ARCHITECT

Rozana Montiel
Richter Architects

Restoring Wright's Robie House
The Cost of Design Competitions
Byzantium in Charleston, S.C.

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Planting a Siedlung

Mexico revisits workers' housing for the 21st century

Beyond the Glass

BRINGING NEW LIFE TO A HARLEM ICON WITH HELP FROM PELLA ARCHITECTURAL SOLUTIONS.

Boys & Girls Club of Harlem | Dattner Architects | New York, NY

After 30 years of vacancy, Public School 186 was on its last leg. Built in 1903, the school was known for its Italian Renaissance Revival architecture and needed to be preserved for listing on the National Register of Historic Places. The Boys & Girls Club of Harlem called upon owner Dattner Architects and the Pella Architectural Solutions team to save the historical landmark while adding the innovation and performance of a new build.

JARON VOS
Manager, Architectural Solutions

INNOVATING SOLUTIONS

"Preserving history is one of our greatest passions. So when Dattner asked if it was possible to give these windows a performance upgrade while maintaining historical accuracy, we got excited knowing our products offered the solution," explained Jaron Vos, Manager of Architectural Solutions at Pella.

Original photographs, on-site trim remnants and extant school drawings helped the team envision and recreate the building's period look while they added a few upgrades. Pella® Architect Series® aluminum-clad wood products – with custom trim – met the criteria for historical accuracy while still delivering low-maintenance exteriors and other modern-day innovations.

RECREATING HISTORY

One of the more complicated projects was recreating the building's fourth-floor windows. They had curve-top exterior openings and rectangular-top interior openings, requiring a special outside-to-inside transition. The windows were monumental in size, with some as large as 5' wide by 10' high, making a complicated task even more challenging. Pella created new custom-designed aluminum extrusions for the vertical and horizontal mullions to go between and around windows. This solution matched the original wood trim while adding a new level of durability. Acoustics were addressed with a unique glazing assembly and glass panes of varying thicknesses for better sound transmission resistance.

EXPERTISE THAT DELIVERS

The insights and innovation brought to the table by Pella experts made this project possible. And after four years, Public School 186 was transformed from a run-down building to beautiful, affordable housing and headquarters for the Boys & Girls Club of Harlem.

"It was incredibly rewarding taking fragments of history and bringing it back to life with innovations that will stand proud for generations," said Vos.

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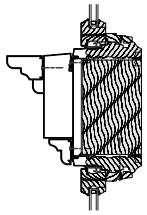

Preserving the past, building the future.

As Public School 186 in Harlem, New York, eclipsed 30 years of abandonment, its iconic architecture was in serious jeopardy. Dattner Architects and the Pella Architectural Solutions team worked together to bring new life to the building with custom solutions for complicated needs. Using old photos and architectural remnants found inside, Pella preserved the historical accuracy while adding modern innovations and durability.

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Weathered Steel Finish

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-J. Mark Wolf, AIA, Vice President, JHP Architecture

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On the cover: Housing Laboratory in Apan, Mexico, by MOS; photo by Iwan Baan.

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RAFAEL GAMO

Three Hundred and Sixty Degrees of Summer

Being tapped for the Museum of Modern Art and MoMA PS1's Young Architects Program is the ultimate cap feather for emerging practitioners. The competition winner designs and builds a summer installation in the forecourt of MoMA PS1 in Queens, N.Y., with the simple requirement to provide seating, shade, and water. This year, Ana Paula Ruiz Galindo and Mecky Reuss of Mexico City–based Pedro&Juana riffed on the 19th-century cyclorama with *Hórama Rama*, a 90-foot-wide circular scaffold supporting wooden spikes on the exterior, a continuous jungle scene on the interior, and hammocks for lazing. The installation runs through Sept. 2.

> *For Aaron Betsky's take on the five 2019 finalists, visit bit.ly/BetskyPS12019.*

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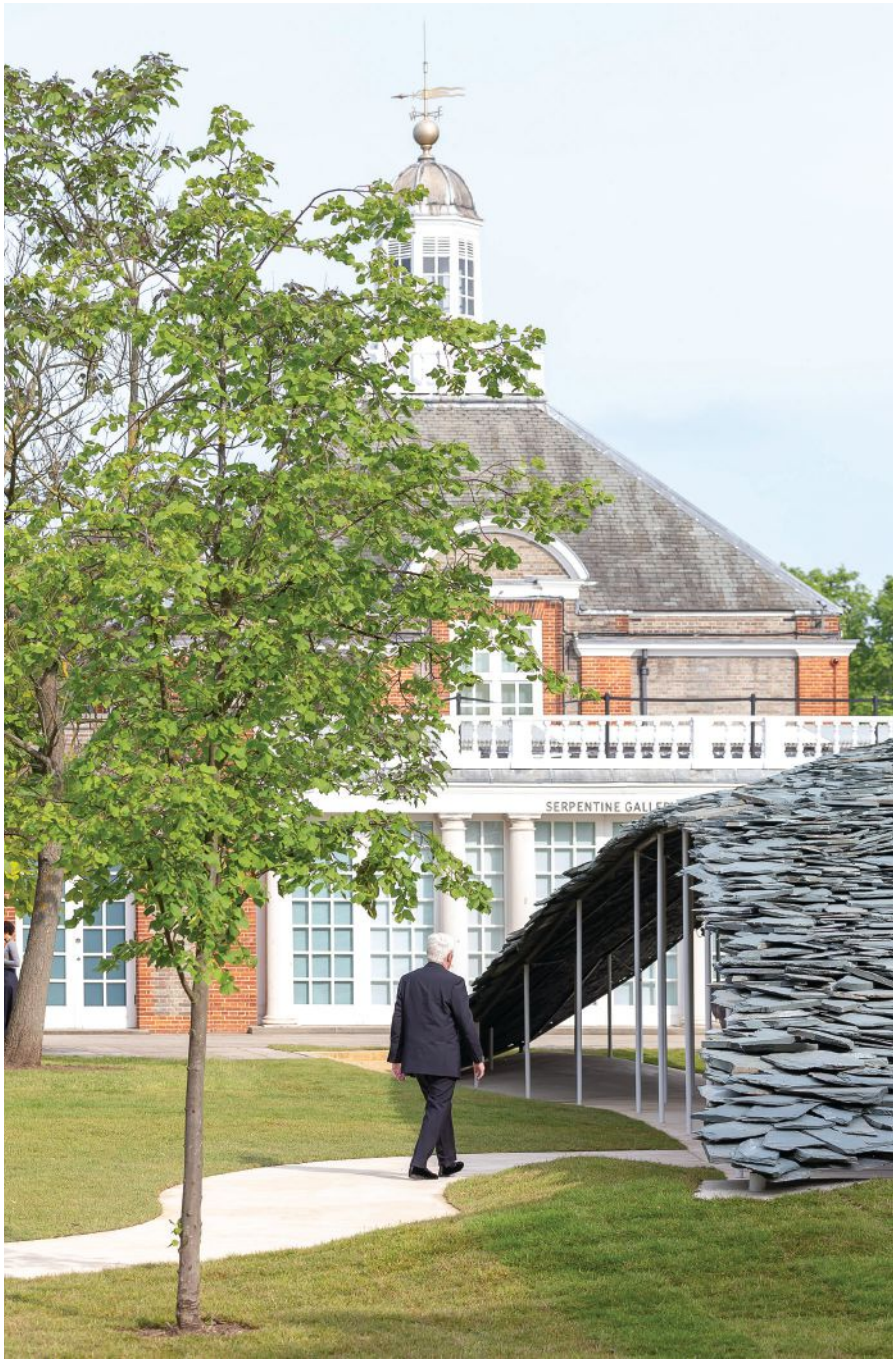

NORBERT TUKAJ

One Paradoxical Pavilion

Japanese architect Junya Ishigami has a thing for roofs—the thinner the better. His design for the Serpentine Gallery's 2019 summer pavilion, in London's Kensington Gardens, applies the aesthetics of slenderness to an inherently massive material: stone. A twiggy metal armature supports hundreds of slate slabs that undulate like one of William Blake's "clouded hills." In March, Ishigami was accused of employing unpaid interns to work on the pavilion. The opening party was sponsored by Chanel and attended by Michael Bloomberg, Lena Dunham, Liam Payne, Lady Kitty Spencer, FKA Twigs, and Suki Waterhouse. Commoners may visit through Oct. 6.

> *To see additional images of Junya Ishigami's Serpentine Gallery pavilion, visit bit.ly/Serpentine2019.*

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Hong Kong Garden

The burgeoning West Kowloon Cultural District in Hong Kong now has its own summer pavilion competition for young architects. The inaugural winner is a timber structure that its designers, Hong Kong– and New York–based New Office Works (NOW), titled Growing Up. The pavilion is sited in the waterfront Nursery Park. The cultural district was master planned by Foster + Partners, and boasts a recently opened opera house by Revery Architecture (formerly Bing Thom Architects) and Ronald Lu & Partners, as well as a museum by Herzog & de Meuron and a theater complex by UNStudios, both of which are under construction.

> *For more about the West Kowloon Cultural District and its opera house, visit bit.ly/XiquCentreFacade.*

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Best Practices: Surviving the Expense of Competitions

TEXT BY JEFF LINK

Design competitions allow practitioners to flex their creative muscles, support social issues, and garner recognition—and maybe even win prize money. Yet it can be difficult to spend time and resources on them while working on projects that support a firm's financial health and profitability. Here, several designers offer advice for deciding which opportunities to pursue and how best to manage your efforts.

Be Selective

Competitions rarely offer fees or awards commensurate with the work hours required. Still, the 15-person New York firm Reddymade dedicates 10 percent of its time to competition submissions annually. "Our policy is to do at least three competitions per year," says founder Suchi Reddy, AIA. "We choose carefully the types of competitions we want to participate in and try to integrate them in the workflow in a way that doesn't disrupt other deadlines."

> "[The costs were] almost impossible to deal with."
>
> —Barry Yoakum, FAIA, co-founder, Archimania

Max Orzi, founder of New York–based Studio Orzi, assesses his practice's goals before deciding which competitions to enter. If winning is the aim, he considers the requirement rigor, interests of the jury, award amount, and size of the applicant pool. A two-time finalist for the Cavin Family Traveling Fellowship, Orzi says the competition was compelling because of its $12,000 travel and research award and strict eligibility requirements—only early practicing professionals 35 and under who matriculated from architecture programs at the University of Oregon and Cal Poly Pomona can enter.

Because the prize could be transformative for his young office, Orzi approaches the competition with a somewhat less radical eye. "This is a different model," he says. "I don't want to be too aggressive in my proposals. Innovation is good but if you're too aggressive, it may throw off the jury."

In other cases, Orzi's intent is not to win, but to pursue a burgeoning professional interest, broaden his portfolio, or engage an idea with more experimental freedom than is typical in client-based work.

Weigh the Benefits Against the Costs

Like Orzi, Reddy says competitions are about more than winning. Reddymade drew widespread attention when it won the 2019 Times Square Valentine Heart Competition, organized by Times Square Arts and AIA New York. "You can't really put something in Times Square and not get exposure," Reddy says, adding that the installation has also served as the backdrop for public weddings.

Though the resource investment to develop the submission was not onerous, the $40,000 budget the firm received to build the structure—the tallest ever created for the competition—did not cover the costs incurred, as "it almost never does," Reddy says. Still, the project allowed the firm "to think outside the constraints of the typical architecture practice" and has sparked new interest in the firm. Reddymade is currently in talks with several municipalities that wish to host the structure.

Turn Experimentation into Leads

The same rigorous expository approach needed for competitions, focused heavily on site and program analysis, can be applied to other work. "The last time we did a design competition was 20 years ago," says Barry Yoakum, FAIA, co-founding principal of Memphis, Tenn.–based Archimania. "We were a small firm then, much smaller than now, and we saw how it affected our profit margins immediately. [The costs were] almost impossible to deal with."

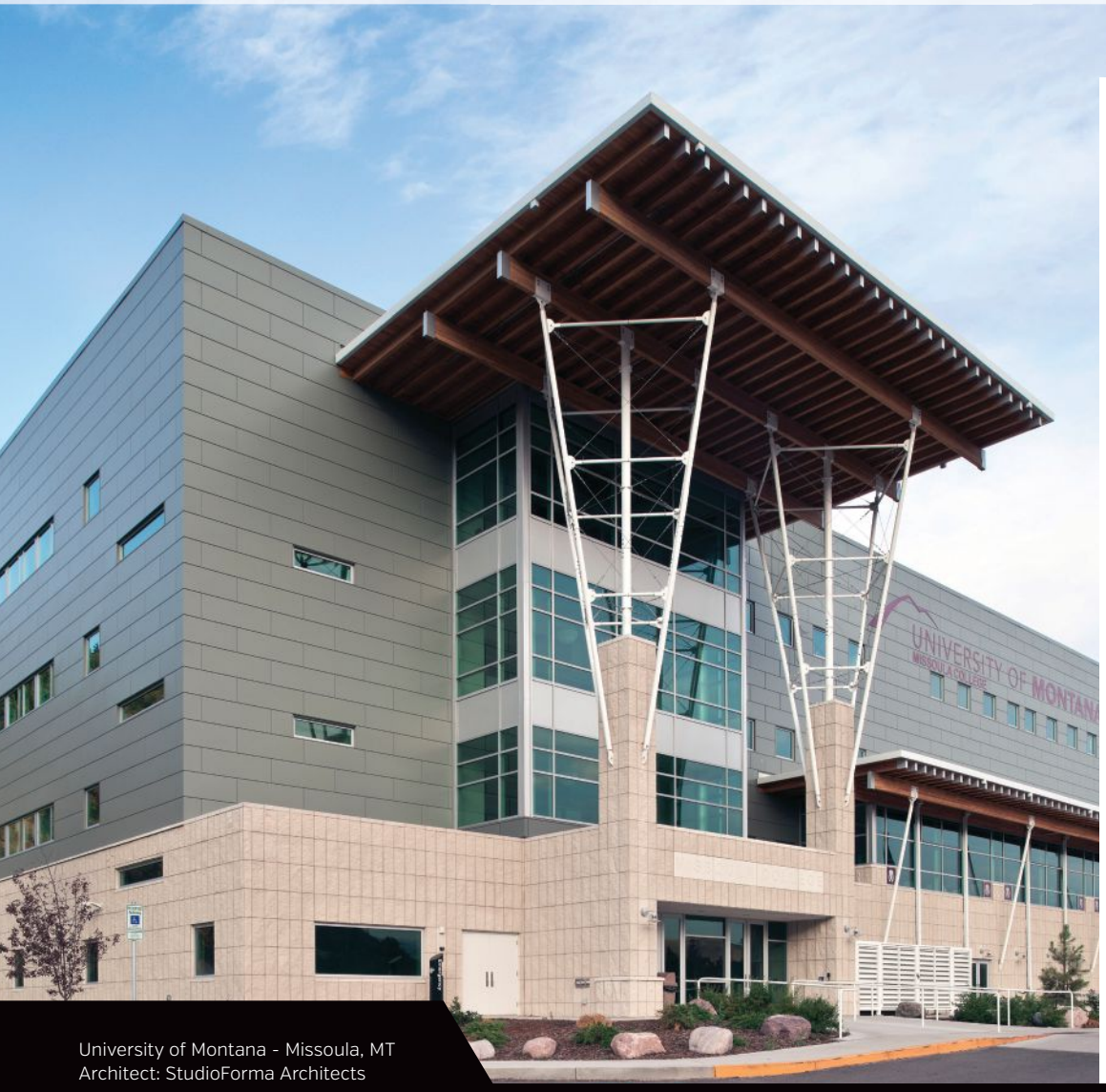
Since then, Archimania has focused on early-stage pro bono design and program planning for regional nonprofits and government entities. This approach has led to some 60 commissioned projects over the past 25 years, including new offices, a performance space for Ballet Memphis, and a chapel adapted from a cooling tower at Methodist University Hospital.

"All are in the same bucket," Yoakum says. "[Clients come] to us because we have this idea of treating pro bono work as a design competition. Often, it's not just about design, but what the program is and how it can support fundraising for a capital campaign."

> *For more tips on entering design competitions while protecting profit margins, visit bit.ly/ARCompExp.*

WHAT HAPPENED TO VALUE ENGINEERING?

When the concept of value engineering was first conceived in the 1940s, the aim was to find real value through careful analysis of products and components. This was accomplished by either improving performance without increasing cost or reducing cost without sacrificing performance. It was understood that value could only be created if functionality and durability remained the priority.



University of Montana - Missoula, MT
Architect: StudioForma Architects

Today, value engineering in construction has fallen far from its origins, with products being chosen and changed out simply because they are cheaper, many times sacrificing performance and longevity. This new process is no longer about creating actual value. Acknowledging that budget is always a concern, there must still be a better way.

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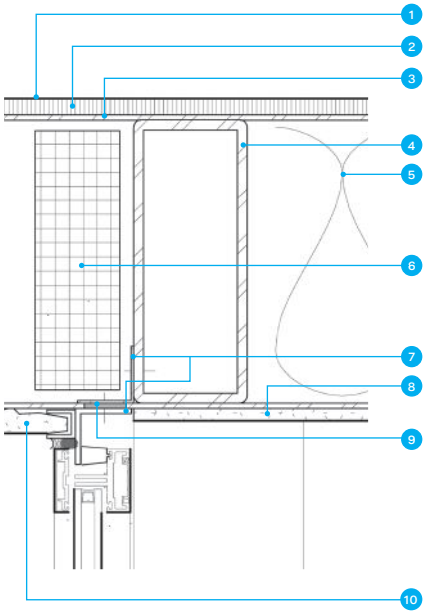
Detail:
Pecos County Rest Area Faceted Canopies

TEXT BY TIMOTHY A. SCHULER



1. PMMA roofing membrane
2. Plywood roof decking
3. 18"-long, 18-gauge Simpson LSTA strap tie with five #10 screws on each side (typ. 2)
4. Continuous, welded HSS beam
5. R-30 batt insulation between cold-formed steel joists 24" o.c. (beyond)
6. 3" rigid insulation board outboard of air barrier (not shown)
7. Continuous 2" × 2" angle, thickness varies
8. Perforated white gypsum board
9. Continuous butyl tape sealant
10. Earth-toned plaster soffit

At the Pecos West County safety rest area along Interstate 10, near Fort Stockton, Texas, two matching buildings feature glazed atrium lobbies topped by jagged roofs inspired by the nearby Davis Mountains. On each 7,600-square-foot structure, the roof dips to the south to offer shade from the intense desert sun and allows views of the mountains and both directions of I-10, emphasizing "this notion of where you came from and where you're headed to," says David Richter, FAIA, who co-leads the Corpus Christi, Texas, firm Richter Architects with Elizabeth Chu Richter, FAIA.

