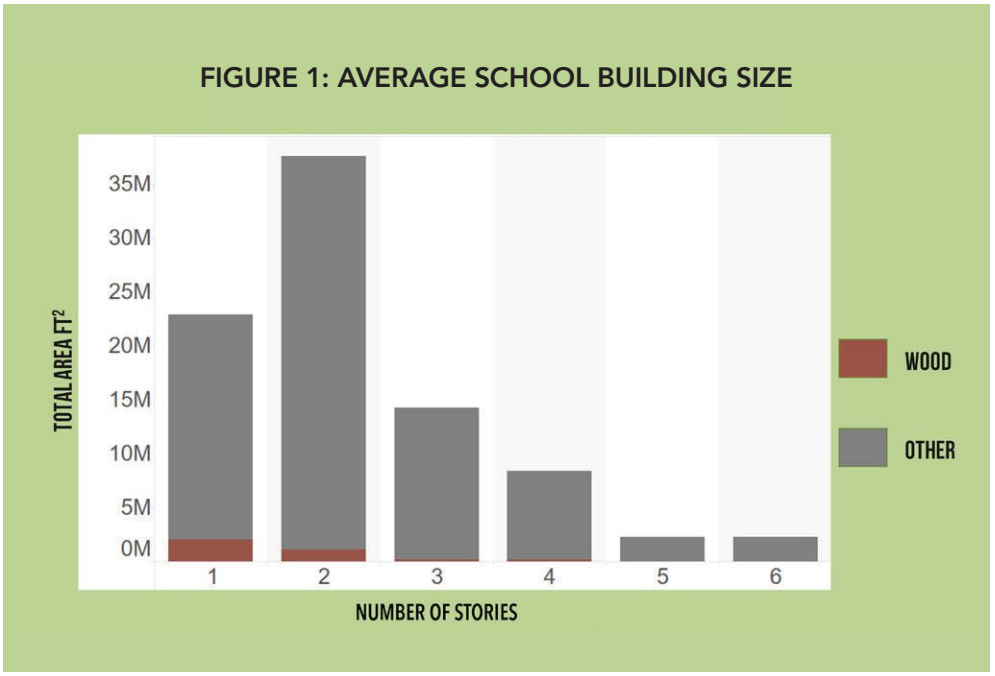
Source: Dodge Construction Data, 2015



cially important for schools, which often have limited budgets and compressed construction schedules.

Increasingly, however, school designers and facility planners are citing other attributes of wood as motivating factors for its use. They point to its light carbon footprint, energy performance, and other environmental benefits. They also cite a growing body of research linking the use of exposed wood to occupant well-being, including potential benefits related to increased concentration. In school construction, wood offers endless opportunities to create warm and inspiring places to learn.

This course takes a practical look at the design of wood schools, emphasizing opportunities with traditional wood-frame construction and, in particular, how to reduce costs. Architectural design and detailing topics include allowable heights and areas, detailing for fire resistance, acoustics, and durability, as well as structural design considerations. The trend toward mass timber is also discussed, along with information on wood's biophilic attributes and environmental performance, including energy efficiency and carbon footprint. Examples of wood schools across the United States are also highlighted.

CONSTRUCTION TYPE AND COST

In Washington state, the Bethel School District's strategy is to save money by using wood-frame construction for the majority of school construction, and to use those savings to buy more expensive but efficient mechanical or lighting systems. This provides operational savings—most of its schools are ENERGY STAR leaders—which, over the long term, puts less pressure on the general fund. The district reports construction costs per square foot that are much lower than the average in the region, an achievement Director of Construction and Planning Emeritus Jim Hansen credits to the use of wood.[3]

According to the "State of School Construction, 2015 Report" by School Planning & Management, the following are average school sizes and costs across the country:

- Elementary schools: 80,000 square feet/$210 per square foot
- Middle schools: 117,000 square feet/$270 per square foot
- High schools: 154,700 square feet/$267 per square foot

The majority of schools are one or two stories (Figure 1), and relatively few are built in wood. Rather, many designers default to steel or concrete, even though wood schools are permitted under the International Building Code (IBC), are required to meet all of the same safety and performance requirements as schools built with other materials, and can offer significant cost savings.

Under the IBC, small and medium-sized spaces in a school typically fall under Educational Group E occupancy. Although large spaces such as a gymnasium or cafeteria can be classified as Assembly Group A, IBC Section 303.1.3 allows schools to be classified as Group E throughout, and this is a common approach.

IBC Section 602 defines five construction types and allows the use of wood as follows:

- Types IIIA, IIIB, IV, VA, and VB: Structural wood framing permitted throughout
- Types IIIA, IIIB, and IV: Fire-retardant treated (FRT) wood framing required for exterior walls
- Type IV: Exposed heavy timber permitted for interior elements provided they meet the minimum size requirements of IBC Section 602.4
- Types IA, IB, IIA, and IIB: Several provisions for the use of wood per IBC Section 603

The IBC specifies the allowable height and area for each construction type, and each has different requirements, largely related to fire protection.

Twice a year, the International Code Council (ICC) publishes building valuation data that includes the average cost per square foot for each construction type and occupancy group. Figure 2 shows the average cost of buildings in Educational Group E, and illustrates the cost impact of construction type and, by extension, choice of building material. Buildings of Type I and II Construction, which are typically steel, concrete, or masonry, cost an average of $172 to $192 per square foot. Buildings of Type III and V Construction, which are typically wood-frame, cost significantly less at $136 to $161 per square foot.

Note: The ICC data includes building costs only (e.g., foundation, structure, mechanical), while the School Planning & Management report cited above includes complete project costs (e.g., furnishings and site work).

Given the potential savings, the question becomes: Is it possible to design an average size school—i.e., 80,000 to 155,000 square feet—as a Type III or V wood building? The answer is yes. Although designers accustomed to steel and concrete often design schools as Type IIA or IIB, nearly identical height and area can be achieved with wood framing (Figure 3).