With more than 20 irregularly shaped facets, the folded-plate roof and canopy created several design challenges. It is supported by a series of approximately 20-foot-long, steel C-channel joists that tie into the building's concrete masonry unit structure and curtain wall sash system. The canopy cantilevers up to 8 feet past the curtain wall, evoking the sense of a floating landform. Richter Architects worked with the Dallas office of JQ Engineering to design a continuous, welded steel tube beam that tucks above the head of the curtain wall and traces the roof's dramatic contours.

Recessing the beam into the roof cavity presented a structural conflict with the intersecting steel joists, which visually appear to run continuously across the curtain wall. "They can't occupy the same space," Richter says. The design team stitched each joist to the beam by attaching two steel plates to the top and bottom flanges of the aligned joists, spanning the intervening beam. To ensure that the orientation of the joists matched in the horizontal and vertical planes, the architects worked on-site with the steel contractor, Richter says, "climbing scaffolding and looking down ridges to verify an acceptable level of precision."

The firm is pleased with the rest area's connection to the austere, breathtaking landscape of West Texas. Civic architecture, Richter says, can often become a caricature of a region. "We have always felt [that] civic buildings ... should be fun and interesting," he notes, "but they should also be serious, genuine, and respectful of their place."

DAVID RICHTER

> To read about more design challenges that Richter Architects addressed on this project, visit bit.ly/ARWPecos.

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Firm size:
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First commission:
My first significant commission was the Void Temple in 2011, a landscape intervention that touches all the themes that concern me as an architectural designer: public space, social fabric, re-signification of simple materials, re-signification of tradition. This land art piece sits amid pine woods and blends with the site topography; it consists of a white concrete wall forming a 40-meter (131-foot) circle that serves as a haven containing the macro-cosmos within the micro-cosmos. The project was part of a collaboration with Dellekamp Arquitectos on a 117-kilometer-long (73-mile-long) pilgrimage route in Jalisco, Mexico.

Special item in your studio space:
Our green roof terrace. It keeps us grounded and sensitive despite being on a fourth floor. It connects interior and exterior in an organic way: We can be at the heart of an urban center and yet stay connected to each other through nature.

Design aggravation:
Stale atmospheres. For me, disharmony in a place begins through the sense of smell. If a space has a moldy or stuffy odor, something was poorly designed.


Rozana Montiel

Recent inspiration:
I visited the Musée Fragonard d'Alfort in Paris and was fascinated by its *écorchés* (figures depicted in art showing muscles without skin) and cabinets of curiosities. These cabinets evoke the manner in which architects "make room" through spatial design: Architectural order creates readings and narratives that can only be decoded in space.

Biggest career leap:
When I began to receive commissions for public projects. It was then that I realized the urban responsibility that architects have when designing collective living spaces. Also, in 2017, I won the Moira Gemmill Award for Emerging Architecture given by *The Architectural Review* in London. It was an important turning point in my career not only because the prize validated my studio's approach to architecture, but also because it has funded my research.

Urgent policy challenge:
Public space development in Mexico City. Most of the public space interventions lack a long-term vision, due in part to the three-year cycles of political administrations. There must be a way of shielding aspects of policy from political change. Currently, we just get snapshots of progress with no cohesive long-term effect.

Currently reading:
Clarice Lispector's *Family Ties* (University of Texas Press, 1984)

JASSO

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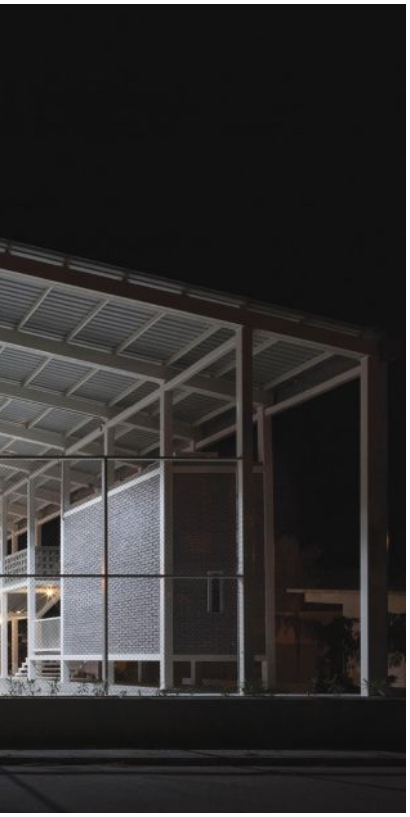
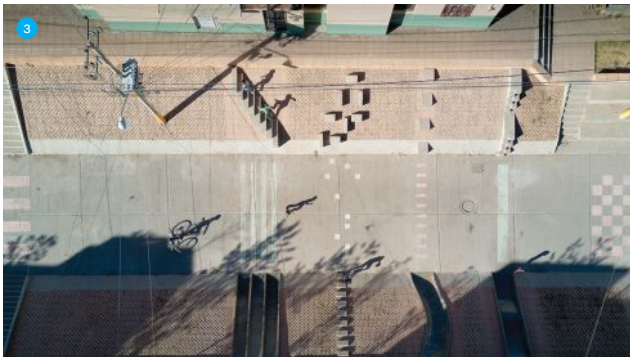
Rozana Montiel Estudio de Arquitectura

1: COURTESY ROZANA MONTIEL ESTUDIO DE ARQUITECTURA; 2, 3: SANDRA PEREZNIETO;
3 (AERIAL): JAIME NAVARRO; 4: IWAN BAAN





1. In *HU: Common Spaces in Housing Units* (Arquine, 2019), Montiel compiles her firm's research on three housing rehabilitation projects across Mexico on Post-its. **2.** Montiel uses latticework and palm wood to evoke the nearby seaside for this community center in Veracruz, Mexico. The space features a multisport court, recreational areas, and balconies. **3.** Located in a former sewage canal near a multifamily complex in Zacatecas, Mexico, this playground features a bridge canopy that extends over an esplanade. **4.** Sitting on the Ruta del Peregrino, the Void Temple is one of eight design interventions along the 73-mile pilgrimage route. Seemingly perched upon the uneven terrain, the circular structure encourages individuals to enter in single file.

Products: Finishes and Surfaces

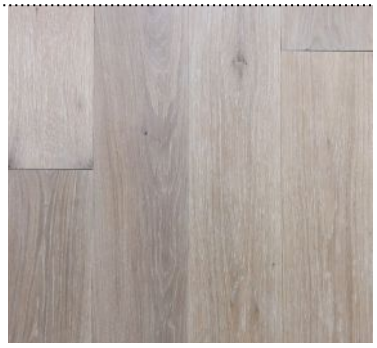
TEXT BY MADELEINE D'ANGELO

Silestone Loft Series, Cosentino
This nonporous kitchen and bath surface line adds two concrete-inspired colors—Silver Lake and Brooklyn—to 90-plus options. Made from a blend of 94% natural quartz. *silestoneusa.com*

VintageWood, Nichiha
With the look of wood and the durability of fiber cement, this cladding system now offers a reduced panel size of 17⅞" by 71⅛". The ⅝"-thick panels come in five colors (ash shown). *nichiha.com*

Figurati, Ann Sacks
Created with Netherlands-based furniture designer Lex Pott, these 6" hexagonal tiles are suitable for vertical kitchen and bath applications. In seven colorways for eye-catching patterns. *annsacks.com*

Wonderlust Collection, Mayer Fabrics and Sunbrella Contract Fabrics
Created with the Museum of International Folk Art, these fabrics (milagro shown) draw from industrial designer Alexander Girard's travels. *mayerfabrics.com*



UL Greenguard Gold Line, Pioneer Millworks
Made with reclaimed and FSC-certified wood, this line of 22 flooring and wall panels comes in several sizes and with low to no emissions. *pioneermillworks.com*

> *To see more new and innovative products, visit bit.ly/ARproduct.*

KINGSPAN LIGHT + AIR GOES ALL-IN ON NORTH AMERICA

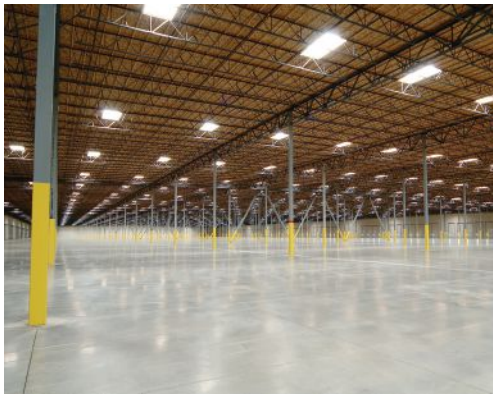
North American President Bill Hogan sheds light on the company's acquisition of CPI Daylighting, Bristolite Daylighting Systems, and Skyco Skylights, and what it means for commercial architects and contractors designing for daylighting and smoke management.

Kingspan is a leading global building envelope company. What role does Kingspan Light + Air play in the commercial design and building space?

We're focused on innovative daylighting and smoke management solutions for buildings in the commercial marketplace. We engineer and manufacture translucent facades, roof systems, canopies, skylights and smoke vents. We're more than just a manufacturer though – we're also advocates for the benefits that natural light and air have on the health and well-being of building occupants. Our role is to help educate and support the efforts of owners, architects, designers, and contractors to help them build healthier and more sustainable commercial buildings.

What types of projects do you work on?

We work on a wide variety of projects, including new construction and retrofits. You can find our products and systems in schools, community buildings, commercial office buildings, shopping malls, warehouses and manufacturing plants. There are really no limits. We are seeing increasing use of our systems in commercial and public buildings as more people learn about the benefits of natural light on productivity and general well-being.



You recently acquired CPI Daylighting, a daylighting solutions provider, plus two skylight companies, Bristolite Daylighting Systems and Skyco Skylights. Why those companies and what does that mean for your customers and partners?

We chose these companies because they were market leaders and had a strong reputation for excellence. They offered innovative products and high-quality performance that allowed us to expand and enhance our existing offerings.

For architects and contractors, it means we are in a strong position to leverage our global resources, national reach, and local expertise to benefit them from start to finish. We now have a broad range of high-performance premium systems in the market, which gives our customers more options. We have a strong track record for delivering products and systems on-time to the contractors in the field. It's no longer about just meeting expectations. Today our customers and partners should expect more, and we're confident we can deliver.

Can you give us an example of how you work with architects?

In this business you must add value every step of the way, and it starts with the architect. First, we want to empower an architect's vision to build aesthetically pleasing, sustainable and healthier buildings. We help inspire them with bold ideas, educate them on the benefits of daylighting, provide more custom solutions, and give them tools they need to specify a design around our systems to help bring their vision to life. It's a collaborative partnership.

What is the future of the commercial construction market and how do you see your business playing a role?

The future is now. Environmentally friendly regulatory rules and the demand for more energy efficient and

healthier buildings are driving design innovation, advanced technologies and the development of sustainable materials. All of these benefits must be delivered competitively and in ways that add value to each step of the design, construction and management of properties. These innovations are allowing building owners, developers, architects, and contractors to shape a more brilliant future for commercial and public spaces, enhancing the lives of everyone who works, lives, studies or plays in these buildings for decades to come. Kingspan Light + Air is at the forefront of this revolution.

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kingspanlightandair.us

Opinion: It's OK to See Color

TEXT BY YISELLE SANTOS RIVERA, ASSOC. AIA

Growing up in Puerto Rico, gender and socio-economic inequities pervaded my life, but I experienced little cultural differentiation: To oversimplify it, you either loved the beach or you didn't. It wasn't until I attended graduate school in the continental U.S. that I realized culturally I was different—and that I was a part of the minority.

I became drawn to firms and organizations that advocated for diversity and led causes that strived to move the needle of inclusion forward for all minorities. Through continual self-analysis on my own journey as a woman, Latina, and a member of the LGBTQ community, I realized that I had moved into another "bubble," in that I lived in a very liberal city and worked with like-minded colleagues and supportive leaders.

When I started looking at nationwide studies of firm leadership demographics, such as that by AIA San Francisco's Equity by Design committee, I saw a profession whose future was hampered by the lack of a common language to talk about equity, diversity, and inclusion (EDI) and one that often confused EDI with human resources.

This is the challenge that EDI leaders face: How do we create awareness beyond those already embedded in the conversation? How do we expand the conversation to those who naively believe and say things like, "I don't see color" and "We are waiting for the women to be ready"? How do we show that the lack of gender data in research has promoted bias, and how structural inequities in society have distorted the so-called path to success?

When my firm's strategic plan outlined a vision for EDI, I realized that if we didn't follow through and invest in this, our firm would become obsolete. As its inaugural director of EDI, I hope to help positively affect our promotion, recruitment, and retention processes, as well as to educate others about the legacy systems that perpetuate inequities across sectors. We need to look beyond the qualifiers that have been set in place by a homogeneous and monochromatic leadership. We are not about promoting a race or a gender in lieu of merit, but we need to acknowledge that different viewpoints and aptitudes can enrich our conversations and our work in ways that a conventional skill set may not.

I envision the EDI movement rising from discrete offices worldwide, with issues addressed locally and regionally. Though the composition of our practices can vary significantly, the goals are the same. And in every case, EDI is a candle that must burn from both ends: from the top leadership to the workforce whose journeys we empower to effect change.

This will require empathy, humility, and vulnerability. As leaders, we must understand that not everyone arrives at the table with access to equal resources in their lives—as such, we must not expect everyone to perform the same, particularly at the start of their journeys. We need to be responsible for providing development opportunities that can create an equitable workplace. Yes, we may have to allocate resources differently and no, we cannot expect one process to uniformly suit thousands of individuals.

My new role also shares goals with my professional growth as a medical planner. I want to strengthen community wellness, as it provides a platform of empowerment and supports a culture of respect and empathy that leads to innovation. By the next decade, I hope that we will be at a place where we are all held accountable for the spaces we create around us, where we are acutely aware of and celebrate our differences, and where our workplaces foster a sense of belonging and safety that allows us to be our genuine selves. And I hope that my role as an EDI director is no longer needed.

Yiselle Santos Rivera, ASSOC. AIA, is HKS' firmwide director of equity, diversity, and inclusion, and a senior medical planner based in Washington, D.C. She is also a co-founder of Latin American Interior Designers, Engineers, and Architects (LA.IDEA), an AIA|DC committee, and the founder of Women Inspiring Emerging Leaders in Design (WIELD), a 2019 AIA Diversity Program Recognition honoree.

> *To read more opinion pieces by thought leaders in the design community, visit bit.ly/AROpinion.*

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Residential: Harboe Architects

TEXT BY EDWARD KEEGAN, AIA

Frank Lloyd Wright's Robie House in the Hyde Park neighborhood of Chicago was considered a *tour de force* when it was completed for bicycle maker Frederick Robie and his family in 1910, but the life of a building—even one considered by The American Institute of Architects to be among the 10 most significant structures of the 20th century—doesn't always run smoothly. Thankfully, recently completed interior renovations led by local preservation architect T. Gunny Harboe, FAIA, showcase Wright's design more clearly than it's been seen in a century.

The house served as a single-family residence for just 16 years, and was twice under threat of demolition by the Chicago Theological Seminary, which owned the building and used it as a dormitory between 1926 and 1958. It was the first structure to be declared a Chicago Landmark (in 1957), the first National Historic Landmark to be named solely on the basis of its architectural merit (in 1963), and one of the first examples of Modern architecture to be named a UNESCO World Heritage Site (this year, along with seven other Wright designs).

The scope of work for this most recent restoration was built on earlier projects and limited to the main spaces of the lowest two floors—the entry, billiard room, and children's playroom on the ground level, and the living room and dining room on the second floor. A new front door with art glass has been fabricated according to Wright's original design. Rich red magnesite floors on the

Exterior view of the Robie House from the southwest.

JAMES CAULFIELD; COURTESY FRANK LLOYD WRIGHT TRUST

Project Credits
Project: Frederick C. Robie House Restoration, Chicago
Client: Frank Lloyd Wright Trust · Karen Sweeney, AIA (project manager)
Architect: Harboe Architects, Chicago · T. Gunny Harboe, FAIA (principal); Robert Score, AIA (project architect); Mark Kasprzyk, AIA (architect)
General Contractor: Bulley & Andrews
Materials Conservator: Building Conservation Associates Inc.
Stained Glass Consultant: Julie L. Sloan
Size: 9,063 square feet (total), 3,700 square feet (project area)
Cost: $2.6 million

> *To see more images of the Frederick C. Robie House Restoration, visit bit.ly/2019RobieHouseRestoration.*

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Photos: ©Henri Khodaverdi / Lumen West Award Winner

Landscape Architect: Mikyoung Kim Design / Architect: Elkus Manfredi Architects
Photograph: © Robert Benson Photography

Lighting Design: StudioKt / Developer: FivePoint Great Park Neighborhoods
Photos: ©Brad Nelson

Lighting Design: Oculus Light Studio / Developer: REthink Development and EverWest
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Residential:
Harboe Architects

ground level have been restored based on original materials—a magnified view revealed the presence of minuscule wood chips in the finish, an unexpected discovery that allowed for a precise match.

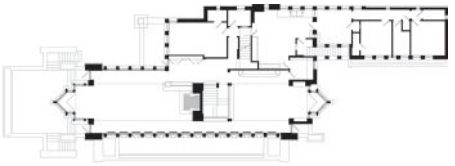
A restored inglenook—long since removed—returns the spatial concept of the living room to Wright's original plan. Without the millwork seat, the central fireplace appeared to be almost classical in composition, sitting symmetrically at the center of the house and separating the living room from the dining room. The space in front of the fireplace now becomes a separate yet integral part of a more nuanced composition: one that provides an asymmetrical sitting area adjacent to the hearth, while better defining the small space at the top of the stairway that sets up the progression from the downstairs entry to living room.

But the most revelatory change is the restored plaster and paint finishes throughout the first and second floors of the house. Harboe carries a pricey little hand microscope that reveals the intricacy of the plaster finishes, where exposed sand aggregate carries a light application of darker colors that give the surface its depth. "That's where the magic is that's been missing," Harboe says. "It has depth and subtlety and variety. It changes every time you look at it, depending on the way the light is hitting it."