FIGURE 2: COST PER SQUARE FOOT BY CONSTRUCTION TYPE, EDUCATIONAL GROUP E OCCUPANCY

IA	IB	IIA	IIB	IIIA	IIIB	IV	VA	VB
$192	$185	$180	$172	$161	$153	$166	$140	$136

Source: ICC Building Valuation Data, August 2016

The ICC publishes cost per square foot averages by occupancy group and construction type.

FIGURE 3: ALLOWABLE BUILDING SIZE BY CONSTRUCTION TYPE, EDUCATIONAL GROUP E OCCUPANCY

	IA	IB	IIA	IIB	IIIA	IIIB	IV	VA	VB
Height (ft)	Unlimited	60	65	55	65	55	65	50	40
Stories	Unlimited	5	3	2	3	2	3	1	1
Area/Story (sf)	Unlimited	Unlimited	26,500	14,500	23,500	14,500	25,500	18,500	9,500

Source: IBC Table 503

With Type III Construction, a wood-frame building can achieve almost the same height and area as a steel or concrete building of Type II Construction. Designers can then use code provisions for further increases.

DESIGN RESOURCE: PROJECT ASSISTANCE

Technical information in this course is based on "An Architectural and Engineering Guide to Designing Modern Wood Schools," a presentation by Richard McLain, MS, PE, SE, technical director, Architectural & Engineering Solutions, of the U.S. WoodWorks program. WoodWorks offers free project assistance related to the design of any nonresidential or multifamily wood building. For technical support, or to request an in-house lunch and learn, visit www.woodworks.org/project-assistance and contact the expert nearest you, or email help@woodworks.org.

Code Provisions for Height and Area Increases

For all but Type I buildings, the square footage shown in Figure 3 is clearly much less than the average school sizes stated above. These are base heights and areas, and numerous code provisions exist for increases beyond those amounts. In the context of a wood-frame school, for example, designers may utilize the following:

Sprinklers: The requirement to include an NFPA 13 sprinkler system is not based on materials or construction type. It is based on occupancy group, occupant load, size of the fire area, and other occupant-specific criteria. Per IBC Section 903.2, an NFPA 13 sprinkler system is required throughout all educational and assembly occupancies where the fire area exceeds 12,000 square feet—which includes the vast majority of school construction. Use of an NFPA 13 sprinkler system allows designers to significantly increase the height and area of these facilities.

- Per IBC Section 504.2, buildings equipped throughout with an NFPA 13 sprinkler system can add one story and 20 feet to the base stories and heights in IBC Table 503.
- Per IBC Section 506.3, buildings equipped throughout with an NFPA 13 sprinkler system can add 200–300 percent to the base floor areas in Table 503. For a single-story building, the base area can be multiplied by four. For a multistory building, the base area can be multiplied by three.
- The story and height increases are permitted to be used concurrently with the area increase per IBC Sections 504.2 and 506.3.

Open frontage: Open space around a building, such as a parking lot or major roadway, provides firefighting access to multiple sides of the structure. If more than 25 percent of the building's perimeter is open for a minimum of 20 feet, IBC Section 506.2 allows an increase to the base floor area in Table 503 of up to 75 percent.

The area increases for sprinklers and open frontage are per story. Per IBC Section 506.4.1, a two-story school building's total area is permitted to be twice the increased area, and a three-story (or taller) school building's total area is permitted to be three times the increased area. Figure 4 shows the total potential square footage impact for Educational Group E occupancy.

Compared to a Type IIA steel or concrete building, a Type IIIA wood-frame building has the same height limits of four stories and 85 feet. The Type IIIA building offers nearly 90,000 square feet per floor, and more than 176,000 square feet for a two-story building. Even a Type VA structure offers an area of nearly 139,000 square feet for a two-story building, which is larger than many schools.

Unlimited area: Per IBC Section 507.3 and Section 507.10, a wood-frame school may also qualify for unlimited area—if, for example, the building:

DESIGN RESOURCES: HEIGHTS AND AREAS

For help calculating the allowable size of a wood-frame school, the 2015 *Code Conforming Wood Design*, a joint publication of the ICC and American Wood Council (AWC), can be downloaded at www.awc.org. WoodWorks also offers a free Heights and Areas Calculator, available at www.woodworks.org, which reviews and analyzes building height and area compliance with the 2012 IBC. As 2015 IBC allowable height and area limits are almost identical to the 2012 IBC limitations, this calculator offers a quick way to estimate the 2015 limitations for educational occupancies.

FIGURE 4: TOTAL ALLOWABLE BUILDING AREA WITH SPRINKLERS AND FULL FRONTAGE INCREASES, EDUCATIONAL GROUP E

	IIA	IIB	IIIA	IIIB	VA	VB
Stories	4	3	4	3	2	2
Height (ft)	85	75	85	75	70	60
One-Story Total Area (sf)	125,875	68,875	111,625	68,875	87,875	45,125
Two-Story Total Area (sf)	198,750	108,750	176,250	108,750	138,750	71,250
Three-Story Total Area (sf)	298,125	163,125	264,375	163,125	Not permitted	Not permitted

Source: IBC Table 503

With sprinklers and open frontage, Type III and Type V Construction offer ample height and area for most schools.

- Has a minimum of 60 feet open frontage around the perimeter
- Is Type IIIA or IV Construction, one story, fully sprinklered, and classified as Educational Group E occupancy
- Is Type III or IV Construction, one story, fully sprinklered, and classified as Assembly Group occupancy (A-4)
- Meets other provisions such as those related to egress

Fire walls: Fire walls are the most restrictive type of wall assembly in terms of their construction and hourly fire-rating requirements. However, they allow areas within a structure to be considered as separate buildings for the purpose of calculating height and area, further increasing the potential size of a project.

The Savings Add Up

Combine the ICC's estimated cost per square footage from Figure 2 with the average school size and costs from the School Planning & Management report, and a picture emerges of significant cost savings. By switching from a Type IIA steel or concrete school to a Type IIIA

Photo: Dennis Ivy; courtesy of WoodWorks

EL DORADO HIGH SCHOOL
Location: El Dorado, Arkansas
Architect: CADM Architecture
Structural Engineer: Engineering Consultants, Inc.