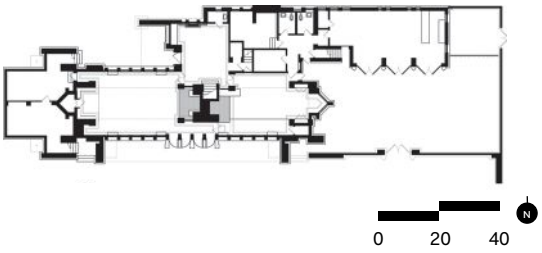
The complex geometries of Wright's windows cast intricate shadows on the surfaces of the interior. But it's only now that these surfaces have been fully restored to their original richness and depth that we can see Wright's genius in rendering an abstracted ornamental scheme that genuinely reflects the complexity of nature itself. Where his mentor Louis Sullivan accomplished similar effects through elaborate reconceptions of traditional surface ornament, Wright takes this to another level, where architecture is achieved in an ethereal manner that requires one experience it in person because it transcends even the most sophisticated pictorial portrayal. The Robie House has always been understood as a work of sublime accomplishment, but it's only now that it can be fully seen.

Having worked closely with Wright's work on several projects has only deepened Harboe's appreciation: "The guy was everything he said he was," he says. "I don't think you can exaggerate this: He was a creative genius."

Second-Floor Plan



Ground-Floor Plan



The second-floor living room, shown shortly after its completion in 1910.

The living room in 2012, long after the inglenook by the fireplace was removed.

LEFT: HENRY FUERMANN, COURTESY OF THE ART, ARCHITECTURE & ENGINEERING LIBRARY SPECIAL COLLECTIONS, UNIVERSITY OF MICHIGAN, ANN ARBOR; RIGHT: COURTESY HARBOE ARCHITECTS

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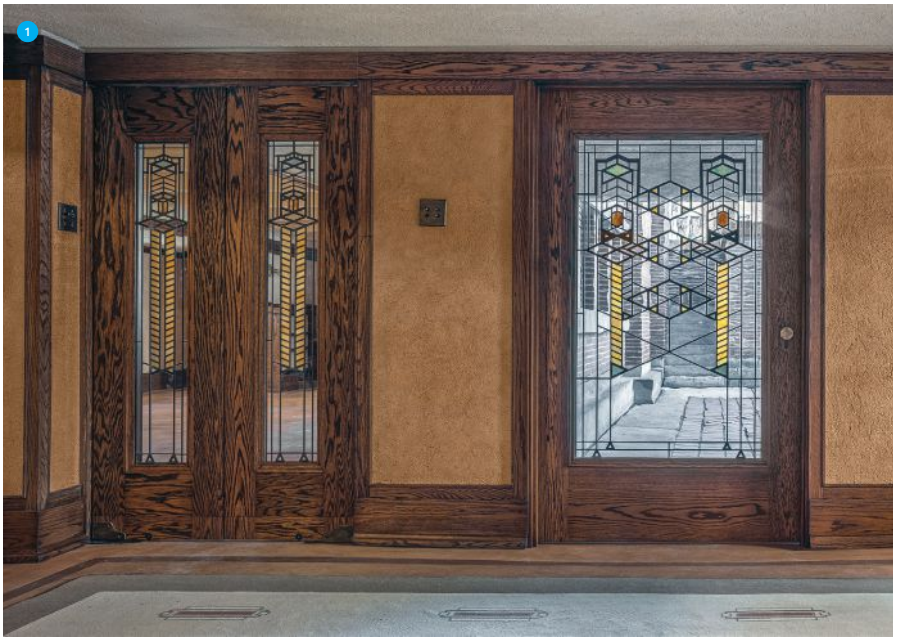
Residential:
Harboe Architects

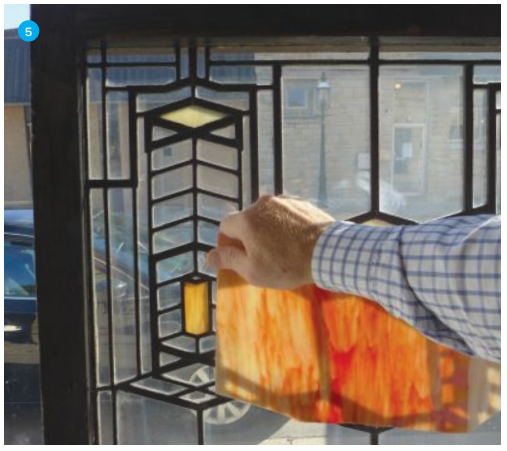
1: JAMES CAULFIELD; 2–5: COURTESY FRANK LLOYD WRIGHT TRUST

6: COURTESY HARBOE ARCHITECTS

1. Harboe Architects' restoration of the living room included rebuilding the inglenook to Wright's original specifications, as well as restoring the glazing, light fixtures, and interior finishes. **2.** The plaster restoration process started by removing non-original or compromised plaster and exposing the original laths. **3.** Crews applied a scratch coat of plaster to the rebuilt inglenook to match (as closely as possible) the original plaster. **4.** Microscopic analysis of the wall surfaces allowed the team to reproduce the original paint colors (samples of which are shown here), which were thinned before being applied to the walls. **5.** During the restoration, the wood trim was removed from the living room and cataloged before several layers of paint were stripped, exposing the original plaster surface. **6.** Where original globe light fixtures could not be restored, faithful replicas (at right) were crafted to match the originals (at left) and compared for accuracy.

Residential:
Harboe Architects

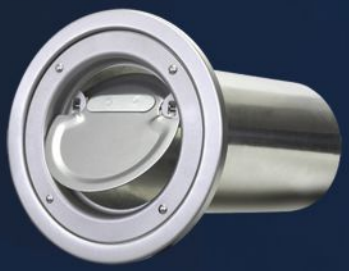




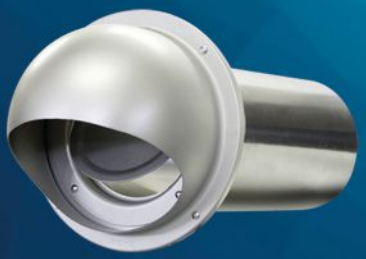
1. The restored front door and foyer, with repainted plaster, refinished magnesite floors, and restored wood trim. **2.** Prior to the restoration of the Robie House's wood trim, each piece was removed and cataloged for restoration and so that it could later be reinstalled in its original location. **3.** Damaged veneer was repaired or replaced with new veneer to bring it back to its original appearance. **4.** Where windows in the house were missing, reproductions (at top left) were crafted by Colorsmith Stained Glass Studio and carefully matched against the originals (at bottom). **5.** Evaluation of the color of the reproduction glass was carried out in natural light to ensure the best match.

1: JAMES CAULFIELD; 2–4: COURTESY HARBOE ARCHITECTS; 5: COURTESY FRANK LLOYD WRIGHT TRUST

DRYER VENTS



Model:**SB-P**
4"& 6" Aluminum



Model:**SFB-P**
4"& 6" Aluminum

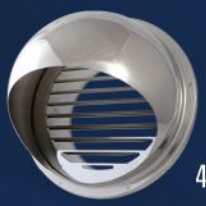
Model
SFZC
4"& 6" Aluminum

Model
RCC-S
4"& 6" Stainless Steel

VENT CAPS

Model
SX
3"-8" Aluminum

Model
KX
3"-6" Aluminum



Model
SFX-S
4"& 6" Stainless Steel

Model
SXL
10"-16" Aluminum

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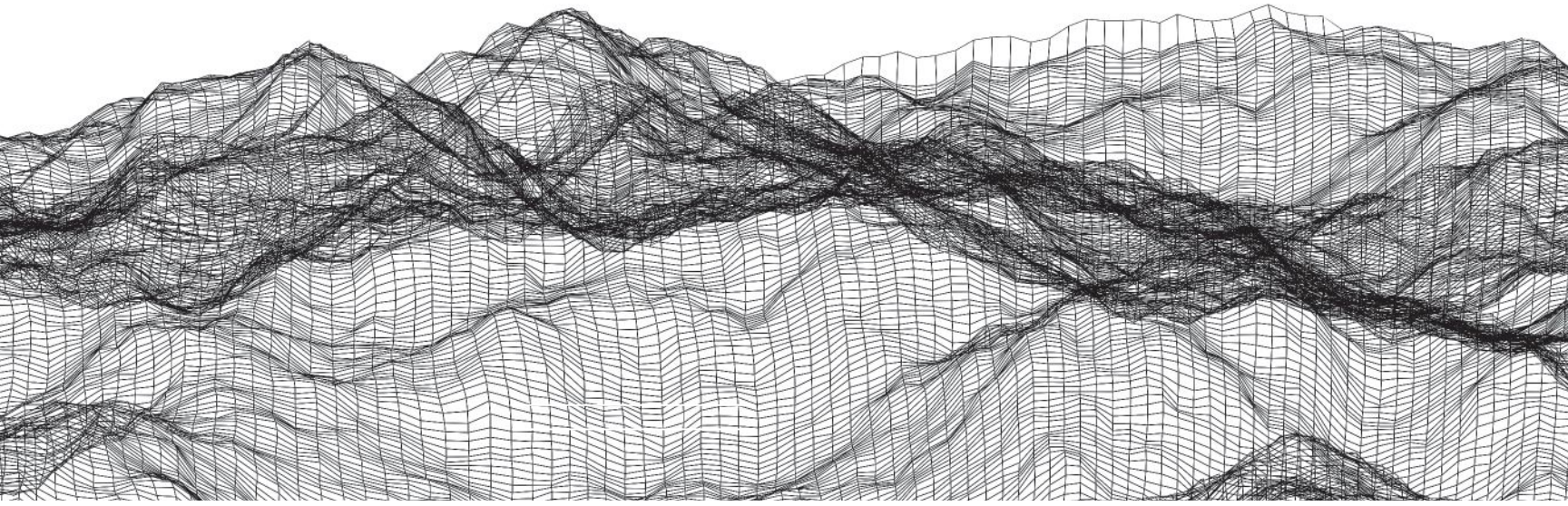

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SUSTAINABLE CURB APPEAL

LEARNING OBJECTIVES

1. Define material health and product transparency and the role it serves in protecting the health and wellness of occupants in the built environment.
2. Compare and contrast building certifications, including LEED v4, Living Building Challenge, and the WELL Building Standard, as they continue to enhance the health and wellness of occupants through sustainable design practices.
3. Analyze the environmental impact of construction materials and the contribution these materials make to improving the health and wellness of occupants.
4. Explore resources available that enable project teams to research and document building products that are environmentally-friendly and occupant-centered.

CONTINUING EDUCATION

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It's hard these days not to hear or see a company making promises about reducing carbon footprints, or about the need to do more for the planet. For many, a commitment to sustainability and leaving behind a softer footprint for future generations is a familiar promise. There is a lot of focus on health and wellness, but the bigger picture remains a puzzle. There must be a business case for sustainability if it is to succeed in driving change.

Sustainability is more than a nice word for doing right by the planet. For business, it's a profit driver. And the building industry is a leading culprit for carbon emissions. In any conversation about meaningful climate change, the industry needs to step forward and make a commitment to do better. The technology and resources exist to make building more sustainable. There is a choice to fundamentally change the way business is done. The real question is, will it?

CLIMATE CHANGE: NOT JUST OUR CHILDREN'S PROBLEM ANYMORE

The 2018 United Nations Climate Report contained a dire warning from the world's leading climate scientists: it is possible that there are just 12 years until rising temperatures due to global warming can be kept at 1.5 degrees Celsius. What happens after that? Even half-degree increases in global temperature will drastically worsen the risks and impacts of natural disasters like drought, floods, and

Butterfly House, Prague, Czech Republic

extreme heat, and put hundreds of millions of people at risk for or in poverty.

Twelve.

That is the number of years left to make massive changes to global energy infrastructure to limit global warming to moderate levels.

Even so, such a commitment remains a monumental task.

Keeping the planet at 1.5 degrees Celsius pre-industrial levels will mean "rapid, far-reaching and unprecedented changes in all aspects of society", not just regarding energy, but changes to how transportation, buildings and industries operate. The United Nation's report is a stark reminder of the harsh challenges that humankind faces in terms of preventing the worst impacts of climate change, the need for engagement and action from all stakeholders, and the importance of the Paris Agreement as a backbone for driving change.

Climate change is real, but where does the building industry fit in? According to research from the World Economic Forum, buildings are responsible for 25 to 40 percent of all global energy consumption. Our industry can claim 30 percent of all greenhouse gas emissions due to buildings. It's important, then, in any conversation about global warming and climate change, to address a significant part of the problem: past and current building industry standards.

The importance of viewing buildings as holistic entities, where both the quality of construction and the materials used are considered equally. Buildings need to be as efficient as possible with their energy use, and that's where product transparency and material health become important[1].

Industry Drivers of Climate Change

Climate change is the fundamental design problem of our time; not education, community, or health. The threat that climate change poses is existential, and buildings are hugely complicit—even more than the automobile. Buildings consume 40 percent of energy annually, and the emit nearly half of the carbon dioxide, through greenfield development, cement production, and the burning of fossil fuels. Carbon dioxide is the chief agent of climate change, making buildings—and by association, the architecture profession—profoundly responsible. Architects face a choice: to remake the built environment so that it produces no carbon dioxide, or to carry on business as usual, and live with the consequences.

The cement industry is one of the most energy-intensive and highest carbon dioxide emitting industries and one of the key industrial contributors to air pollutions like PM, SO_2, and others. The cement industry accounts for approximately five percent of current man-made carbon dioxide emissions worldwide. Producing one ton of cement releases an estimated 0.73 to 0.99 tons of carbon dioxide depending on the clinker-per-cement ratio and other factors. More than 50 percent of carbon dioxide emissions from the cement industry are process-related emissions from the calcination process and have nothing to do with fuel use. About 40 percent of carbon dioxide emissions come from the burning of fuels to heat the cement kiln, and the remainder of carbon dioxide emissions come from electricity use and transportation.

Concrete and steel, which have been the backbone of traditional building methodology, have a huge impact on emissions. Reducing the amount of these materials in the construction process would not only reduce overall emissions, but also allow builders to optimize other materials already available on the market.

Global Stakeholders

Interactions between rating systems, design firms, databases and more are very complex. The industry is making progress to increase the knowledge-sharing and having a huge global influence has helped to spread awareness and information about green building practices and increase transparency.

The agents of change are many in the fight against climate change, and the whole system is interconnected. Ratings systems like LEED v4, the WELL Building Standard, the Living Building Challenge, and many others define what sustainability looks like for both clients and product labels and help inform designers of appropriate standards. Clients like Google, Microsoft, and Amazon use this information to spearhead innovative building projects, which inspire Influencers like JLL, ASBP and CBRE to market and manage innovative commercial and industrial real estate. Designers report and log their information and research into databases, which in turn informs product labels. Product labels like Declare, cradle2cradle and HPDC in turn collaborate with the ratings systems on transparent product and materials knowledge.

With all this information, research, product labels, and design standards, the databases contain immeasurable quantities of information

GLOSSARY

1. Cradle2Cradle: A certification for continuous improvement in sustainable building design administered by the Cradle to Cradle Products Innovation Institute.

2. Declare: Administered by the International Living Future Institute, the Declare label is an easy-to-read label listing a product's material ingredients, end-of-life options, and compliance with Living Building Challenge criteria; Declared products are stored in a public database.

3. Environmental Product Declaration: An independently verified and registered document communicating transparent and comparable information about the lif-cycle environmental impact of products.

4. GreenScreen: A scorecard for identifying and assessing chemical hazards and a benchmark for choosing safer alternatives.

5. HPD Open Standard: Administered by the Health Product Declaration Collaborative, the Open Standard is a comprehensive, voluntary specification sheet to report the material contents and related health information about building products. Also includes full disclosure of potentially hazardous product ingredients.

6. Life Cycle Assessment: A methodology used to evaluate the environmental impacts associated with a product or service from cradle to grave; also calculates the environmental footprint of a product at each stage of the supply chain.

7. Material Circularity Indicators: Measures the materials flow of a product on a scale of 0 to 1 in a circular economy, where higher values indicate higher circularity; considers a product's input in the production process, utility during use phase, destination after use, and efficiency of recycling.

8. mindful MATERIALS Collaborative: A digital product library for the building industry that provides a common platform to access and communicate product transparency and optimization.

9. Red List: A list of worst-in-class chemicals used in the building industry; chemicals pollute the environment, bioaccumulate and endanger animals, and/or harm construction and/or factory workers

10. Substitute Cementitious Materials (SCMs): Added to concrete to make concrete mixtures more economical, hydraulic, or sustainable. Common examples include fly ash, slag cement, and silica fume.

that the building industry can use to improve sustainability. And yet, most of the current technical queries mainly focus on volatile organic compounds and life cycle information. There is so much more that can be done.

AIA's Materials Initiative

Portland Community College—Portland, OR

The materials that builders use have a big impact on the environment, in communities, and on public health. To select materials wisely, architects must know what's in them and what effects they have before, during, and after their use.

That's why AIA promotes transparent and accurate information about materials—so architects have information to help choose the right materials for every project. This represents a big opportunity, but it is also a big change.

The case for sustainable design is not limited to the Americas, nor is innovation only happening in Europe. Globally, the building industry is making strides to be better connected—that's why various stakeholders from around the world are involved in so many phases of new building design and construction.

The built environment has an important part to play in combating climate change. Building codes are starting to catch up, paving the way for a deeper transformation of green building design. LEED has been a big driver in fundamental shifts in high-performance buildings, but it's not the only ratings agency to drive change in the industry.

BUILDING CERTIFICATIONS TO ACHIEVE SUSTAINABILITY

S.J. Quinney College of Law, University of Utah—alt Lake City, Utah, USA

Ratings systems are in place to give the building industry a barometer for responsible design and to let consumers know that a building has gone above and beyond to ensure cost savings, energy reductions, and a healthier environment in which to live and work. There are more than a dozen certification options for green building design; LEED v4, the WELL Building Standard, and the Living Building Challenge will be discussed here.

LEED v4

Of the various ratings systems, few have the history of LEED, not to mention its global reach. Now in its fourth iteration, LEED has undergone significant changes to streamline requirements, increase product transparency, and encourage an interactive, integrative process to building design and construction.

Major changes from LEED 2009 to LEED v4 are:

- **Updated rating system and dependency on project type**—*21 rating system adaptations that cover five broad categories, including Building Design & Construction (BD+C) and Interior Design & Construction (ID+C)*
- **Changed core credit categories**—*new to v4, Location & Transportation, which emphasizes reducing the cost and environmental impact of daily commutes*
- **New LEED system goals, or impact categories**—*seven different project goals, like "Build a Greener Economy" that were implied with previous versions of LEED, and are now clearly stated to help explain exactly what LEED is supposed to accomplish*

With LEED v4, it's easier for projects to achieve LEED ratings that are better aligned with holistic building standards. The newest version, LEED v4.1, represents an incremental update to the Materials and Resources credit. This category changed because of the need for designers and contractors to work together to improve product transparency and increase energy-saving ideas. LEED v4.1 encourages a team approach from the beginning of a project to building occupancy to achieve sustainability.

WELL Building Standard

This is one area that's gaining significant traction in the commercial building sector, especially in interior design. The WELL Building Standard™, from the International WELL Building Institute, is the first building

FIVE THINGS ALL ARCHITECTS SHOULD KNOW ABOUT MATERIALS TRANSPARENCY

Transparency is the new normal. There is a growing expectation that everyone involved in a building project, from initial design to occupancy, should have access to information on the potential health and environmental impacts relating to those products.

Materials transparency represents opportunities for architects. These opportunities include competitive advantage, thought leadership, design innovation, and environmental and human health leadership.

New practices and procedures inherently present potential risks. We accept that there is some risk in advocating for materials transparency and sharing composition information with our clients. This white paper explores those risks in detail.

It will be important to manage potential risks with increased transparency. Although the risks associated with materials transparency are new, architects are familiar with risk management. This white paper offers several strategies for effectively evaluating and mitigating risk.

The AIA has tools and resources to help architects navigate materials transparency risks and opportunities. Along with this white paper and existing online resources, the American Institute of Architects published new model contract language to specifically address materials transparency issues. In addition, our materials knowledge working group, made up of expert members, practitioners, and partner organizations, is continually developing education and practice tools to help architects optimize their approach to materials transparency.

standard to focus exclusively on the health and wellness of the people in buildings. WELL is a performance-based system for measuring and certifying features of buildings that impact human health and well-being through 11 concepts: air, water, nourishment, light, movement, thermal comfort, sound, materials, mind, community, and innovation. It marries best practices in design and construction with evidence-based medical and scientific research—harnessing buildings and communities as vehicles to support human health and well-being.

Since most people spend about 90 percent of their time indoors, the buildings where people live, work, learn, and relax have a profound effect on well-being: how we feel, what we eat, and how we sleep at night. WELL is grounded in a body of research that explores this connection between buildings and people. Each WELL feature is designed to address issues that impact the health, comfort, or knowledge of people in buildings through design, operations, and behavior.

Applying LEED and the WELL Building Standard™: Strategies for Interiors, New Buildings, and Existing Buildings Seeking Dual Certification

The following table highlights examples of which LEED credits translate to WELL features; what each LEED credit is worth; and how that translates to WELL feature parts. This is only a small piece of the overlap in the BD+C category. Projects can reach both credits with inherent crossover, credit for credit, and in the table below architects can see what's gained from striving for both. With how connected LEED and WELL credits are, there is an opportunity to push the design teams to challenge which certification they're seeking and create more sustainable buildings.

This article continues on http://go.hw.net/AR082019-1. Go online to read the rest of the CEU course, complete the corresponding quiz for credit, and receive your certificate of completion.

QUIZ

1. According to research from the World Economic Forum, buildings are responsible for _____ percent of all global energy consumption.
   a. 25 to 40
   b. 20 to 25
   c. 25 to 30
   d. 35 to 40

2. How much carbon dioxide does one ton of cement release?
   a. .50 to .70
   b. .72 to .99
   c. .73 to .99
   d. .25 to .39

3. What is the new category added to LEED v4?
   a. Sustainable Sites
   b. Location & Transportation
   c. Energy & Atmosphere
   d. Indoor Environmental Quality

4. Of the 11 concepts in the WELL Building Standard, which one of the following is NOT included?
   a. air
   b. materials
   c. movement
   d. space

5. There are three options to list inventory on an HPD form, and the newest option is _____.
   a. Basic Inventory Method
   b. Nested Product Inventory with Material-Level Threshold
   c. Nested Materials Inventory with Product-Level Threshold
   d. Nested Materials Inventory with Material-Level Threshold

6. What is the GreenScreen score for a chemical of high concern?
   a. BM-1
   b. BM-2
   c. LT-1
   d. LT-P1

7. Which section of the Declare label lists expected product lifespan warranty, material composition, and end of life solutions?
   a. Identification
   b. Attributes
   c. Imperatives
   d. Origins

8. In the full Life Cycle Assessment for the construction industry, how much is allocated to end of life?
   a. 0.7%
   b. 1%
   c. 3%
   d. 5.4%

9. In the case study example, _____ accounted for approximately ____ percent of the project's whole building impacts and 40 percent of its global warming potential.
   a. concrete, 40
   b. concrete, 50
   c. steel, 40
   d. steel, 50

10. What are the top three materials that contribute to a construction project's global warming potential?
    a. Concrete, Metals, Openings and Glazings
    b. Concrete, Masonry, and Metals
    c. Metals, Finishes, and Wood/Plastics/Composites
    d. Concrete, Metals, and Finishes

SPONSOR INFORMATION

Kingspan

Kingspan is a global leader in high performance insulation and building envelope solutions, designed to reduce the carbon footprint of the built environment. Kingspan has five insulated metal panel plants in North America and is one of the largest IMP manufacturers in the world.

QuadCore™ protects against fire, smoke and ordinary design.

Kingspan insulated panels featuring QuadCore™ Technology are designed to make you look good. Inside and out. For starters, the innovative cell formulation inside each panel provides superior fire resistance and unmatched health and wellness certification. Back that up with unrivaled thermal performance, a 30-year thermal warranty and enviable design flexibility, and you'll quickly see how the QuadCore™ portfolio can help bring your design vision to life. Get the full details at **kingspanpanels.com.**


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Presented by:

BUILD WITH STRENGTH

CONCRETE INNOVATIONS

The Jubilee Church. Photo: Elio Lombardo / Alamy Stock Photo

LEARNING OBJECTIVES

1. Understand new technologies used in concrete manufacturing.
2. Discover how innovative concrete products can improve project performance.
3. Learn how to implement the latest concrete innovations in building and infrastructure projects.
4. Demonstrate the importance of incorporating new technologies to enhance resilience and sustainability in the built environment.

CONTINUING EDUCATION

AIA CREDIT: LU/ELECTIVE
AIA COURSE NUMBER: AR082019-2

AIA Continuing Education Provider

Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR082019-2 to view the entire CEU and complete the quiz. CEU courses are free of charge once you create a new learner account; returning users log in as usual.

By: Lionel Lemay, PE, SE, LEED AP. Executive Vice President, Structures and Sustainability, National Ready Mixed Concrete Association
Brian Lemay, Research Assistant Intern, National Ready Mixed Concrete Association

INTRODUCTION

What do the Jubilee Church and the Pantheon have in common? They are both places of worship in Rome, but besides that, they are both built with innovative concrete. The Romans mastered the use of concrete 2,000 years ago to build some of the most iconic structures ever built. Although different than today's concrete, Roman concrete used the same principles, combining aggregate with a hydraulic binder. The aggregate included pieces of rock, ceramic tile and brick rubble often recycled from demolished buildings. Volcanic ash, called pozzolana, was the favored binder where it was available, but gypsum and quicklime were used as binders also. Even 3,000 years before, the Egyptians used a form of concrete made with mud and straw to build the pyramids. Today, most concrete is made with portland cement, invented in 1824, and combined with high quality quarried aggregate. Most modern concrete is augmented with innovative products and additives to enhance both plastic and hardened properties.

Innovative supplementary cementitious materials (SCMs) such as fly ash, slag cement and silica fume are used to increase strength, durability and workability. Chemical admixtures affect set time, freeze-thaw resistance and flowability. Tiny fibers are added to increase ductility and control cracking. Carbon dioxide is injected into concrete to improve strength and capture greenhouse gasses. Some enhancements actually scrub pollutants from the surface of concrete and from the surrounding atmosphere, which is what makes the concrete on the Jubilee Church so innovative. The exterior curved

The Pantheon. Photo: Hercules Milas / Alamy Stock Photo

surfaces are coated with titanium dioxide (TiO_2) cement which eats smog, helping to keep the surface clean.

Concrete is the most widely used building product in the world. For the most part, concrete is made locally with local materials. It is cost effective, readily available, strong and durable. Although conventional concrete can tackle most jobs, it is also the material of choice for the tallest buildings in the world and infrastructure designed to last centuries. New concrete products and manufacturing methods are enhancing concrete's performance to tackle modern challenges. This article explores some of these latest innovations.

GLOSSARY

1. Portland cement—Most common type of cement in general use around the world as a basic ingredient of concrete, mortar, stucco, and non-specialty grout

2. Supplementary cementitious materials (SCMs)—fly ash, slag cement, and silica fume used to increase strength, durability and workability

3. Photocatalysis—the acceleration of a photoreaction in the presence of a catalys

4. Graphene concrete—made by suspending flakes of graphene in water, then mixing that water with traditional concrete ingredients such as cement and aggregate

5. Carbonation—Naturally occurring process by which carbon dioxide (CO_2) penetrates the surface of hardened concrete and chemically reacts with cement hydration products to form carbonates

6. Self-consolidating concrete (SCC)—Non-segregating concrete that can flow into place, fill formwork and encapsulate reinforcement without any mechanical vibration

7. Silica fume—Waste byproduct of processing quartz into silicon or ferro-silicon metals in an electric arc furnace, used as an SCM in concrete

8. Blast furnace slag—Waste byproduct of iron manufacture, used as an SCM or lightweight aggregate in concrete.

9. Coal ash—Waste byproduct of burning coal in electric power plants

10. Beneficiation—Taking coal ash from landfills and processing it so it meets the necessary standards for beneficial use

11. Bendable concrete—Concrete containing fiber additives to enhance ductility and crack control

12. Geopolymer concrete—Concrete made with fly ash and/or slag cement combined with an alkaline activator as the binder.

13. Fly ash—one component of coal ash which is used as an SCM in concrete

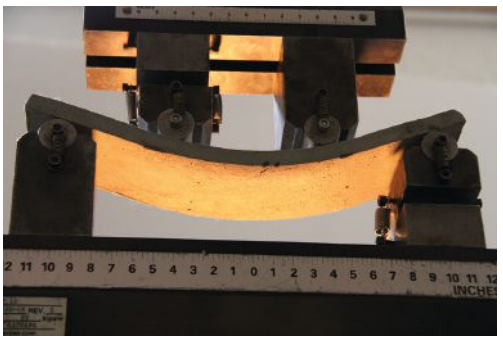
SELF-CLEANING CONCRETE

Imagine concrete that can clean itself and even the surrounding air of harmful pollutants. That's what concrete made with titanium dioxide (TiO_2) can do. The function of TiO_2 cement is to break down harmful pollutants in the air via a reaction catalyzed by light, or photocatalysis, due to titanium dioxide which is added to the cement during its production. This capability of TiO_2 cements was inspired by the ability of certain microbes to break down harmful chemicals by modifying their oxidation state, also through photocatalysis. However, in photocatylitic cements, the reaction is carried out by the titanium whereas microbes rely on natural enzymes. The cement breaks down organic, as well as inorganic pollutants. It is intended to be used for projects in urban centers where air pollution and poor air quality are most pronounced.

An example of how TiO_2 cements break down pollutants can be seen in its conversion of nitrogen dioxide (NO_2), a harmful compound mostly produced by burning fuels in cars and trucks. Nitrogen dioxide is one of the compounds responsible for acid rain, smog, respiratory problems and staining of buildings and pavements. The reaction with sunlight produces hydroxyl radicals which react with NO_2 to produce NO_3 which is dissolved by water after reacting with the cement surface.

Research data of a TiO_2 cement manufacturer in the US, indicates that "up to 50% of these atmospheric pollutants could be reduced in some cities if only 15% of the buildings and roads were resurfaced with a TiO_2 cement." A TiO_2 cement was first used for the curved panels on the Jubilee church (also known as Dives in Misericordia Church) in Rome, which used the photocatalytic cement panels for its stylistic shells. Since then an Italian company has dedicated decades of research to photocatalytic cement products. This cement is promising in its potential to greatly improve urban life and the environment.[1]

BENDABLE CONCRETE



Bendable concrete is 300–500 times more ductile than conventional concrete. Photo: Victor C. Li

Bendable concrete presents an efficient alternative primarily in the construction and maintenance of infrastructure, where concrete is subject to harsh weather conditions and extreme loading. The design which gives bendable concrete, or engineered cementitious composite (ECC), its impressive ductility is based off nacre, the substance that coats the inside of abalone shells. Nacre is composed of small aragonite platelets that are held together by natural polymers, allowing it to be both hard and flexible as platelets are free to slide from side to side under stress. This effect is mimicked in bendable concrete by dispersing tiny fibers throughout. Victor C. Li of the University of Michigan, where ECC was first researched and

CASE STUDY: JUBILEE CHURCH, ROME, ITALY

Photo: Edmund Sumner-VIEW / Alamy Stock Photo

According to architects Richard Meier and partners, the Jubilee Church in Rome was "conceived as part of Pope John Paul II's millennium initiative to rejuvenate parish life within Italy." The project consists of the church itself as well as both secular housing and housing for the clergy. The church is most easily distinguished by the three large concrete shells which are meant to represent the Holy Trinity. Given the symbolic importance of the shells, their appearance is a priority. Because the shells need to remain in pristine condition, it was only natural that "self-cleaning" photocatalytic concrete was used to ensure that the shells would not accumulate stains due to smog. Completed in 2003, the photocatalytic shells have notably remained clean and white, performing constant self-maintenance.

invented, states that bendable concrete "can deform up to 3 to 5 percent in tension before it fails, which gives it 300 to 500 times more tensile strain capacity than normal concrete." It is the incredible ability to tolerate tensile strain that makes bendable concrete unique.

This enormous increase in ductility suggests various potential applications. Firstly, in roads as well as other paved surfaces which must bear repeated loading of heavy vehicles, bendable concrete would crack less often, preventing further weathering primarily from road salts which corrode steel reinforcement. Further, due to ECC's capacity to absorb greater quantities of energy without being damaged, it can be used to make reinforcing elements such as the dampers on the Seisho Bypass Viaduct in Japan, which is roughly 28 kilometers long. Dr. Li states that ECC has been employed as earthquake resistance in tall buildings in Tokyo and Osaka and further suggests that ECC would be useful in underground construction as well as the construction of water infrastructure.

However, before it can be more widely commercialized for such large-scale projects, bendable concrete must become more readily available. To be economically viable, it must be supplied efficiently and not overused on projects. It is paramount that design professionals be made aware of the product and its potential as they might otherwise overlook a promising concrete option for structures that require the ability to deal with considerable tensile strain.

Bendable concrete also has self-healing capabilities. Because bendable concrete keeps cracks relatively small, natural reactions within the hardened concrete generate "healing" through carbon mineralization and continuous hydration which repairs the cracks and restores the durability of the concrete. Bendable concrete is a promising technology that already has proven itself through commercialization by several companies.

In fact, fiber reinforced concrete is not new. Many companies supply fibers for use in concrete with the objective of improving the strength and durability of the concrete in some way. Fiber reinforced concrete accomplishes this by incorporating fibers made of steel, glass or organic polymers (plastics). Sometimes naturally occurring fibers such as sisal and jute have been used as well. These fibers are primarily used to combat plastic shrinkage and drying shrinkage which can otherwise crack and damage the concrete. This resistance to shrinkage and subsequent cracking is the key to extending the lifespan of concrete, decreasing the frequency of costly repairs. Fibers also keep existing cracks from widening and further damaging the concrete when they do appear. More recently, steel fibers have been used in structural applications to reduce the amount of traditional steel reinforcing bars, saving time and labor.

Ultra-High-Performance Concrete (UHPC)

One building product manufacturer became one of the first companies to commercialize bendable concrete with an ultra-high-performance concrete (UHPC) that incorporates fibers into the concrete mixture in order to improve strength and ductility along with a host of other benefits. The manufacturer states that they use "high carbon metallic fibers, stainless fibers, poly-vinyl alcohol (PVA) fibers or glass fibers" to increase the concrete's ability to withstand tensile loads and deformation.

This UHPC is also less porous than conventional concrete, making it more resistant to chlorides,

CASE STUDY: 42 BROAD, FLEETWOOD, NEW YORK

Photo: Bluestone Organization. Photo: ICF Panels, Inc.

42 Broad is a 16-story mixed-use development near New York City being built with Insulating Concrete Forms (ICF). ICF construction is becoming more mainstream with thousands of projects built in the US but is still considered innovative by many. ICFs sandwich a reinforced concrete wall between forms made of rigid polystyrene insulation that stay in place after the concrete hardens. There are several taller ICF buildings in Canada, but at 16 stories, 42 Broad will be the tallest in the US.

The real innovation on this project is panelizing the ICF blocks and using steel fiber reinforcement. The ICFs are assembled off-site in a nearby plant and arrive at the jobsite as custom panels up to 50 feet long, which results in labor and time savings on the job site and means the owner can occupy the building earlier. Part of what makes this process possible is the use of steel fibers in the ready mixed concrete to replace the horizontal reinforcing steel which eliminates costly horizontal rebar slices.

CASE STUDY: PEREZ ART MUSEUM, MIAMI, FLORIDA

Photo: Ian Dagnall / Alamy Stock Photo

The Perez Art Museum in downtown Miami is notable largely for its application of an ultra-high-performance concrete (UHPC). The museum houses roughly 200,000 square feet of indoor and outdoor space for the presentation of modern and contemporary art. However, the property comes with one significant challenge: The museum is built on Biscayne Bay where it is subject to sea air and salt. Additionally, it is at risk of tropical storms and hurricanes and must withstand the forces associated with these extreme weather events. An UHPC was used to produce roughly 100 16-foot-long mullions to support the world's largest impact resistant window at the time of its construction in 2013. The concrete mullions were made to be thin, maximizing visibility, while also meeting the Florida building code for hurricane resistance.

acids, and sulfates. It is also generally much more impermeable to water, making it ideal for roofing as well. In addition, this UHPC has self-healing properties. This bendable concrete has been thoroughly researched and is commercialized.[2]

Graphene Concrete

Graphene concrete is made by suspending flakes of graphene in water, then mixing that water with traditional concrete ingredients such as cement and aggregate. Graphene concrete is concrete reinforced by a single layer of carbon atoms tightly bound in a hexagonal honeycomb lattice. Layers of graphene stacked on top of each other form graphite, a naturally occurring crystalline form of carbon most commonly used in pencils and lubricants. The layers of graphene in graphite can be separated into sheets only one atom thick. Graphene is the thinnest compound known to man, the lightest known material and the strongest compound discovered—over 100 times stronger than steel.