When the initial steel and masonry design for this 320,000-square-foot, Type IIIA high school came in well over budget, the project team evaluated alternative systems. The intent had always been to utilize exposed heavy timber in select areas. However, by changing approximately 40 percent of the nonexposed structural materials to wood framing, the team was able to save $2.7 million.[4]

CREATING EXCEPTIONAL SPACES WITH MASS TIMBER

One of the exciting trends in U.S. school design is the growing use of mass timber—i.e., large solid wood panel products such as CLT, nail-laminated timber (NLT), and glued-laminated timber (glulam)—for floor, wall, and roof construction, or to create innovative sculptural buildings.

Because of their strength and dimensional stability, products such as CLT offer a low-carbon alternative to steel, concrete, and masonry for many applications. A complement to other wood-framing systems, mass timber can be used on its own, in conjunction with other wood systems such as post-and-beam, or in hybrid structures with steel or concrete. Except where desired for aesthetic reasons, mass timber is not necessarily a good substitute for light wood-frame construction, only because dimension lumber framing offers such a compelling combination of structural performance, cost, and environmental advantages where permitted by code.

For school designers, the speed of mass timber construction is especially attractive. Because materials come premanufactured as large solid panels, it is possible to construct an entire school during a relatively small window when students are off campus.

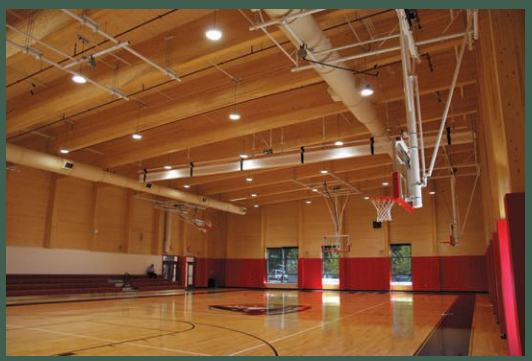
For a 14,000-square-foot addition to Common Ground High School in New Haven, Connecticut, for example, Gray Organschi Architecture and engineering partner Bensonwood chose a combination of CLT and glulam. Assisted only by a mobile crane, a five-person assembly crew installed the entire primary structure and enclosure in just four weeks.

Other attributes that make mass timber appealing for schools are the potential efficiencies of replicable modular designs, a lighter carbon footprint than non-wood building materials, and the positive impacts of exposed wood on student well-being.

Architect Alan Organschi, who designed Common Ground High School, says, "It's well-known that, as a hygroscopic material, wood surfaces serve as moisture buffers, moderating swings in interior humidity and thereby improving air quality. It's worth mentioning that during the first few weeks the new building was being used, a teacher commented to me that people were remarking on the freshness of the air in the classrooms. Anecdotal, I know, but it squares with the scientific predictions of health benefits of using wood (especially unfinished wood) in building interiors." (See Health and Well-Being.)

The fact that mass timber weighs less than other materials also has potential benefits, including smaller foundation requirements and lower forces for seismic resistance.

While NLT and glulam have been recognized in the IBC for many years, CLT is a relatively new addition. The 2015 IBC recognizes CLT products manufactured according to the ANSI/APA PRG-320: Standard for Performance Rated Cross-Laminated Timber. Under the IBC, CLT at the required size is specifically stated for prescribed use in Type IV buildings. However, CLT can be used in all types of combustible construction—i.e., wherever combustible framing or heavy timber materials are allowed. AWC's National Design Specification® (NDS®) for Wood Construction is referenced throughout the IBC as the standard for structural wood design, including CLT.



WASHINGTON LATIN PUBLIC CHARTER SCHOOL
Location: Washington, D.C.
Architect: Perkins Eastman
Structural Engineer: Arup

Photo: KLH USA

Photo: Costea; courtesy of LPA, Inc.

SOUTH TAHOE HIGH SCHOOL
Location: South Lake Tahoe, California
Architect: LPA, Inc.
Structural Engineer: LPA, Inc.
Size: 67,500 square feet
Fire resistance of exposed wood members can be calculated using the provisions of Chapter 16 of the NDS.

wood-frame school, the ICC estimates show a potential 11 percent savings. Now factor in the average school size:

- Elementary school: 80,000 square feet/save $1.8 million
- Middle school: 117,000 square feet/save $3.3 million
- High school: 154,700 square feet/save $4.4 million

For most elementary and middle schools, the average size falls within the maximum allowable by Type VA Construction, bringing the potential savings closer to 22 percent.

DETAILING FOR FIRE RESISTANCE

An important yet little known piece of information for many designers is that there are many sources for tested assemblies that meet 1-hour and 2-hour fire-resistance ratings required for wood buildings—not just UL.

In addition to UL's Fire Resistance Directory, assemblies can be found in publications such as:

- Intertek Testing Services' *Directory of Listed Products*
- Gypsum Association's *Fire Resistance Design Manual*

They can also be selected from one of the prescriptive assemblies provided in IBC Section 721, which are based on ASTM E 119 or UL 263 test results, by calculating an assembly's fire resistance using IBC Section 722, or by other methods indicated in Section 703.3 of the code.

Assemblies tested by the wood industry are also available. AWC's Design for Code Acceptance 3: *Fire-Rated Wood Floor and Wall Assemblies* contains fire ratings of wood-frame wall and floor/ceiling/roof assemblies. Other sources include APA – The Engineered Wood Association's *Fire-Rated Systems* (Form W305), and Wood Truss Council of America's *Metal Plate Connected Wood Truss Handbook*. Some manufacturer websites and catalogues also reference tested assemblies that include their products.

Designers also have the option of integrating exposed, fire resistance-rated heavy or mass timber structural members into their designs, adding warmth to interior spaces. Because these products are thick and solid, they char on the outside at a slow and predictable rate, while retaining strength, slowing combustion, and allowing time to evacuate the building. The char protects the wood from further degradation, helping to maintain the building's structural integrity and reducing its fuel contribution to the fire.

Per IBC Section 722, the fire resistance of exposed wood members may be calculated using the provisions of Chapter 16 of the NDS. AWC's Technical Report No. 10: *Calculating the Fire Resistance of Exposed Wood Members*, contains full details of the NDS method as well as design examples.