This technology's strength largely lies with its accessibility; it is inexpensive and compatible with modern, large-scale manufacturing requirements. According to "Ultrahigh Performance Nanoengineered Graphene–Concrete Composites for Multifunctional Applications," published in *Advanced Functional Materials*, graphene concrete impressively shows a "146-percent increase in compressive strength as compared to regular concrete, a 79.5-percent increase in flexural strength, and a decrease in water permeability of almost 400 percent.'' In addition to its increased strength, graphene concrete is also more environmentally friendly since it requires less cement than is typically required to produce concrete at a specified strength. Alternatively, higher strength graphene concrete could be used to produce smaller structural elements, thus reducing the amount of material used.

CARBON CAPTURE

Like most manmade materials, concrete is considered a carbon dioxide (CO_2) emitter, mainly due to the cement manufacturing process. However, what if you could reverse that process and capture or sequester CO_2 in concrete through natural processes or carbon capture technologies.

This article continues on http://go.hw.net/AR082019-2. Go online to read the rest of the CEU course, complete the corresponding quiz for credit, and receive your certificate of completion.

QUIZ

1. Bendable concrete uses fibers to improve
   a. Color
   b. Ductility
   c. Flowability
   d. Slump

2. The primary benefit of concrete made with titanium dioxide cement is
   a. Increased strength
   b. Improved flowability
   c. Staying clean
   d. High early strength

3. Steel fibers have been used in concrete to
   a. Improve color uniformity
   b. Replace steel reinforcing bars
   c. Increase set times
   d. Improve surface appearance

4. In addition to increased ductility, bendable concrete also has the benefit of
   a. Staying clean
   b. Resisting extremely high temperatures
   c. Reduces surface friction
   d. Self-healing

5. Graphene concrete is made by
   a. Suspending flakes of graphene in mixing water
   b. Wrapping concrete with graphene sheets
   c. Recycling pencil lead into concrete
   d. Using graphite cement

6. Carbon dioxide is absorbed by concrete in a process called
   a. Hydration
   b. Carbonation
   c. Calcination
   d. Photocatalysis

7. Carbonation of concrete is higher when
   a. Surface-to-volume ratio is higher
   b. Surfaces are painted
   c. Concrete is buried
   d. Concrete is denser

8. Carbon dioxide injection reduced carbon footprint of concrete in two ways
   a. Reduces strength and increase cement demand
   b. Sequesters CO_2 and increases strength
   c. Eliminates the need for portland cement and increases need for water
   d. Reduces labor and set times

9. One company makes artificial limestone by
   a. Crushing see shells under high pressure
   b. Growing and harvesting coral
   c. Mining coal ash from landfills
   d. Combining CO_2 with metal oxides

10. Self-consolidating concrete (SCC) is often used to
    a. Eliminate mechanical vibration
    b. Reduce on-site labor
    c. Improve surface appearance
    d. All the above

11. Which of the following has NOT been commercialized to any great degree?
    a. SCC
    b. SCMs
    c. Geopolymer concrete
    d. Fiber reinforced concrete

12. Beneficiation of fly ash involves
    a. Recovering and processing fly ash from landfills
    b. Creating fly ash bricks
    c. Spreading fly ash on the surface of concrete
    d. Converting fly ash to portland cement

SPONSOR INFORMATION

Off-site fabrication, on-site efficiency.

A new hotel pushes modular construction techniques to the limit

A closer look at 333 W. Spokane Falls Blvd. in Washington highlights concrete innovation at its best.

Building on the fast track. Modular construction cut the time it took to build the 17-story Davenport Grand Hotel by an entire year. One floor per week was assembled, with 26 precast modular concrete wall panels placed every day.

Breaking records. With its precast concrete wall and floor panels, and a cast-in-place foundation, the Davenport Grand used more concrete than any other project in Spokane for the past 25 years.

Setting standards. Modular construction allowed the installation of building elements before final assembly. For example, glass windows were mounted into exterior panels, painted, and then the entire panel was lifted into position.

Modular construction cuts waste, keeps projects green

Building key elements off-site allows highly accurate assembly and ordering of materials, cutting waste and allowing for efficient recycling of any extra materials. It also minimizes disturbance at the site, reducing a project's impact on the surrounding environment.

Modular Materials + Flexible Design.

They can go together—we'll show you how.

It really is possible to create a structure that's stunning, innovative and resilient, too. So whether you're looking for guidance on modular construction, non-combustible materials, structural design, cost estimating, green standards, LEED optimization or building codes, our team of experts will help you do it all for free. Because the only thing we like more than talking concrete, is helping you do something amazing with it.

BUILD WITH STRENGTH

A COALITION OF THE NATIONAL READY MIXED CONCRETE ASSOCIATION

Backed by the National Ready Mixed Concrete Association, Build With Strength is a diverse coalition that educates the building and design communities on the benefits of concrete. **Join us at BuildWithStrength.com.**

LED LIGHTING FOR EXTERIOR ARCHITECTURE

Presented by:

TARGETTI

LEARNING OBJECTIVES

1. Discuss how exterior lighting effects form and function in design.
2. Examine the history of exterior lighting technology, from the mid-20th century to today.
3. Understand fundamental landscape lighting techniques that help to achieve modern exterior lighting design.
4. Review the latest advances in LED technology for exterior light fixtures used to achieve effective landscape lighting techniques.

CONTINUING EDUCATION

LA CES/NON-HSW CREDIT: 1 PDH

AIA CREDIT: 1LU/ELECTIVE

AIA COURSE NUMBER: AR082019-3

Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR082019-3 to view the entire CEU and complete the quiz. CEU courses are free of charge once you create a new learner account; returning users log in as usual.

LIGHTING A LANDSCAPE—SETTING THE SCENE

Landscape lighting is a key feature that can set a building or landscape apart, as it plays with light and dark, creating contrast, shadows, and silhouettes. It provides curb appeal at night, introducing drama and intimate spaces softly washed in light, or well-lit spaces that invite you to sit and stay. Landscape lighting is both aesthetic and functional, highlighting features that might go unnoticed during the day. Numerous exterior lighting techniques and technologies are available, all aided by LED innovation. Unique features in a yard such as a pond, a sculpture, or a large tree may be spotlighted. Walls can provide a grounding backdrop when grazed with light and shadow. Stairs or pathways are lit to ensure the safety of those traversing the space. The entryway is the final calling card, welcoming visitors with a wash of light delivered by wall sconces. Remember that the goal of landscape lighting is to only see the effect of the light, not the light source itself, save for path lighting, which is designed to be decorative and on display.

GLOSSARY

Incandescent light sources[1]—A source of electric light that works by incandescence, which is the emission of light caused by heating the filament. An incandescent bulb typically consists of a glass enclosure containing a tungsten filament. An electric current passes through the filament, heating it to a temperature that produces light.

High-intensity discharge (HID) light sources[2]—A family of gas-discharge arc lamps which create light by sending an electrical discharge between two electrodes and through a plasma, or ionized gas. An additional gas is generally used, and this gas serves as an easy way to classify the major types of HID lamps: Mercury, sodium, and metal halide.

5mm LED—Based on two leads and an epoxy housing—the chip is placed on the cathode lead with a reflector cup and then connected with a bond wire to the anode lead. The light is bundled by the reflector and the lens shape of the epoxy housing.

High power LED—Has a built-in ceramic base that serves as a heat spreader, on which the chip is placed. The cathode and anode leads are connected to pads on the bottom side of the ceramic base. A silicone encapsulant is placed on top of the chip.

LED source efficacy—Measures how efficiently a LED chip performs.

LED fixture efficacy—Measures the efficiency ratio of the total amount of lumens output by the luminaire to the amount of electricity required to power the light fixture.

Ingress Protection (IP)—A rating that determines how resistant an electrical device is to fresh water and common raw materials like dirt, dust, and sand.

Ingrades—Exterior lighting fixtures that are recessed into the ground, sitting flush with the surface, and are used for uplighting, floodlighting, and spotlighting.

Linear LED Projectors—Adustable linear LED projectors are used to light building facades and are available as either a recessed luminaire for in-ground applications or as a projector for minimally visible façade installations.

Dynamic Beam Shaper (DBS) technology—Projectors with variable optics that can vary the beam opening using digital input without using any mechanical system.

WHAT DOES LIGHT DO?

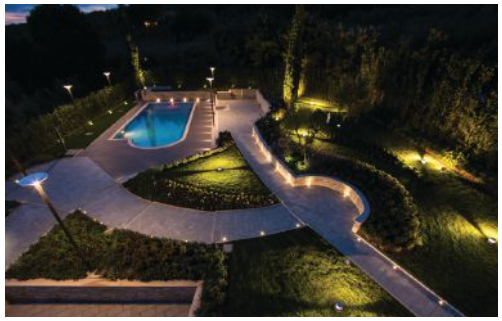
Light defines form

Use light and luminous surfaces as methods to define the form of structures and landscapes.

Light creates sparkle and ambiance

Properly designed exterior areas can provide a soft glow to enhance the architecture or hardscape.

Light defines a pathway



Properly designed pathway lighting can provide a soft glow and appropriate footcandle level to enhance the exterior wayfinding experience.

Light enhances architectural lines

Properly designed exterior grazing lighting is used to highlight building lines and shapes with a minimal lighting footprint.

Light adds an artistic experience

Properly underlighting exterior tables and seating areas provides a soft glow complimenting unique architectural shapes.

MID-CENTURY MASTERS[3]

Charles-Édouard Jeanneret, popularly known as Le Corbusier, was a Swiss-French architect, designer, painter, urban planner, writer, and one of the pioneers of the mid-century architectural style now called Modernism. Other highly influential architects of the mid-20th century, among others, were Philip Johnson, Alvar Aalto, Walter Gropius, and Mies van der Rohe.

The Modernists, as they are called, creatively and intentionally played with both interior and exterior light. Many of the Modernists were born in Germany or Scandinavian countries where the long winters and few hours of sunlight inspired these designers to create bright, light-filled, practical environments. Their proclivity for designing homes with open floor plans allowed light to pass through the space, one of the primary considerations in mid-century design. Vast expanses of glass, windows proportioned and positioned intentionally within the space, angled ceilings, and transparent doors all worked together to harness natural light and brighten the home.

Artificial lighting also played a significant role in mid-century design, with streamlined pendant lamps, ceiling lamps, floor lamps, table lamps, and spotlights. New lamp technologies, spotlights, and dimming capabilities allowed designers to rotate lighting devices to direct them toward work surfaces, highlight artwork, or create atmosphere. They also sought to provide lines of light on exterior architecture via new lighting technologies, reflective materials such as steel and glass, as well as well-placed exterior lighting that illuminated architectural features. The Modernist architects began to use light and luminous surface as methods to define the form of their structures.

Recently deceased, I.M. Pei was another very influential mid-century architect who said this about light: "The essence of architecture is form and space, and light is the essential element to the key to architectural design, probably more important than anything. Technology and materials are secondary."[4]

THE EVOLUTION OF EXTERIOR LIGHTING

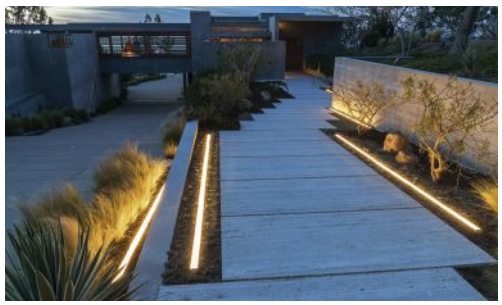
Providing these narrow lines of light on exterior architecture was always challenging with traditional lighting technology. Conventional exterior lighting sources include:

- Incandescent
- Halogen
- Fluorescent
- Gas-discharge (i.e., neon)

Conventional electric lighting sources have been with us for decades and, in some cases, well over a century. Most people are familiar with their inherent advantages and disadvantages. Indeed, each has significant issues in application. Incandescent and halogen lamps (in layman's term, the bulb) and lamp shades would

overheat, fluorescent lamps had socket shadows and maintenance issues, and gas-discharge lamps had a perceivable start-up time.

Outdated exterior lighting technologies include metal halide lights and wall pack lights that are mounted on the exterior walls of buildings; these were the standard for illumination of outdoor spaces for more than 50 years. These exterior lighting methods are energy hogs, high maintenance, very bulky, not aesthetically pleasing, and do not allow for spectral control. Sports arenas have long relied on metal halide to light playing fields. As that technology has aged, facility operators are beginning to retrofit stadiums with LED lighting systems because they provide better lighting for athletes, viewers, and television broadcasting.[5]



Outdated exterior lighting technologies most often included metal halide lights and wall packs that were mounted on the exterior walls of buildings. Today's LED technology allows lighting to become part of the environment and architecture.

LEDs are a newer technology that offers better solutions for narrow lines of light. In fact, the use of LED's has dramatically changed exterior landscape lighting in the following ways:

- Their footprint is smaller, using less energy, fewer circuits, and smaller shapes
- LEDs meet today's energy and compliancy codes such as Title 24
- LEDs are drive-over rated, cool to the touch, and energy efficient
- They also control glare

Nick Holonyak invented the LED in 1962. At the time, Dr. Holonyak worked for General Electric in a research laboratory in Syracuse, NY. Many scientists knew that semiconductors could be made to emit radiation, initially in the infra-red, and Nick was the first to create visible radiation in the red part of the spectrum. The first LED was dim and inefficient, but it had promise. Ironically, GE, the largest lamp company in the world at the time, decided against further work in the area and Nick left for the University of Illinois where he has been ever since. However, in his years at the University of Illinois, many of his students have gone on to leading roles in optoelectronics and LEDs. This is perhaps his greatest contribution to the field.

LEDs continued to improve over the years. The first applications were indicators to replace tiny incandescent sources and later, in the 1970s, displays for watches and calculators. LEDs also continued to improve in output and became available in a variety of colors. By the mid-1990s high-brightness LEDs were available in red, yellow, and even green, but blue proved to be elusive.

In the 1990s an electronic engineer named Shuji Nakamura created the missing color, blue, making available all the primary colors. He worked for Nichia Chemical in Japan, a manufacturer of phosphors used in fluorescent lighting. This was the real impetus for LED lighting applications.[7]

A BRIEF LED HISTORY

1962 First visible LED (Holonyak@GE)
- 0.001 lumens

1960's Red LEDs (HP and Monsanto)
- 0.01 lumens

1970's–1980's Green LEDs, Watches, Calculators
- 0.1 lumens

1990's Blue LEDs (Nakamura@Nichia)
- 1 lumen

2000+
- 10–100 lumens

2005
- 1000 lumens (Multichip Packages)

2010
- 11,392 lumens (Outdoor Architectural Flood Light)

2012
- 21,237 lumens (Theatrical Cyc Light—six foot long)

LED SYSTEM BENEFITS

There are a number of advantages for solid-state lighting (SSL), aka LED lighting. LEDs last a very long time, with a source life of 50,000–100,000 kilowatt hours. LEDs are highly efficient at 60+ lumens per watt, and they have low power consumption and maintenance, no moving parts, no UV emissions, and no radiated heat (IR) from light. LEDs are digitally controllable, unaffected by cold temperatures and high vibration, and have a fast response, meaning they don't have to ramp up like a fluorescent or gas discharge lamp.

LED SOURCE EFFICACY (≠ LED FIXTURE EFFICACY)[8]

LED source efficacy is not the same as LED fixture efficacy. LED source efficacy measures how efficiently a LED **chip** performs. LED fixture efficacy refers to how efficient the **entire lighting fixture** is. It measures the efficiency ratio of the total amount of lumens output by the luminaire to the amount of electricity required to power the light fixture. This means that luminaire (fixture) efficacy is more important to designers when comparing different lighting solutions.[9]

Greater LED efficacy allows more light to be produced with less power at lower operating temperatures. Therefore, lighting manufacturers and designers can choose to decrease the number of LEDs, reduce the light source size, reduce electrical power input, decrease the number of LEDs, increase light output for a given source size, and reduce the amount of generated heat.

The efficiency of incandescent sources has remained flat since the 1920s, as has that of halogens, which were developed in the 1950s. The only lighting technologies that have seen significant advancements in luminous efficiency are LED, and white LED, which saw a sharp

CASE STUDY

Lighting Design: Oculus Light Studio
Architect: Shubin+Donaldson Architects
Photos: ©Henri Khodaverdi

5300 McConnell
Playa Vista, CA

Project Description
"Conceptually, there were two main criteria for the project: illuminate the portal without any punctures in the metal and highlight the slatted screen. Ingrade linear uplights, luminaires integrated into door beams, and uplighting on canopies make this possible. The result is an inviting and comfortable nighttime environment that concentrates and amplifies the architectural features." – Oculus Light Studio.

Wall Washing
Wall washing allows linear accents to become part of the architecture. At 5300 McConnell a recessed wall wash was the ingrade linear uplight solution that helped the designers achieve their design goals. The 3000K output provided a consistent and soft glow of illumination by the entrance, the ideal amount of accent to reflect on the colorful architectural entry.

rise in the early 2000s. Today, the operating performance of LED lighting products is primarily limited by "droop," an efficiency fall-off that occurs with increasing current density in LEDs.

TYPES OF LED SOURCES

5mm LED vs. High Power LED

A 5mm LED is based on two leads and an epoxy housing. The chip is placed on the cathode lead with a reflector cup and then connected with a bond wire to the anode lead. The light is bundled by the reflector and the lens shape of the epoxy housing.

The heat generated in the chip has to travel through the cathode lead and solder, but the heat has difficulty escaping from the package. As more power equates to more heat, the power handled by a 5mm LED is limited. Secondly, epoxy is sensitive to blue light, and therefore, the lifetime of blue and white 5mm LEDs is limited. Epoxy is also vulnerable to over-temperature, therefore not suitable for higher temperatures.

A high power Philips LUXEON LED has a built-in ceramic base that serves as a heat spreader, on which the chip is placed. The cathode and anode leads are connected to pads on the bottom side of the ceramic base. A silicone encapsulant is placed on top of the chip. Due to the heat sink, the package can handle up to 5W. The materials used are each designed for more than 60,000 hours of operating lifetime.

SPONSOR INFORMATION

TARGETTI

Targetti specializes in the field of interior and exterior architectural lighting products and creative custom solutions that are developed in response to specific functional and aesthetic challenges. As one of the most respected and recognized manufacturers of sophisticated architectural lighting solutions, Targetti offers a wide range of indoor and outdoor architectural lighting and creative custom solutions for the U.S. market. We specialize in a variety of recessed downlights, linear and in-ground LED solutions made with the finest quality and craftsmanship.

Targetti products are sold in the U.S. exclusively through the Targetti Group North American headquarters located in Costa Mesa, California and Targetti USA sales representatives. For a complete listing of available products and representatives, visit www.Targetti.US.

QUIZ

1. Conventional lighting fixtures have been used for decades with known issues. Which conventional exterior lighting source had an issue with socket shadows?
   a. Incandescent
   b. Halogen
   c. Fluorescent
   d. Gas-discharge
   e. Metal halide

2. When were the first visible LEDs invented by Holonyak at GE?
   a. 1952
   b. 1962
   c. 1972
   d. 1982

3. Which of the following is a benefit of LED lighting systems?
   a. Long lasting
   b. Highly efficient
   c. Low power consumption and maintenance
   d. No UV emissions
   e. No radiated heat (IR) from light
   f. All of the above

4. _____ measures how efficiently a LED chip performs.
   a. LED source efficacy
   b. Color rendering index
   c. Lumen output
   d. LED fixture efficacy

5. Which exterior lighting technique is used to highlight dramatic shapes by placing the light source behind the item and lighting toward the main vantage point so that the light source itself cannot be seen?
   a. Uplighting
   b. Silhouetting
   c. Shadowing
   d. Grazing
   e. Washing

6. Which exterior lighting technique uses a wide-beamed light placed between the main vantage point and the surface to cast an even, gentle glow over the whole area?
   a. Uplighting
   b. Shadowing
   c. Moon lighting
   d. Grazing
   e. Washing

7. _____ determines how resistant an electrical device is to fresh water and common raw materials like dirt, dust, and sand.
   a. Ingress Protection (IP)
   b. Drive-over rating
   c. BUG rating

8. _____ are exterior lighting fixtures that are recessed into the ground, sitting flush with the surface, and are used for uplighting, floodlighting, and spotlighting.
   a. Ingrades
   b. Bollards
   c. Projectors
   d. Grazers

9. Used to light paths of egress commonly used for pedestrian pathways and accent lighting, _____ provide a more advanced feature rich luminaire with multiple optic options.
   a. Ingrades
   b. Illuminated Bollards
   c. Projectors
   d. Grazers

10. A _____ optic makes it possible to obtain a completely homogeneous effect on the wall, avoiding any bright stripes or separate beams that are typical of linear fixtures fitted with visible LED strips.
    a. Wall washer
    b. Wall grazer
    c. Spot
    d. Zoom

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Thinking Beyond Accessibility

Erick Mikiten thinks good design should work for everyone.

Erick Mikiten, AIA, was deeply involved in conversations about accessibility long before passage of the Americans with Disabilities Act (ADA) in 1990. A principal at Mikiten Architecture, Mikiten is an expert in the practice of universal design, defined as "the design of products and environments to be usable for all people to the greatest extent possible without the need for adaptation or specialized design." He sees building codes and the ADA as a bare minimum starting point—and implements that philosophy in a variety of building types, pushing boundaries in single-family homes and multifamily complexes to institutional facilities and commercial buildings.

As told to Katherine Flynn

When my wife and I started our firm, we focused on affordable housing projects. I was born into public housing in the Bronx, and my wife helped start a local nonprofit housing development company while in grad school at UC Berkeley. Our passion was to bring green building and artful design into the affordable housing sector, where each were lacking at the time.

Based on my personal experience as a lifetime wheelchair rider, I designed accessibility into those projects that was more thoughtful than the simplistic code requirements. That was always important to me, remembering the elements that I couldn't use as a kid in the 5,000-unit complex that my family lived in—the public facilities, the pools, and the playground—and a lifetime of other buildings that made me feel unwelcome. It was natural to design everything to be available to everyone, regardless of ability, regardless of age. It took years for that idea to be defined as universal design and come into the public consciousness, or at least the consciousness of the profession.

Early in my career, some firms I worked for pigeonholed me as an access technician. The main drive of why I wanted to start my own firm was to grow beyond that perception and find opportunities for artistic expression. Although I always approached projects from a universal design mindset, I often kept it in the background so that my clients wouldn't pigeonhole me. It took years for me to realize that these two ideas—accessibility and art—didn't need to be either/or; that my drive for sculptural expression could actually be the vehicle for inspiring people to do better universal design. So I started consciously integrating the two. People shy away from accessible design because they believe it will be cold and institutional. But as I tell our clients and the other firms I work with, the more deeply you understand the rationale behind universal design, the easier it integrates into beautiful buildings.

Keeping all people in mind benefits everybody at all times of their lives, which in turn, makes everyone feel welcome. And that's just good design. AIA

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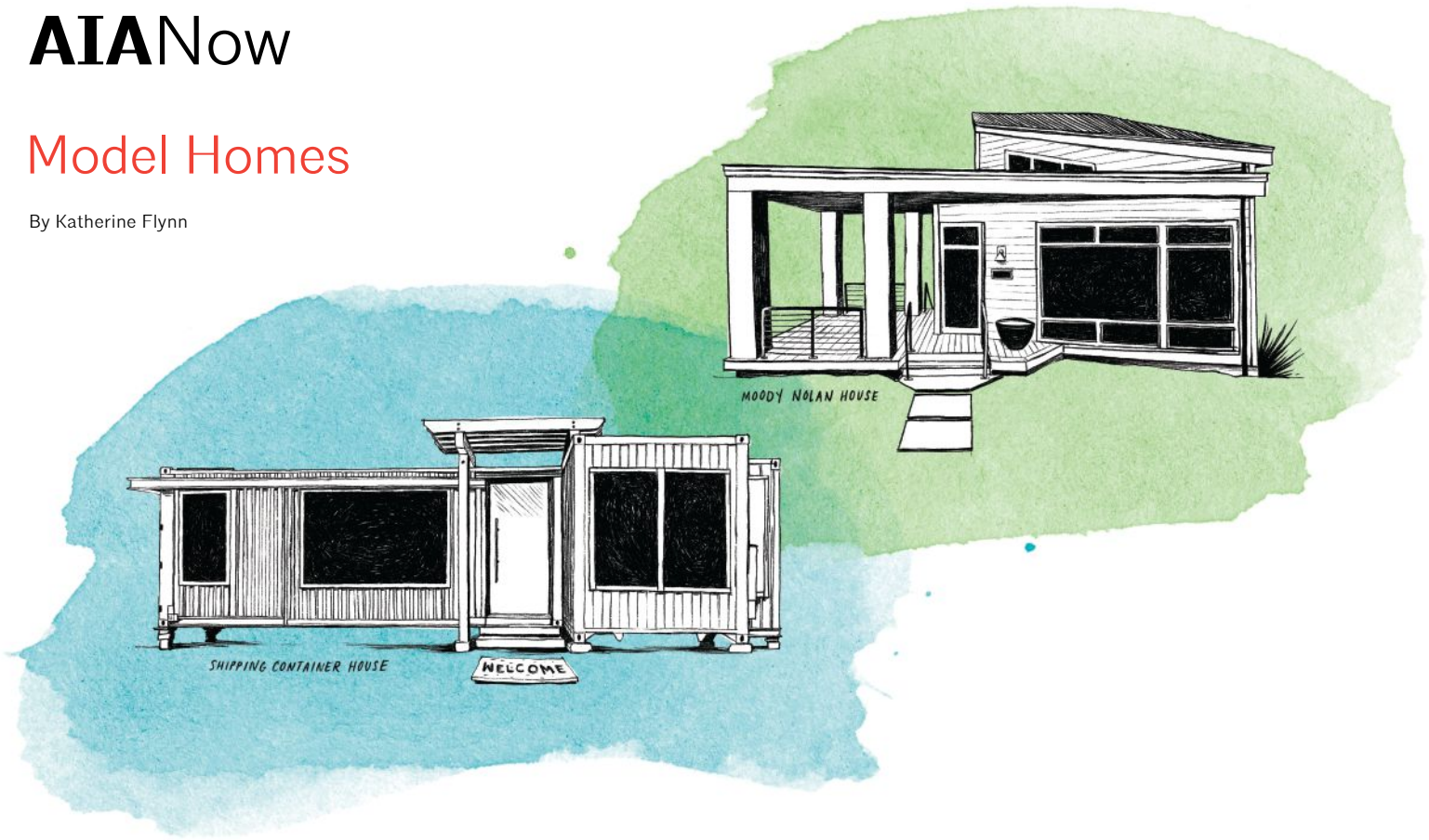
Vote by September 27, 2019. **aiafilmchallenge.org**

AIA Film Challenge

AIANow

Model Homes

By Katherine Flynn



CREDIT: LAUREN NASSEF

Moody Nolan in Columbus, Ohio, and Relevant Buildings in Oregon City, Ore., are providing new paradigms for what affordable housing can look like.

Shelter is a basic need, and across the country, the cost of housing has slowly been creeping beyond what many families can afford. Nearly two-thirds of renters say they can't afford to buy a home. Additionally, zoning laws are largely stacked in favor of single-family housing, limiting rental options.

In the spirit of seeing a problem as an opportunity, architects and other AEC industry innovators across the country are tackling shelter issues with more than just a blueprint—they're rolling up their sleeves and building them, too. These are just two examples in Ohio and Oregon.

Moody Nolan Legacy House, Columbus, Ohio

Jonathan and Curtis Moody, of Moody Nolan Architects in Columbus, Ohio, saw a dire problem in their city's underserved neighborhoods—a lack of investment in single-family residences. They envisioned the Legacy Project as a solution whereby families who were unable to afford a down payment on a house, but had the means to maintain one, received a mortgage-free home. The first Legacy Project House measures approximately 750 square feet with three bedrooms, a kitchen, two bathrooms and a family room. The first home was gifted to a family, selected by the YMCA of Central Ohio and Southeast Inc., at the end of February.

Moody Nolan, the largest African American–owned and managed firm in the country, operates 12 offices and is headquartered in Columbus. Planned as an annual gift, the Legacy project will involve the firm designing and overseeing the construction of a home in each of the 12 communities in which it operates.

Curtis Moody, a principal at Moody Nolan, says that the firm is already seeing the ways in which their commitment to this project is serving as an example for the profession and the larger industry. "The goal is that, as architects, we don't just do pro bono services and then walk away," he says of the model he and his firm are promoting. "It would be better if there's something really tangible that is left. Not just that we happen to help somebody, but that it lives on."

Relevant Buildings, Oregon City, Oregon

Relevant Buildings, headquartered in Oregon City, Ore., takes advantage of an underutilized resource—used shipping containers sitting empty in West Coast shipyards—to create the option of a more affordable and sustainable home.

Inspired by student housing in the Netherlands, founder Carl Coffman, a former excavation contractor, says that the company's goal is to be at least as cheap as a more traditional wooden house—while meeting code and producing a more durable product for a climate-changing world. "We hope our homes inspire others to consider man's impact on Earth's resources in a more sustainable fashion," he says. The company's offerings range from small accessory dwelling units (ADUs) to more complex three-container structures, and range in price from $50,000 to $230,000. Coffman hopes to sell future developments to nonprofits for use as affordable housing.

The homes offered by Relevant Buildings also have the advantage of being modular—an entire unit can be built and shipped to a construction site, and all models have a solar-ready option.

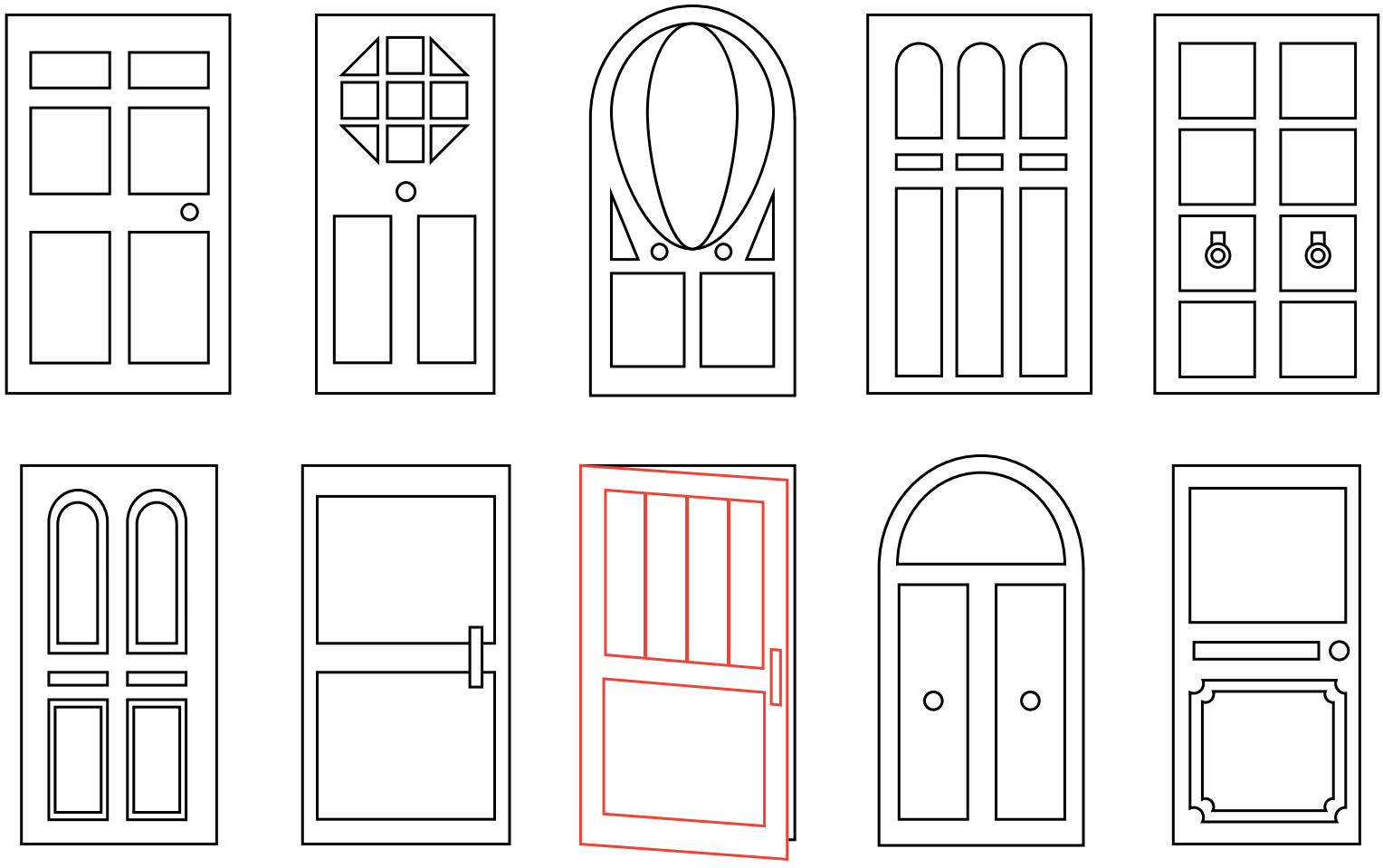
"We hope our efforts to provide a model of living in smaller, upcycled homes will jump start other initiatives in that direction, and provide a day-to-day reminder of our need to live lightly," he says. AIA

AIAFeature

Why Equity Is Crucial to Your Firm's Success

The growing movement toward a more diverse profession is supported by AIA's Guides for Equitable Practice.

By Kathleen M. O'Donnell



CREDIT: RACHEL JONES

"We all inhabit multiple identities," says Emily Grandstaff-Rice, FAIA. A senior associate at Arrowstreet and AIA at-large director, Grandstaff-Rice encourages her colleagues to think "we're architects and," so they will feel confident allowing their different identities to influence how they design.

According to Grandstaff-Rice, just as project teams need to include individuals of various skills and expertise, they should also include equal opportunities for people with diverse backgrounds and perspectives. The future of the profession depends on it.

Gender expression, race, ethnicity, sexual orientation, age, physical abilities, religion, and socio-economic status all influence our point of view and in turn, our contributions at work and in society. The acknowledgment that architects can—and should—use their experiences and background to inform their work is catching on. They just need the chance to do so.

"I define equity as the opportunity to engage in the profession of architecture," Grandstaff-Rice says. "It's really about being aware and breaking down barriers that might keep people away." Throughout her career, she's noticed a trend: a growing idea that you can "bring your whole self" to work. This trend may point to a cultural shift where diverse identities are celebrated, not diminished or ignored in the workplace.

Academic researchers, as well as architects like Grandstaff-Rice, have found that diversity in teams drives a high level of performance. "Well-managed diverse teams are utilizing their differences in a way that's productive, giving more points of view, more creativity, more innovation," said Renee Cheng, FAIA, dean of the University of Washington's College of Built Environments, from the AIA + ARCHITECT stage at the AIA Conference on Architecture 2019.

And what is architecture if not a profession that seeks to be more creative, innovative, and forward-looking?

Bringing Equity Into Focus at Firms

Cheng and Grandstaff-Rice were both central to the development of the AIA Guides for Equitable Practice. Under Cheng's leadership, work on the guides began at the University of Minnesota and moved with her to the University of Washington. Partnering with Cheng and her team, AIA's Equity and Future of Architecture Committee set out on a monumental task last year—to give architects the tools they need to address issues of equity, diversity, and inclusion in the workplace. The guides are a part of AIA's long-term commitment to "lead efforts that ensure the profession of architecture is as diverse as the nation we serve."

The guides currently have a total of six chapters available to everyone with internet access, covering topics of intercultural competence, workplace culture, compensation, recruitment and retention, negotiation, and mentorship and sponsorship.

"We designed them to be very accessible in order to convert intentions into actions," Cheng said at A'19. Each chapter provides case studies, a list of supporting resources, and tactical advice so any individual employee or group, regardless of role or position, can have productive conversations about equity and inclusion and make changes in the workplace.

At Arrowstreet, which was founded in 1961, Grandstaff-Rice has noticed "a larger inclusionary conversation" taking place among colleagues recently. She says that seemingly small acts of inclusion like asking about food sensitivities are reshaping the way employees interact day-to-day.

Actions towards achieving equity can be big or small, structural or informal. In addition to facilitated conversations, widespread change and commitments on behalf of firm leaders need to happen to ensure not only that their workplace is equitable, but that everyone has a chance to participate, and hopefully, succeed.