Continues at ce.architecturalrecord.com

Photo: Steve Hall © Hedrich Blessing

Contemporary design has assigned a much more prominent role to doors and windows in the home. **Architect:** Booth Hansen

Capturing Timeless Values with Contemporary Design

Modern multi-panel door systems incorporate aesthetics, efficiency, and performance

Sponsored by LaCantina Doors | *By Amanda Voss, MPP*

Contemporary craftsman. American farmhouse. Modern shed. The box home. Contemporary design is radically shifting the look of America's homes.

Windows and doors play a leading role in contemporary design. A stamp of the movement is to increase both the amount and the size of windows and doors on the facade. Glass is maximized, and frames, stiles, and rails are kept crisp and minimal. Doors, in particular, receive specific attention, as walls are supplanted with multi-panel door systems, eliminating the barrier between indoors and out.

In partnership with this focal aesthetic role, advancements in multi-panel door systems and component technology allow contemporary design to achieve energy-efficiency goals, performance, and service life, creating a project that transcends trends.

EMERGING TRENDS: CONTEMPORARY DESIGN

A key shift is underway in architectural home design and style. The rise of contemporary design in homes draws from the pages of known historical styles, preserving the essentials of the original movement while updating these elements with clean lines and modern materials. A modern or contemporary craftsman home will still employ low-pitched roof lines, decorative brackets, an extended front porch, and 4-over-1 or 6-over-1 double hung windows, but these elements will be modernized with simple lines and thin stiles and rails at the windows. Simulated divided lights are present, but with thin, simple grids. In an American farmhouse, traditional rustic styling is updated with a more pitched roof, material mixing, and a heavier use of metal, particularly at the roof, and in windows and doors, to contrast with wood features. Updated colonial homes maintain their historical proportions yet contrast them with asymmetrical elements by applying a new color palette and new materials, and by using less formal spaces in the interior. The modern shed and box home represent ultra-contemporary design, as they redefine a home's footprint and embrace geometric profiles.

Across the movement, an emphasis is placed on outdoor living and the use of the exterior of the home and its surroundings to create new living spaces. As traditional styles are reborn

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Learning Objectives

After reading this article, you should be able to:

1. Discuss emerging trends in windows and doors.
2. Identify the types of multi-panel door systems available and their most appropriate applications.
3. Explain what performance testing and certifications are for windows and doors, and how they measure product performance.
4. Describe the types of component improvements and innovations that enhance contemporary design, while also enabling greater energy efficiency and performance.

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through contemporary design, they offer refined, clean lines. And importantly, each expression of contemporary design embraces the heavy incorporation of glass throughout the building.

THE NEW RULES: MODERNIZING A WINDOW AND DOOR PACKAGE

Windows and doors play a crucial role in modernizing a contemporary design, helping set the up-to-date home apart from its traditional counterpart. A contemporary craftsman stands out on the street because of its bold incorporation of windows along the front facade; an American farmhouse might feature a pivot entry door system greater than 6 feet wide and a multi-panel zero-post corner system. Contemporary designs are, at their core, glass centric. To modernize a fenestration package, narrow frames, stiles, and rails are necessary. In style, frame elements should be minimized, with square lines rather than traditional bevels.

Hardware has undergone a similar reformation. Locks and handles are combined into a seamless, simplified, single system, removing unnecessary visual clutter from doors and windows. Door sills are completely recessed, avoiding the creation of a defining line between rooms or spaces.

Contemporary design is also changing window framing materials. While all-aluminum windows and doors were once a budget-driven, lower-grade window, thin-frame, all-aluminum window and door packages with high-performance values are currently in demand to capture a more up-to-date feel in homes. Metal finishes, whether aluminum, clad, or anodized, dominate the current palette. Regardless of the framing material selected—wood, clad, or metal—thinner frames with simplified details define the trend.

Unique window and door configurations, more commonly seen in commercial spaces are also embraced by contemporary design. Their translation from commercial into residential is changing the face of homes. Massive multi-slide and folding door systems are a hallmark of the trend, but beyond this staple is also an increase for doors with zero post corners. Additionally, folding or multi-slide windows that combine directly into a multiple panel door system without a post are gaining in popularity. Kitchen servery windows that fold or slide into a recessed pocket are also current.

Products that augment a modern, clean feel and maximize daylight indoors are key. Emerging trends in windows and doors are driven by the demand to meld indoor and outdoor spaces together and facilitate design vision.

To accommodate indoor/outdoor blended living, modern fenestration packages incorporate much larger door systems. While a decade ago multi-panel door systems could be found in fine resorts and commercial applications, the rise of contemporary design finds a place for these systems in every home. The expansion of doors applies even to entry doors: traditional entry door panels are being supplanted by large—up to 8 feet wide—glass panels on pivot hardware to create a statement entry.

Contemporary design's emphasis on more glass, minimal sightlines, and open space creates a perfect fit for large sliding, pocketing, and folding door systems. Particularly, patio doors are much larger and create the ability to seamlessly open interior spaces to the outside. As contemporary design seeks to maximize nontraditional living spaces, it calls for door systems that enhance the ability to tie formerly divided spaces together.

Photo: Shelley Metcalf (top); Photo courtesy of LaCantina Doors (bottom)

Doors and windows are front and center in a modern home. Architect: Bill Bocken

Pictured is an aluminum wood multi-slide system with a stacked configuration with all panels to one side when fully opened.

Photo: Build LLC

Pictured is a three-panel aluminum thermally controlled multi-slide system in clear anodized finish. Architect: Build LLC

CASE STUDY HOUSES, ANDREW VAN LEEUWEN, BUILD LLC

The project: The Case Study House series is the manifestation of a tried and true design process that BUILD has been refining continuously for 15 years. The 2,900-square-foot CSH2014 is designed to function as a comfortable, modern city residence for an active family of four. The project incorporates a reverse floor plan with the common areas on the top level, bedrooms at the middle level, and garage along with accommodations for a future accessory dwelling unit at the lower level. Floor-to-ceiling windows, moving walls, and a rooftop terrace allow for optimal enjoyment of the outdoors.