"The bigger move," Grandstaff-Rice says, "is being intentional about making connections with people who are different from you." To this end, Arrowstreet has established a buddy system for new employees to connect with established professionals in different studios, and the firm hosts in-office networking and mentoring events to encourage an open and collaborative environment. "You can't truly understand architecture or how it works without interacting with your co-workers," she states. "And even if you're a sole proprietor, you have many people outside of the office that you have to interact with just to get something done. It truly is a social profession."

For some firm leaders, equity and inclusion are at the heart of their mission. "Our practice and our business are shaped around our beliefs," says Mark Gardner, AIA, principal at New York's Jaklitsch/Gardner Architects (J/GA). Gardner and his partner Stephan

AIA Feature

CONTINUED

Jaklitsch, AIA, strive to hire employees with differing backgrounds and experience levels so their projects can be more reflective of the clients and communities they serve. They find the rich discourse that takes place in their office of eight contributes to more successful designs. "As a group, we tend to actually help shape and make something better," he says.

In recent years, J/GA has pursued more and more public projects, finding satisfaction in working with a range of stakeholders and community members. Gardner believes "it starts with the power of empathy and acknowledgment of difference."

"Being inclusive means that you're taking the extra steps to look for viewpoints and experiences that are outside of your own," Gardner says.

Inclusion means that people not only are included, but also feel included. That can be tricky for young people who don't see their identities reflected in schools of architecture or who witness others struggling in the profession itself.

The barriers to entering the profession are notably systematic in architecture, an industry with deep patriarchal and white male–dominated roots, as well as ableist and gender-normative ones. Coupled with the fact that young people of color and those with lower socio-economic status often don't have family members working in design fields, limited education about architecture in primary and high school curriculum persists. As a result, many don't even know that architecture school is an option. Those that do consider pursuing a degree are often discouraged because of limited funding, bias in the application review process, and exclusive or hostile environments at colleges and universities.

Having a Seat at the Table in School and in the Field

As an assistant professor of architectural practice and society at the New School's Parsons School of Design and a board member of the University of Pennsylvania Graduate School of Design, Gardner experiences firsthand the struggles that educators experience in engaging a diverse student body within design schools. Gardner and his colleagues challenge structures that have prohibited students, specifically students of color, from awareness of architecture and access to architecture education. "Everyone acts like the choices are outside them," he says about administrations who have looked the other way as the lack of diversity continues in academia.

"Being inclusive means that you're taking the extra steps to look for viewpoints and experiences that are outside of your own."
—Mike Gardner, AIA

He's found that being intentional and personal with outreach is crucial for educators, likening these efforts to a handshake. "You don't just stand there waiting for the other person to put their hand out. It's a mutual thing," he says. "You have to show that any particular group is welcome here, and in fact, you really want them to be there."

For Gardner and his fellow educators, it's an "ongoing struggle" to demonstrate to all students that they are welcome, and that their viewpoints are appreciated in architecture school. Getting students of diverse backgrounds in the door is one massive challenge. Providing proper support and guidance can prove equally difficult, he says.

That's a big problem for many practitioners, as well. When it comes to supporting and retaining women once they reach the workplace, the profession particularly continues to fail itself. "We've been graduating the same number of men and women for 20 years and we still have a problem," Grandstaff-Rice says.

When women are met with structural barriers, like unequal pay, a lack of comprehensive or flexible benefits, and little opportunity for growth, that cause them to leave the profession, their voices are lost and their seats at the table eliminated. The industry can't hope to have highly diverse teams when half the population has been sidelined for so long.

Seeding even deeper than structural workplace barriers, women are subject to bias (some unconscious, some conscious) that prevent them from working on complex and rewarding projects. Grandstaff-Rice says that there are common misconceptions that women are best suited to be project managers and are less technologically inclined. Getting past those assumptions is necessary for any firm leader, regardless of the size or location of the company. "If you're a two- or three-person firm," she says, "I think you [need to] ask yourself if you give equal opportunity to people regardless of gender."

Diverse Teams Make the Profession Stronger

While a lack of equity in the architectural workforce can be attributed to pipeline issues and workplace barriers precipitated by centuries of precedent, the potential negative implications of it expand far outward. Well-supported diverse teams not only improve office culture and employee morale, but they are better equipped to serve their clients and the public. Simply put, diverse teams "create solutions that are more relevant and of greater value," Grandstaff-Rice says.

Making thoughtful choices to achieve equity inside a firm is not only an ethical necessity, it's also what architects must do to withstand some of the challenges that are closing in on them. "We have to care about diversity, equity, and inclusion beyond the fact that it is the right thing to do," Cheng said at A'19. "It will ensure the relevance, success, and resilience of the profession."

Technological advancements and addressing the effects of climate change will define how buildings are designed and constructed in the coming decades, but architects can't solve the challenges of the 21st century alone, according to Cheng. "We have huge ground to make up," she said, referencing the changing influences to the way architecture is practiced. "We have to address this cultural issue, or we run the risk of missing out on those new technologies and opportunities."

Encouragingly, Gardner finds that the rising generation of architects are hungry to collaborate with diverse teams and that they inherently design more holistically, taking into account materials, energy, health, and well-being. He says their approach to thinking about how a building is made and how it affects its inhabitants and community is "at the very core of what we should be concerned about."

Including diverse perspectives also means going outside the world of the architecture firm. The AIA Guides for Equitable Practice give architects an opportunity to "lead a larger industry conversation," Grandstaff-Rice says. Engaging engineers, contractors, landscape architects, and urban planners will encourage a more connected, diverse, and equitable industry capable of addressing the environmental and social problems facing us all.

But architects must step up in their firms first. AIA

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Gen Z Is Coming. Is Your Firm Prepared?

This tech-savvy and entrepreneurial cohort has the power to change the workplace.

By Michele Russo

As we eye the opportunities and upheaval posed by rapidly evolving technology and societal shifts, it may be today's young people (known by demographers as Generation Z) that are poised to make the most significant disruptions. Architecture firms could prove to be in a prime position to attract today's youth, since the profession offers ample opportunity for unique expression while also advocating for the creation of a better world through concrete actions and increasing technology use.

Gen Z, with their technical savvy and tendency toward collaboration and individual expression, may be the best fit yet for the profession. However, there is a lot to be considered to attract, retain, and harness those traits.

To date, there has been notable study on the ways that millennials (born 1981–1996) have changed the workforce, and office culture in particular. For example, millennial influence can be seen in the emergence and growth of flexible and collaborative work

environments, telecommuting, and workplace benefits aimed at better work-life balance (i.e., things like paternity leave and flexible work hours). In some ways, the collaborative nature of architectural practice has made architecture firms better prepared for millennial influence in terms of workplace engagement. However, like many other professions, architecture firms are still working to create a culture that embraces the benefits demanded by the large cohort of millennials.

But as large a cohort as millennials have been, the oldest of the generation are nearing 40. As we envision the practice of the future, it is now to the subsequent generation—Gen Z—that we must look. The Pew Research Center defines Generation Z as those born from 1997 to 2012—spanning today's elementary school and college students, the oldest of whom are just starting to enter the workplace. This is the largest generation to date (estimated in the U.S. at 86 million, as compared to the 72 million millennials). This cohort already holds tremendous purchasing power, something unheard of in prior generations. Current estimates value their current consumer spending influence at $40 billion.

Profile of a Generation

Gen Z is a cohort with glimmers of the past. Socially, its members are in sync with their millennial predecessors. According to 2018 surveys by the Pew Research Center, 62 percent of Gen Zers believe increasing amounts of racial and ethnic diversity are good for society, equivalent to the 61 percent reported by millennials, and significantly higher than reported by earlier generations. They also share millennial views that the government should do more to solve problems, that the Earth is getting warmer due to human activity, and that same-sex marriage benefits our society.

In approach, it mirrors Generation X (born 1965–1980), the one that makes up the largest proportion of Gen Z's parents. They are similar in their pragmatism and work ethic. According to the University of Michigan's annual Monitoring the Future survey, high school seniors in 2017 were more willing to work overtime than their millennial peers, at levels that are on par with Americans in Generation X.

In circumstance, it also shares much in common with the Silent Generation, those born from 1928 to 1945, who emerged after World War II and the Great Depression during a time of economic disaster and recovery. Likewise, Gen Z came of age during a time of economic and social turmoil, following the Great Recession and 9/11. Their society is one plagued by global conflicts and wars, climate disruption, and school safety threats. It has led to a cautious generation, but one born at a time of opportunity.

Along with these commonalities, Gen Z has an identity of its own, bringing new energy and skills, as well as new challenges, to the workplace. Having never known a world without mobile devices, it is a group used to having information available all the time, and as a result they are both highly sophisticated online but also wary of the content they find there. They are constantly connected, but less so in person. They are realistic, yet still hopeful of a better future. They are economically cautious, yet highly entrepreneurial. And they are risk-averse—an attitude borne from a deep trust of adults coupled with economic insecurity.

Implications on Workplace Benefits

Given some of the unique demographic attributes of Gen Z, their arrival into the workforce will create significant disruption. For human resource managers, this cohort poses a number of new disruptions with regard to health challenges, benefits, and compensation.

Gen Z has a health crisis: A third of high school students get six or fewer hours of sleep a night, significantly lower than the recommended nine hours. Sleep deprivation leads to lower cognitive skills and negative health outcomes. Sleep quality is also lessening—attributed in large part to the increasing use of mobile devices whose screens emit blue light, which disrupts sleep patterns. Our incoming class of adults face an exhaustion level not seen before.

Additionally, over 30 percent of America's teens are currently obese or overweight, contributing to stress and negative health incomes. They will enter adulthood with the highest rate of obesity of any generation to date.

Depression, anxiety, and other mental health disorders have created a new health crisis in today's youth. According to a 2016 study published by the American Academy of Pediatrics, 19 percent of adolescent girls and 6 percent of adolescent boys had a major depressive episode during their teens—a significant increase from 2005 to 2014. And one in eight college freshmen in 2016 felt depressed frequently, according to an annual study by UCLA.

In order to accommodate this new workforce, well-being benefits packages will become even more critical. Gen Zers enjoy competition, so step challenges and other "games" that are part of today's wellness programs should continue. However, wellness programs will need to focus more heavily on access to healthy foods and improving sleep.

According to one survey, 72 percent of high school students want to run their own business.

This may mean the elimination of vending machines in favor of easy and affordable access to healthy food, water, and snacks. It may also mean instituting "nap times." While most companies today would scoff at allowing naps in the office, there is ample evidence of the cognitive benefits of 20-minute naps. For workers with a lifetime of sleep deprivation, sleep pods and daily nap breaks may be one of the best ways a firm can improve the performance of its employees.

Impact on Workplace Culture

Gen Z is the most diverse generation in our history—48 percent are not white, compared with 39 percent of millennials and 30 percent of Generation Xers. As such, they will look for a culture that embraces diversity, equity, and inclusion.

Gen Zers are also very brand savvy, feeding into their individualistic entrepreneurial attitude. According to one survey, 72 percent of high school students want to run their own business. Some children and teens are already using YouTube as a platform for creating a brand and reaping financial reward. In this ethos of sharing, they also disclose salary information as well as other aspects of the organizations they engage with. It is a cohort that expects transparency and authenticity—and will reward it with their time, money, and loyalty.

It is also a generation that craves financial security. According to an annual survey by UCLA, 82 percent of current college freshmen think being well-off financially is important, higher than any class going back to the start of the survey in 1966. Many are eschewing more elite schools in favor of more affordable college to reduce the student debt plaguing millennials today.

Therefore, firms will need to consider these trends of diversity, transparency, and financial security to attract and retain staff. Firms that embrace transparent and inclusive policies, such as salary and wage transparency, will be rewarded.

Professional Training and Development

Gen Z will bring tremendous technological savvy and skill to the workplace. They fluidly consume and research information online,

AIAFuture

CONTINUED

and despite some perceptions, do not blindly trust online content. According to a study by Common Sense Media, only a quarter of children think that news posted online by news organizations and people they are close to is very accurate, and even fewer (only 7 percent) think news from people they don't know is very accurate. These online skills will be ones that workplaces should embrace and nurture, rather than try to stymie. Technology is rapidly changing. Your Gen Z employees may help you stay competitive as this change occurs.

In contrast, Gen Z will, in general, bring less experience with interpersonal skills. In a 2016 national survey, 92 percent of teens were concerned about the gap in their interpersonal skills, something deemed highly important in most professions, but especially for architecture firms where the relationships with colleagues and clients often define a firm. Firms should be prepared to have to build these skills.

Unlike their millennial predecessors, Gen Z does not necessarily expect to jump from workplace to workplace. Furthermore, a large portion of Gen Z is used to having supportive adults engaged in their development. Firms can look to link Gen Z employees up with leaders from prior generations to share institutional knowledge. Similarly, this cohort can develop teaching and communication skills by helping less-technologically savvy colleagues become more adept.

Harnessing Passion

One of the most exciting aspects of this generation is its passion for social change and its natural inclination to take action. Their natural pragmatism, combined with global connections and the power of social media, have shaped a generation that is using its collective talents to improve society. They are responsible for organizing the 2018 March for Our Lives, invigorating a nationwide movement protesting gun violence in schools. They are also leading the way in prompting climate action: 1.6 million students in 300 cities around the world marched out of school for climate action in March 2019 and a group of teens has sued the U.S. government for failing to protect them from climate change.

Generation Z will become the largest portion of our workforce in the next two decades. Between social activism, technological savvy, and creative entrepreneurial energy, there is great potential for Gen Z to provide an exciting new workforce for architecture firms.

They are coming. Are you prepared? AIA

AIAPerspective

PHOTOGRAPHY: GREG POWERS

21st-Century Leadership

Fostering a more inclusive profession is everyone's job.

As the 2019 President of The American Institute of Architects, I have had the honor to learn from and listen to colleagues from across the nation and around the world. Those interactions have reinforced what I always knew: Our similarities, as people and as professionals, far outweigh our differences.

We don't all speak the same language, come from the same family background, or share the same cultural heritage, but we do share a commitment to advancing our communities and our societies through the power of design.

Today, architects are finding ways, both small and large, to improve the profession's environmental stewardship of the built world. In the years ahead, we must commit to leaning into this effort. I am proud of the clear direction of the board, Strategic Council, and members to seize the leadership moment presented by climate change, and I look forward to sharing the first steps in AIA's years-long effort to lead on this issue.

However, leadership in the 21st century takes more than noble ideals and a clear vision. Today it requires the inclusion, innovation, ingenuity, and leadership of everyone.

As a profession, we are becoming more diverse, but it's taking place slowly—especially in comparison to the society we serve.

For example, 46 percent of students enrolled in schools of architecture are women, up from 25 percent in 1985. In 2016, women accounted for 36 percent of newly licensed architects. That's substantial progress, but we have a considerable way to go. After all, women make up 51 percent of the total population and 56 percent of all college students.

On the issue of race, progress has been harder to achieve, especially concerning African Americans and Hispanics. Currently, about 13 percent of college students identify as African American and a little more than 18 percent identify as Hispanic. In contrast, African Americans account for roughly 5 percent of architecture students.

Further along the career pipeline, roughly 19 percent of new architects identify as nonwhite. These statistics stand in sharp distinction to prevailing national demographic trends. For example, 39 percent of millennials self-identify with a race or ethnicity other than white, about double the share of the baby boomer generation at the same age. And according to census data, 48 percent of Gen Z (post-millennials) identify as nonwhite.

To help facilitate and advance the critical conversations needed to expand the pipeline of women and minorities into architecture and to retain them throughout their careers, AIA's Guides for Equitable Practice, created in partnership with the University of Minnesota and AIA's Equity and Future of Architecture Committee, continue to facilitate necessary discussions about fostering a more inclusive profession.

I am convinced that as we expand the definition of who is an architect, we will extend what architecture can accomplish. As firms and schools conduct critical conversations to better understand and eliminate the barriers and biases that challenge underrepresented groups in the profession, we will dramatically improve, impress, and ultimately inspire the society we serve through diverse design thinking.

To lead, we must be more diverse—as diverse as the population we serve. All of us have a critical role in ensuring that the talent and perspective of everyone, without regard to race, age, socio-economic background, or gender, is included in our effort to create a more equitable, compassionate, and environmentally responsible built world—and, by extension, society. AIA

William Bates, FAIA, 2019 AIA President

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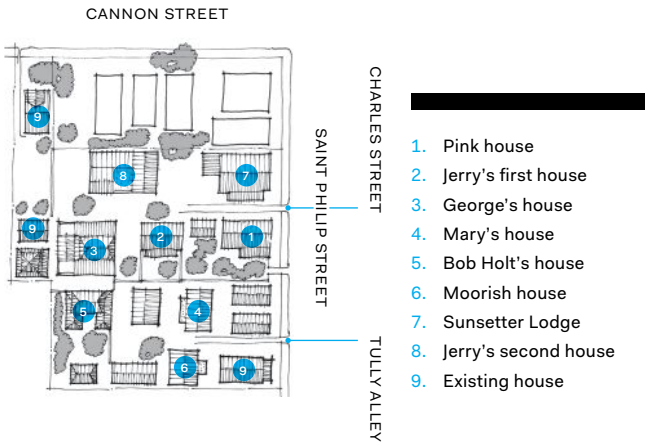
“Tully Alley did not develop according to a master plan. Like Topsy, it just grow’d. This contributes to the impression of an old established place.”

A Portrait of Organic Growth in Charleston by Witold Rybczynski, HON. FAIA

This is the story of how a quirky group of amateur builders, working organically and without a grand plan, achieved that most elusive of urban qualities: a sense of place. The setting is Charleston, S.C., in the mid-1980s. George Holt is a 26-year-old college dropout with an interest in old architecture and building but no experience. With two friends, Jerry Moran, a serving U.S. Air Force pilot, and Cheryl Roberts, who had been managing a large toy store, he founds Historic Renovations of Charleston, a construction company. George is the contractor and designer; Jerry has the building experience and an actual credit rating; and Cheryl takes care of the business side. They buy an old house that had been repossessed by the Veterans Administration, fix it up themselves, and live in it while they are doing the work. Their second house, a derelict, is a more ambitious project and requires jacking up the structure while building a new foundation and first floor. They keep the properties, rent them out, and look for more opportunities. That's how they start.

Renovating old houses was hardly an original idea in Charleston in the 1980s. Thanks to a dynamic new mayor, Joseph P. Riley Jr., a world-famous music festival, and an increase in tourism, Charleston was experiencing a small real estate boom. The city had a long history of historic preservation, but Mayor Riley had brought new energy to the conservation of its architectural heritage. The historic center of Charleston, unlike most southern cities, had escaped the ravages of 1950s urban renewal, and its beautiful antebellum houses had become a major cultural attraction, not only for tourists but for wealthy second-home buyers. The main building activity was in the venerable historic district, but a few adventurous souls, like George and his pals, were buying old houses in run-down neighborhoods farther north on the peninsula.