The influences of contemporary design on the project:

- Floor-to-ceiling windows to compensate for the long, dark winters here in the Pacific Northwest
- Clean lines and a simple palette of materials; use of a clear anodized aluminum door finish system to match the window package
- From a design standpoint, the project is everything it needs to be and nothing more. The components of the project, like the window and door package, were selected with this philosophy in mind.
- The aesthetic of the home and its components are a direct extension of their functions.

The decision to incorporate multi-panel door systems:

- Multi-panel systems were selected for a variety of benefits, including optimizing the natural daylight and ventilation while creating strong indoor-outdoor relationships, and the ability to open up the interior during the warming months while allowing for natural cooling of the home.
- The durability of the doors along with the ease of operation is impressive.
- The doors we selected use an attenuated frame with minimal floor and ceiling tracks to maximize the glazing area.

AN INTRODUCTION TO MULTI-PANEL DOOR SYSTEMS

Multiple-panel door systems, or multi-panel doors, are composed of multiple panels, allowing a single installation to span a large width. These systems allow doors in a home to transcend the limits of a traditional 6- or 8-foot patio door. With their structural integrity and performance, multi-panel doors allow for replacement of entire walls with glass when closed and, when open, seamlessly blend indoors and out. The way in which these panels operate defines the type of system. The most common types of multi-panel door systems are folding and multi-slide. Multi-slide doors may be further separated into stacking multi-slide or pocketing multi-slide.

Photo courtesy of LaCantina Doors

Aluminum pocketing multi-slide system spanning a 15-foot-wide opening.

Operation Types

Multi-Slide Doors

In a multi-slide door, panels stack within the opening. They may stack to one side when fully open, divide and stack to either side of the frame, or be stacked and contained out of sight within a pocket framed into the building's wall.

Multi-slide glass doors are generally used to create large openings in walls or to take the place of an exterior wall altogether. The size of the panels and the total door unit can vary and may be custom fabricated to suit a particular building project. Usually, it is the glass itself that imposes limits on the size of each individual multi-slide panel. Most single pieces of glass are limited to 60 square feet in size, or a typical maximum height, with frame, of 12 feet and a width of 8 feet. The number of individual panels can be varied to meet the desired opening dimensions.

The configuration of multi-slide door panels can be designed so that all panels stack behind each other on one side of the opening or so that panels are split to stack on both sides of the opening. There are two basic options for how the individual panels appear when stacked. The first option is to keep one glass panel fixed, or stationary, and to slide all adjacent panels to stack evenly behind this stationary panel. In using this option, when fully stacked, some manufactured designs appear as a single panel when viewed from the inside or outside. The second option is to conceal the sliding panels in a wall pocket when open. In this style, the sliding panels disappear altogether, giving the appearance of a full opening in an otherwise solid wall area.

Multi-slide doors do not need to be limited to a single wall plane. Manufacturers have developed methods to allow doors to meet at a corner location, eliminating the need for a post or frame element. When open, the corner virtually disappears, allowing a full visual and physical three-dimensional connection between outdoors and inside. When fully closed, the door panels come together to form the corner.

Folding Doors

In a folding multi-panel door system, panels stack perpendicular to the opening when fully opened. As with multi-slide systems, in folding systems,

doors may stack to one side when open or can divide and stack to both sides of the opening. The folding action mimics the expansion and contraction of an accordion. The panels may be inswing or outswing, depending on design preference and use. Because of the weight of the system and the more complex operation, individual folding door panels are typically limited to 39 inches in width; standard heights may be 7 to 8 feet tall, but some manufactures offer folding panels up to 10 feet tall. Despite those limitations, openings for a full system of folding doors can reach up to a staggering 65 feet wide.

Folding glass doors may either be floor mounted or top hung, with top hung systems the predominant method. In a top-hung folding door system, the top track carries the weight of the doors and the floor track serves as a guide. Precision bearings and rolling hardware are used to operate the door. Top hung bifold door systems allow for effortless and smoother operation and longer lifespans. The frame must be secured to an adequate header that does not deflect downward when the doors are installed. The structural support required and header size depend both on the weight of the doors and the surrounding structural conditions.

The "Perfect Match" Concept

Visually, certain manufacturers' multi-panel door system sizes and proportions may be chosen to match the complement of single doors and windows in the building. Creating a unified design scheme for fenestration will help shape finish, operation, and profile options. Depending on the manufacturer, stile and rail sizes for multi-panel systems can be ordered to exactly match other doors and windows in the facade. This also allows for a perfect match across various door systems so that folding and multi-slide systems can be placed side by side with no visual disruption. For contemporary design, the ability to maintain narrow stiles and rails and to maximize glass is vital to preserving the heart of the project's style.

Materials and Options

Multi-panel door systems, both folding and multi-slide, are available in a variety of materials, including aluminum, wood, and vinyl. While contemporary design often favors metal for its doors and windows, certain applications, like contemporary craftsman, still prefer a wood interior to preserve a style theme.

Photo courtesy of LaCantina Doors

An aluminum thermally controlled folding system in bronze anodized finish with a flush guide sill offer a seamless transition from inside to outside, creating an open-air dining area.

Aluminum

Aluminum systems have a clean, modern appeal, with some manufacturers offering up to a 2¾ inch narrow stile and rail profile, allowing for maximum glass and light. Aluminum is suitable for use in exterior applications or as interior space dividers. The basic configuration is an extruded aluminum panel with an overall thickness of 1¾ inches and single panels up to 10 feet tall. A 10-inch-tall bottom rail and low-rise sill meet commercial Americans with Disabilities Act (ADA) requirements. Aluminum frames are offered in several finish options. White, clear, and dark bronze anodized aluminum stiles and rails match most commercial aluminum window finishes. Selecting aluminum eliminates the need for finishing and offers low maintenance. Aluminum typically has the highest U-factor and is best suited for use in moderate climates, where heat loss is not a concern.

Aluminum Thermally Controlled

This system offers improved thermal performance suitable for climates where it is desirable to prevent extreme weather from impacting the conditioned interior space, and where higher resistance to water and air infiltration is required. Featuring nonconducting thermal breaks throughout and narrow stile and rail profiles, aluminum thermally controlled systems are designed for optimal energy efficiency and structural performance that minimizes condensation build up and heat-cold transfer. European thermal struts create a nonconductive bridge between the outside and the inside of the door. Thicker panels (2¼ inches) are suitable for high-wind environments and can include impact-rated features. A proprietary panel design by a leading manufacturer allows for split finish color options for the interior and exterior, providing maximum design flexibility.

Aluminum Wood

Better suited to exterior environments than a solid wood door, an aluminum wood system features a low-maintenance aluminum exterior with a natural wood interior.

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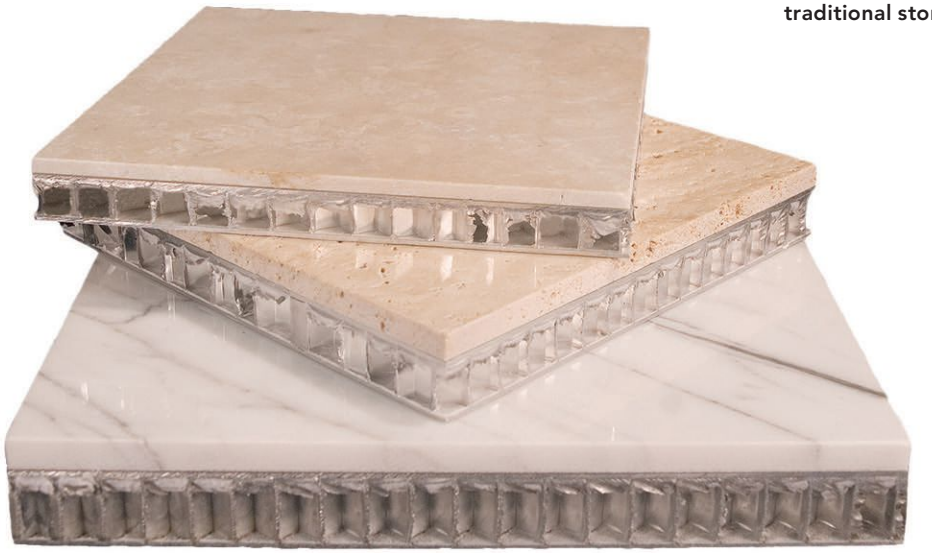
***Amanda Voss, MPP**, is an author, editor, and policy analyst. Writing for multiple publications, she also serves as the managing editor for* Energy Design Update.

All images courtesy of StonePly



Stone veneer panels on aluminum honeycomb provide an innovative alternative to traditional stone cladding.

Enhancing the Stone

Stone veneer panels on aluminum honeycomb combine the beauty of natural stone with the design freedom, strength, and lightness of metal panels

Sponsored by StonePly | *By Robyn M. Feller*

For thousands of years, stone has been a much-lauded ingredient in building design and construction. And with good reason. As a natural material, stone has many appealing qualities, including its unmatched durability, versatility, and unlimited beauty. Design choices know no bounds with stone's wide-ranging variety of colors, types, patterns, and textures. Used over the centuries for everything from mighty ancient Greek and Roman structures, Egyptian pyramids, and English burial chambers to graceful churches and temples around the globe, stone has stood the test of time as a premier material choice.

Over the past hundred years or so, though, the use of stone in construction has waned. Traditional stone masonry is rarely used in modern buildings; its main drawbacks have been its unwieldy weight, high labor costs, and quarry, cut, and transport challenges in getting stone from point A to point B. Today's architects, however, looking for innovative ways to incorporate stone's many benefits into their current projects, no longer need to dismiss stone as an option. A lighter, cost-effective, sustainable, and proven product is available: lightweight aluminum honeycomb-backed reinforced stone panels.

THE BASICS OF THIN STONE ON ALUMINUM HONEYCOMB BACKING

Natural stone veneer on aluminum honeycomb panels are composite panels consisting of a thin layer of natural stone (such as granite, marble, travertine, or limestone), typically ⅜-inch to ¼-inch thick, bonded with high-strength epoxy (think aircraft quality) to a lightweight yet extremely durable aluminum honeycomb backing. The total panel thickness including stone and aluminum honeycomb is typically either ¾ inch or 1 inch. The panels offer designers the beauty of the natural stone face combined with aluminum's increased strength and light weight. The panels are typically custom made to the size and shape required for the specific project. Corners, sills, and special shapes can be factory fabricated.

Natural stone facing is attached to the aluminum honeycomb backing with an extremely durable aerospace-grade epoxy.

The Process: How Does It Work?

The panels are custom fabricated in the stone type, color, finish, size, and shape selected by the designer. The first steps involve providing stone samples and shop drawings to ensure the designer's vision is being expressed. Once

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Learning Objectives

After reading this article, you should be able to:

1. List the benefits of using natural thin stone veneer on aluminum honeycomb panels in a variety of applications.
2. Compare stone veneer on aluminum honeycomb panels with traditional stone cladding in terms of design freedom, aesthetics, cost, service life, safety, and durability.
3. List the varieties of stone available in thin natural stone on aluminum honeycomb panels.
4. Discuss the characteristics of stone veneer on aluminum honeycomb panels in terms of green building goals.

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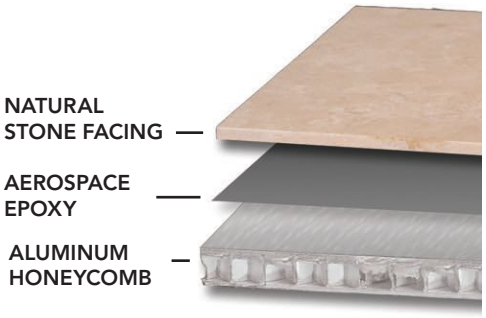

Natural stone facing is attached to the aluminum honeycomb backing with an extremely durable aerospace-grade epoxy.

shop drawings and submittals are approved, the manufacturing process begins.

The manufacturing process starts at the stone quarry, where large blocks of stone are extracted. The blocks are then taken to giant saws where they are cut into slabs, typically 1¼ inches thick. The aluminum honeycomb panels are prefabricated with high-quality aluminum, which are then bonded with aerospace-strength epoxy to each face of the stone slab. The aluminum backing increases the strength and impact resistance of the stone and makes installation much easier and more secure than with traditional veneers. Panels weigh just 3.5 pounds per square foot but offer impact resistance up to 60 times greater than stone slabs.

At this point, the panel is a sandwich of aluminum honeycomb on both faces with the stone in the middle. The panel is then sawn down the middle of the stone slab to produce two panels with stone veneers roughly ⅝ inch thick. Next, the panels go to the finishing process where they receive a final finish and texture. Depending on the project and the designer's preference, the finish can be polished, honed, flamed, sandblasted, or tooled. Other options include carving or laser engraving. The panels then go to the fabrication area, where they are cut to the specific dimensions required for the project and corner pieces and any special shapes are custom fabricated. Finally, the panels are packaged along with installation drawings and instructions and shipped to the jobsite.

HOW STONE VENEER ON ALUMINUM HONEYCOMB PANELS ENHANCE THE PROJECT—INSIDE AND OUT

Stone veneer on aluminum honeycomb panels offer designers and owners the beauty, low maintenance, and quality look and feel of natural marble, granite, travertine, or limestone. But unlike heavy and fragile stone slabs, stone on aluminum honeycomb panels are lightweight, strong, and easy to install, offering design freedom to use them in ways heavy slabs cannot be used.

According to Ashley McDermott, project manager for StonePly, a manufacturer of natural stone veneer panels, "Honeycomb-backed stone panels are an innovative solution to natural stone. The lightweight panels cut installation cost and time without sacrificing the beauty of having natural stone on your project. With the reinforced honeycomb backing, you also gain strength and durability, eliminating many of the problems faced with solid stone slabs."

Stone on Aluminum Honeycomb Panels vs. Traditional Stone Cladding

There are several important advantages of stone on aluminum honeycomb panels, including the following:

- Traditional stone panels weigh approximately 27 pounds per square foot. Stone veneer on aluminum honeycomb panels weigh between 3 to 4 pounds per square foot.
- Traditional stone panels are prone to bowing because of thermal hysteresis. The outside facing surface of the stone panel expands and contracts as it is exposed to warmer than cooler temperatures. In some cases, the panel does not contract fully, which can lead to bowing. A greater load is placed on the stone anchors as a result.

Continues at ce.architecturalrecord.com

Robyn M. Feller *is a freelance writer and editor specializing in the architecture, design, and construction industry.*
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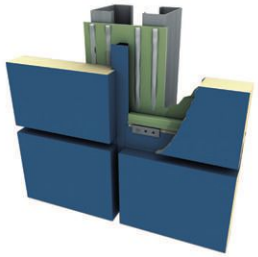

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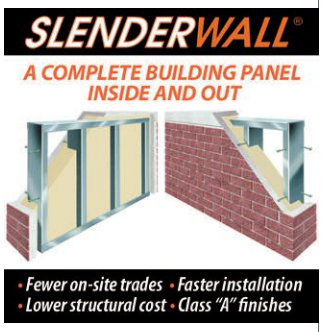

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SUBMISSION DEADLINE: **FEBRUARY 15, 2017**

Good Design Is Good Business

CALL FOR ENTRIES

The editors of **ARCHITECTURAL RECORD** are currently accepting submissions for the **2017 ARCHITECTURAL RECORD GOOD DESIGN IS GOOD BUSINESS** awards program. Good design is a priority for leaders of business and industry looking to boost productivity, rebrand, and attract customers. The Good Design Is Good Business awards honor architects and clients who best utilize design to achieve such strategic objectives. Winners will be published in the April 2017 issue.

The fee is US$150 per entry and $50 for each additional project. Find all details and submit your entry at **architecturalrecord.com/call4entries**. E-mail questions to arcallforentries@bnpmedia.com. Please indicate **GDGB** as the subject of your e-mail.
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Archive of Creative Culture is a nomination-based, participatory project documenting the histories of respected creative thinkers. Intended as a cultural resource, it results in a collection of books from selected visual, performing, and literary artists, musicians, curators, and cultural figures. Each book, on display at the Museum of Craft and Design, is intended to be a go-to reference or source of inspiration. For more information, visit sfmcd.org.

Moholy-Nagy: Future Present
Los Angeles
February 12–June 18, 2017
This exhibit, the United States' first László Moholy-Nagy retrospective in nearly 50 years, reveals a utopian artist who believed that art could work hand in hand with technology for the betterment of humanity. *Moholy-Nagy: Future Present* examines the career of this pioneering painter, photographer, sculptor, and filmmaker, and includes more than 250 multimedia works from public and private collections across Europe and the United States. At the Los Angeles County Museum of Art (LACMA). For more information, visit lacma.org.

Ongoing Exhibitions

Reading Room: A Catalog of New York City's Branch Libraries
New York City
Through January 7, 2017
This exhibition at the Center for Architecture features Elizabeth Felicella's work documenting all 210 branches of New York's extensive public library systems. Felicella's subtle and technically accomplished photographs depict the libraries at varying scales—from full-scope exterior shots to intimate studies of window plants and pencil sharpeners—inviting the viewer to appreciate the intricacy, complexity, and vastness of these vital and evolving public resources. For more information, visit cfa.aiany.org.

Building Optimism: Public Space in South America
Pittsburgh
Through February 13, 2017
Held at the Carnegie Museum of Art and spanning projects in Argentina, Brazil, Chile, Colombia, Peru, and Venezuela, *Building Optimism: Public Space in South America* investigates ways that emerging architects and designers instigate change through design of public space. Using photography, video, drawings, and models, the exhibition immerses visitors in the inventive ways that public spaces can become social spaces as the sites respond to the circumstances and pressures of their communities. Visit cmoa.org.

Model Behavior: Snøhetta at SFMOMA
San Francisco
Through January 14, 2017
This exhibition explores the design process behind Snøhetta's expansion of the San Francisco Museum of Modern Art. Architectural models, sketches, an interactive app, and a narrated walk-through of the building reveal how the firm responded to the built environment and its cultural context. At SFMOMA. For more information, visit sfmoma.org.

City of Ideas: Architects' Voices and Visions
Chicago
Through February 25, 2017
City of Ideas: Architects' Voices and Visions is an ongoing conceptual installation project that has traveled to the Chicago Design Museum from Sydney University's Tin Sheds Gallery. Its key objective is to present original visions of leading international architects recorded and transcribed by curator Vladimir Belogolovsky. Each installation will include different groups of voices, interpreted with continuously changing design by local artists, architects, and designers collaborating with its curator. For more information, visit chidm.com.

Pierre Chareau: Modern Architecture and Design
New York City
Through March 26, 2017
The Jewish Museum presents the first U.S. exhibition focused on French designer and architect Pierre Chareau. Showcasing rare furniture, lighting fixtures, and interiors—as well as designs for Maison de Verre, the glass house completed in Paris in 1932—the exhibition brings together more than 180 rarely seen works from major public and private collections in Europe and the United States. For more information, visit thejewishmuseum.org.

Lectures, Conferences, and Symposia

Design San Francisco 2017
San Francisco
February 15–16, 2017
In addition to keynote presentations by renowned design professionals, the San Francisco Design Center's showrooms will host seminars and workshops, each conceived and developed to support attendees' creative potential and to improve marketing acumen. For more information, visit sfdesigncenter.com.

Competitions

Kip Island Auditorium International Competition
Registration deadline: January 18, 2017
The Riga Exhibition Centre, located in the heart of the Latvian capital, is soliciting design proposals for an addition to its already well-established complex, which houses two large exhibition halls, conference rooms, and meeting rooms. The addition should include an auditorium, more conference rooms, and a new exhibition hall, and aim for iconicity. Visit kipislandauditorium.beebreeders.com.

eVolo 2017 Skyscraper Competition
Registration deadline: January 24, 2017
Established in 2006, this annual contest recognizes outstanding ideas that redefine skyscraper design through the implementation of novel technologies, materials, programs, aesthetics, and spatial organization, along with manifesting flexibility, adaptability, and change wrought by globalization and the digital revolution. Designs should reflect investigation of public and private space and the role of the individual in relation to the collective in a dynamic vertical community. There are no restrictions in regard to site, program, or size. Visit evolo.us.

Blue Clay Country Spa
Registration deadline: January 25, 2017
This competition, in partnership with SRED Global real-estate developers, is calling for architecture enthusiasts to present ideas for a rural spa and guesthouse in the Latvian countryside. The focus is to create an ecofriendly and cost-effective spa in which visitors can relax in the luxuriant natural landscape. Visit blueclaycountryspa.beebreeders.com.

2017 AIA Design Awards
Submission deadline: January 27, 2017
This awards program recognizes outstanding architectural design by AIA New York chapter members, New York–based architects in any location, and work in New York by architects around the globe. Awards will be granted in four categories: architecture, interiors, urban design, and projects. Award levels for all categories include: the Honor Award, the Merit Award, and Best in Competition. Winners will be announced at the Design Awards Jury Symposium. Submissions should reflect a broad and inclusive definition of design excellence, demonstrate exemplary skill and

creativity, and exhibit a strong sense of place, history, or purpose. For more information, visit aiany.org.

The SOURCE Awards
Submission deadline: January 30, 2017
Now in its 40th year, the SOURCE Awards competition is open to all lighting designers, architects, engineers, professional designers, and consultants who use Eaton's lighting fixtures and lighting-control systems in interior or exterior design projects. Students currently enrolled in any of these disciplines are also eligible to enter projects based on conceptual lighting designs that utilize Eaton's lighting and controls products. For more information, visit thelightingresource.eaton.com.

2017 Architectural League Prize | Support
Submission deadline: January 30, 2017
The theme of the 2017 Architectural League Prize Competition is "support." Whether social or structural, evidentiary or technical, the idea of support in architecture today has proliferated such that its role is obscured by the multiple ways that it operates. This year's competition looks first to forms of support and asks: What does support stand for? What props up architecture today? Young architects and designers are invited to submit their work. Projects of all types, either theoretical or real, and executed in any medium, are welcome. Visit archleague.org.

Metals in Construction Magazine 2017 Design Challenge: Reimagine Structure
Submission deadline: February 1, 2017
This competition invites architects and engineers to submit designs for a high-rise that integrates its enclosure and its primary structure for the purpose of minimizing embodied energy. The competition challenges participants to substitute a hybrid frame-and-skin system for the typical aluminum-and-glass curtain wall. Entries will be judged on embodied energy reduced and overall performance, with a prize of $15,000. Visit metalsinconstruction.org.

E-mail information two months in advance to recordevents@bnpmedia.com.

snapshot

PROJECT THE CLOSEST CHURCH
LOCATION GIMPO, SOUTH KOREA
DESIGNER IDMM ARCHITECTS

IN A DENSE residential area of the South Korean city of Gimpo, just west of Seoul, a church's sculptural form breaks up the surrounding cityscape of banal apartment towers. Seoul-based IDMM Architects designed the reinforced-concrete structure—defined by stacked volumes, shadow-filled crevices, and a variety of apertures—to maximize its multifaceted program on a compact site. It is "a space between contemporary spiritual practice and everyday urban life," says principal Heesoo Kwak. Named to highlight its ecumenical practice, the seven-story building contains a main chapel with bleacher seating that spans from the second to fifth levels. Above and below this space, the architects placed a lobby, community room, two secondary chapels, and offices on top of one another like pieces of a 3-D jigsaw puzzle. The client, the Presbyterian Church of Korea, hoped not to offend the sensibilities of local residents, who subscribe to a range of beliefs, so asked for modest religious references. The shape of a cross, delicately carved out of the facade and illuminated at night, distinguishes the building's function with a "humble voice," says the architect. An exterior stair zigzags up to the rooftop—which can be used for worship services as well as community functions—evoking a sense of movement. The overall result of the design, says Kwak, is a "harmonized place" without the "strong color of religion."
—*Alex Klimoski*

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