The lot on Saint Philip Street, with pink house at far right



1. Pink house
2. Jerry's first house
3. George's house
4. Mary's house
5. Bob Holt's house
6. Moorish house
7. Sunsetter Lodge
8. Jerry's second house
9. Existing house

COURTESY NEW WORLD BYZANTINE; SITE PLAN: WITOLD RYBCZYNSKI

A Good Deal in a Rough Neighborhood

In 1991, George came upon a large lot on Saint Philip Street. The L-shaped property included four houses, all vacant: a large house on Saint Philip, a tiny masonry house behind it, and two derelict houses around the corner facing Cannon Street. Elliotborough was a rough neighborhood known mainly for open drug dealing and consisting of dilapidated houses and scores of vacant and boarded-

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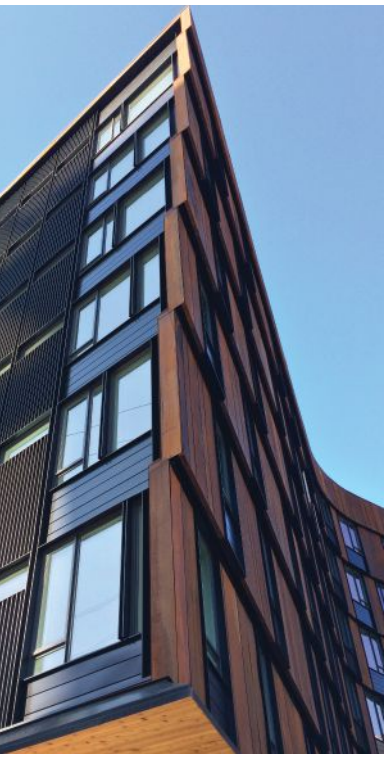

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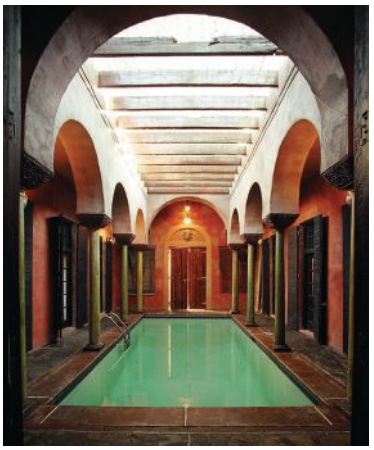

George's Byzantine-inspired house, which features an enclosed swimming pool

COURTESY NEW WORLD BYZANTINE

up structures. "I thought it was a good deal, in spite of that," George remembers. The Medical University of South Carolina and the College of Charleston were nearby, and they were a potential source of tenants. King Street, Charleston's main shopping street, was only a block away, although this end of King was distinctly seedy, lined with pawnshops, thrift shops, and empty storefronts. It was only a matter of time, George reasoned, before the neighborhood revived. The lot cost $78,000, the company's largest investment to date. As was common in Charleston, the lot was very deep—200 feet—so there was plenty of room for additional buildings. But that was in the future. "We didn't have anything specific in mind," says George. "At that point our plan was to fix up the old houses and rent them out."

About two months after the sale, something unexpected happened: The large house on Saint Philip Street collapsed—it simply fell down. Fortunately, it was still unoccupied; George had been negotiating with a local theater company that wanted to rent it for rehearsal space. "It looked okay inside," he recalls, "but the foundations turned out to be really bad." As a replacement, George drew up a three-story structure—his first design—with a two-bedroom apartment on the first floor and a four-bedroom dwelling with a tall veranda above. While this was under construction, he renovated the little masonry house in the rear and an acquaintance bought it for about $80,000, which covered the initial investment.

The two boarded-up houses facing Cannon Street had been empty for a long time. The smaller one in the rear dated back to the early 19th century, but since it had been renovated in the 1930s, it did not require much work to turn it into rental apartments. "The front house on Cannon Street had been unoccupied for years when we bought it, and we discovered that it was being used as a squat and a shooting gallery by crack and heroin addicts," George recalls. "We hired a hazard cleaning crew to clear out all the needles, waste, and debris, and converted it to a rental property." Despite the rundown neighborhood, both rentals were successful. "Our tenants were mostly young downtown restaurant and bar workers who didn't make the sort of money that's typical today. They couldn't even scrape together enough cash to make a security deposit, or pay a full month's rent in advance, so we screened carefully and rented by the week."

Byzantine Architecture Comes to Charleston

The back half of the lot on Saint Philip Street was empty. After a year, George, Cheryl, and Jerry decided that they should do something with the vacant land. It was time to build houses for themselves, one with apartments for George and Cheryl, and another one for Jerry. George was a Navy brat who had been born in Spain and grown up on various naval bases, including in Istanbul. He loved Byzantine architecture, and he based his house on an 11th-century domed church, the Church of the Holy Savior in Chora. Because he was the contractor as well as the designer, he was able to do unconventional things, but his use of recycled materials, of columns that were slightly out of plumb, and of a barely perceptible asymmetry were not efforts at artificial aging but rather an attempt to incorporate what he saw as an essential quality of Byzantine architecture. He made the exterior of the house nondescript so that it did not seem out of place in the neighborhood—the magic was all on the inside. The entrance was an arcaded atrium with a swimming pool. "That was Cheryl's idea," says George. "She wanted a pool for exercise. I had designed an entrance court between our two apartments, so that seemed the best place to put it. She didn't want the bother of cleaning leaves and debris, so I put a roof over it." Jerry's house was more conventional, two stories with stepped gables and an attic with dormers; small, but with the luxury of a walled garden.

George painted the exteriors of the stuccoed houses different colors: the house on Saint Philip Street was pink, Jerry's was adobe-colored, and his own was white. The colors and the walls and arched gateways enclosing the backyards recalled a Mediterranean village. The walls were not decorative—they were there for security. After they moved in, George and Jerry discovered that conditions in the neighborhood were much worse than anything they had experienced elsewhere. The vacant houses had attracted a flourishing drug trade, crime was widespread, and

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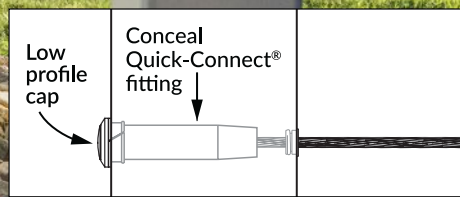

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drive-by shootings a regular occurrence. George and Jerry installed floodlights. When that didn't work they took other measures. "We reckoned that if we could discourage the drug buyers, who were chiefly college students who lived elsewhere, that would disrupt the drug trade," George explains. At that time, Charleston police officers were allowed to moonlight in their off-duty hours as security monitors in stores and bars. "We hired the officers for two or three late-night shifts a week at random times to ensure a lack of predictability, and asked them to park their squad cars out front, on the street. Things would get really quiet during those times." Eventually, the drug buyers stayed away, and the dealers, who were likewise not from the neighborhood, took their business elsewhere.

The house immediately behind Jerry and George's homes was another source of aggravation. The broken-down duplex contained an illegal bar where drug

The Moorish house with its striking porch

dealing was rampant, and the parking lot was the site of nightly fights and occasional shootings. George and Jerry spoke to the absentee owner who indicated that he was willing to sell. The problem was the price, almost twice as much as George and Jerry had paid for the first lot. They needed an outside investor and George approached his brother Bob, who was interested in building a house for himself. Pooling their resources, they bought the lot, evicted the tenants, and tore down the duplex. Bob reserved the back part of the lot for his own house. That left space on the property for four small houses. The architectural style of the four houses was unremarkable: gable roofs, clapboard siding, traditional details. The exteriors were painted different colors—yellow, green, aquamarine, plum; Bob's house was white. To provide access for parking, George laid out a narrow lane down one side of the lot. Because Jerry's sister, Mary Turner, was the first resident, they asked her to name the lane, and being of Irish descent she settled on Tully Alley.

When a lot next door to the alley came on the market in 1998, despite the high asking price, they made an offer. Bob bought the back third of the new lot that adjoined his property, which allowed him to enlarge his garden and add a guesthouse. There was space remaining on the lot to build two additional houses. The first was rather conventional: a pretty pastel-pink cottage with shuttered windows and an airy second-floor veranda. The second house was different. "I wanted to have some fun," George says. He designed a striking entrance porch with Moorish pointed arches and square columns topped by low-relief capitals. The porch was cast in concrete in a single pour using elaborate sculpted molds; the balcony above included a balustrade with concrete grilles and ornamental urns. The stucco walls of the house were painted with an orange wash the color of marigolds. The interior was similarly exotic. George worked with a team of cabinetmakers, who paneled the walls in black walnut. The vaulted living room had a massive fireplace decorated with a relief pattern of swirling acanthus leaves that George had seen in a Byzantine church.

A Gamble That Paid Off

George and Jerry were turning into experienced developers. A decade after they had bought the first lot on Saint Philip Street, the neighborhood had slowly improved. Vacant houses were renovated, abandoned corner stores were turned into coffee shops, bakeries, and restaurants, boutiques popped up here and there. In the process, real estate values and rents went up. One of the small houses on Tully Alley that had sold for $220,000 in 1995 was resold six years later for more than twice as much. As for the Moorish house, it fetched the princely sum of $595,000. Their gamble was paying off.

In 2000, shortly after George finished the Moorish house, he was approached by the owners of the property immediately adjacent to the pink house on Saint Philip Street. The Sunsetter Elks Lodge was a fraternal order that used the old house as a social club.

COURTESY NEW WORLD BYZANTINE

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Architect: Smithgroup JJR
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George recalls the members well: "The Sunsetters were a fun group of older black men who had boisterous weekly outdoor fish fries with often more than a hundred people. I was invited to hang out and did so on a few occasions. There was a clubhouse-type bar and grill for members in a series of cobbled together additions. They only used the ground floor of the house due to years of a dilapidated roof letting water into the building. The place was in bad shape."

The lodge was interested in relocating, not only because of the poor condition of its building—and insufficient parking—but chiefly because most of its members had moved out of downtown Charleston. If the Sunsetters could sell the old house they could buy a newer building in the suburbs of North Charleston, close to where the majority of their members now lived. The lodge had acquired the old house on Saint Philip Street in the early 1980s for $24,000; two decades later, thanks in large part to George and Jerry's efforts, the property was worth considerably more: the asking price was $280,000—the Sunsetters eventually settled for $240,000. "That was three times as much as we paid for our first property," George said, "but it was the last piece we could buy, and the deep lot had space for as many as three additional houses." The new lot was also wide enough to accommodate a narrow lane that would provide car access all the way back to George's house; they called the lane Charles Street. Jerry bought the property and immediately resold the rear lot to George and the front house and one building lot to Bob.

Jerry kept the center lot for himself. He had decided to build a new house. "My first house was the equivalent of a starter home," he explained. "I wanted more space as well as income-generating apartments." George designed a U-shaped two-story building resembling a Roman villa with a second-floor terrace, sitting on top of three small guest apartments and a carport. A roof deck provided splendid views across the city. It was not a shy building. The exterior was painted pink and ochre with green shutters. A giant order of Tuscan columns supported an architrave across the face of the raised terrace.

The raised Roman terrace of Jerry's house

COURTESY NEW WORLD BYZANTINE

The sort of inner-block development that George, Cheryl, and Jerry were engaged in was not unusual in Charleston. Space on the peninsula had always been in short supply, and the city had a long tradition of small outbuildings—slave quarters, carriage houses, artisans' dwellings. The modern zoning code encouraged what city planners call infill development—adding dwelling units to the rear of lots to increase neighborhood density. The zoning along Saint Philip Street, for example, allowed a maximum of 35 percent coverage—that is, buildings could occupy up to 35 percent of the ground area. That meant that a typical deep lot could accommodate as many as three or four additional houses—as long as they were small. The exact number was dictated largely by the city's parking requirements: two car spots for each free-standing house, one-and-half for each rented apartment. Tully Alley had seven houses; Charles Street had five houses with space for two more. The lots were combined into a single property, which was owned in condominium. The advantage was that all the open space, whether it was a lane, a parking spot, or a private garden, was counted together. The nature of the private outdoor spaces varied; some houses had courtyards or walled gardens, others made do with a veranda or a porch.

A Portrait in Organic Growth

Tully Alley and Charles Street, which comprise almost an acre, did not develop according to a master plan.

Like Topsy, they just grow'd. This seemingly haphazard way of building contributed to the impression of an old established place. Speculating about the beauty of old towns, the celebrated art historian E.H. Gombrich wrote: "The very conditions of slow and unplanned growth may sometimes be productive of qualities that are hard to imitate by deliberate planning." Gombrich called this quality organic.

The architect and theorist Christopher Alexander uses the same term to describe beautiful old towns in his 1987 book *A New Theory of Urban Design*: "This feeling of 'organicness,' is not a vague feeling of relationship with biological forms. It is not an analogy. It is instead, an accurate vision of a specific structural quality which these old towns had … and have. Namely: Each of these towns grew as a whole, under its own laws of wholeness. … and we can feel this wholeness, not only at the largest scale, but in every detail: in the restaurants, in the sidewalks, in the houses, shops, markets, roads, parks, gardens, and walls. Even in the balconies and ornaments."

First, Alexander writes, organic urban growth is piecemeal, occurring bit by bit. This is certainly the case with George, Cheryl, and Jerry's project, which was built over more than a decade. The parts are not uniform. George, Jerry, and Bob's houses are the largest, the old masonry house on Charles Street is the smallest, and there are many sizes in between. Since the houses were not all constructed at the same time—and some were built a long time ago—there is the same pleasant variety that we take for granted in old towns, but which is missing in brand-new developments, whether they are public housing projects or upscale planned communities.

Second, according to Alexander, organic growth is unpredictable—that is, the end result is not necessarily apparent at the beginning. The earliest houses on Tully Alley are straightforward, almost generic—pitched roofs, dormers, balconies—and the two unprepossessing houses that face Saint Philip Street are almost identical, except that one is painted plum and the other aquamarine. George's self-effacing

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house is almost invisible; on the other hand, the theatrical Moorish house and Jerry's Roman villa stand out like hothouse flowers. There is a similar variety in the nature of the private outdoor spaces: a mixture of porches, balconies, verandas, terraces, and walled gardens. The front doors are carefully located, generally—but not always—to create intimate semipublic spaces in front of the house. Houses that face the street line up with their neighbors, whereas houses inside the block face different directions. As in a medieval European town, you are never quite sure what you will find around the corner.

Alexander's third organic feature concerns coherence: piecemeal growth should not result in a jumbled free-for-all, the fragments should adhere and form a harmonious whole. Coherence contributes to what architects call a sense of place. Not all coherence is the same, however. A conventional parking lot, for example, is coherent, but it is a mechanical sort of coherence: the entire surface covered in asphalt, the regular white lines of the parking stalls, the uniform lighting fixtures. One parking lot looks pretty much like another. The parking in Tully Alley and Charles Street is different: cars are sometimes parked in front of houses, sometimes alongside a lane, sometimes in an auto court, and sometimes under a covered carport. The lanes are paved with old bricks dug up on the site, and some of the parking spots are paved. The parking court outside Bob's house is paved with stone slabs, while the parking lot in front of the pink house is gravel, the stalls demarcated by thin stone strips. While an asphalt parking lot appears orderly, the parking on Tully Alley and Charles Street represents a richer order—of different textures, materials, and scales.

Tully Alley contains bollards to protect exposed building corners from being damaged by carelessly driven vehicles. Such devices are commonly steel pipes painted safety orange; in other words, they are eyesores. On Tully Alley they are square masonry piers topped by slightly projecting imposts made of flat tiles; at the corners of the Moorish house the imposts are pyramidal. Not much of a difference, just enough to signal that somebody cared. Which is Alexander's fourth and final feature: an organic place must be "full of feeling." He is referring to the impression that a place has been thoughtfully made, that it has a human imprint. That is something that Tully Alley—like so much of the old city of Charleston—most certainly demonstrates.

This essay was adapted from Witold Rybczynski's most recent book, Charleston Fancy: Little Houses & Big Dreams in the Holy City*, which is published by Yale University Press.*

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Housing Laboratory Apan, Mexico MOS and ...

... 1. De Villar-Chacón Arquitectos, 2. Frida Escobedo, 3. Dellekamp + Schleich, 4. Rozana Montiel Estudio de Arquitectura, 5. Ambrosi | Etchegaray, 6. Zooburbia, 7. Zago Architecture, 8. Taller | Mauricio Rocha + Gabriela Carrillo, 9. Taller de Arquitectura X, 10. Griffin Enright Architects, 11. Tatiana Bilbao Estudio, 12. Francisco Pardo Arquitecto, 13. TEN Arquitectos, 14. Pita & Bloom, 15. BGP Arquitectura, 16. Zeller & Moye, 17. Accidental Estudio de Arquitectura, 18. Nuño MacGregor De Buen Arquitectos, 19. SAYA + Arquitectos, 20. Cano|Vera Arquitectura, 21. Fernanda Canales, 22. RNThomsen Architecture, 23. Productora, 24. Agraz Arquitectos, 25. Rojkind Arquitectos, 26. Tactic-A, 27. Gaeta-Springall Arquitectos, 28. Taller ADG, 29. Taller 4:00 A.M., 30. CRO Studio, 31. JC Arquitectura, and 32. DCPP Arquitectos

IWAN BAAN

TEXT AND INTERVIEWS BY KATIE GERFEN
PHOTOS BY IWAN BAAN
HOUSE PHOTOS BY JAIME NAVARRO

Why a Housing Laboratory?

A campus of house prototypes explores solutions for affordable housing in Mexico.

Affordable housing—how to provide enough of it, and how to improve the quality of it—is hardly a uniquely American crisis, and nations around the world have different approaches to fixing the issue. In Mexico, the Institute for the National Fund for Workers, or INFONAVIT, was established in 1972 to help working-class and low-income citizens secure permanent housing. In 2018, INFONAVIT issued its 10 millionth mortgage—more than 3 million of which, according to a government press release, were issued between 2012 and 2018. But according to a 2017 World Bank report, "Most Mexicans cannot afford the cheapest formal house produced by the market. This type of unit (known as *vivienda económica*) costs around MXN225,230," (about US$11,812 as of July 2019). The report says that the *vivienda económica* is affordable for households earning around three times the minimum wage but accounts for just 13 percent of the units produced—a result of high land costs in urban areas. The remaining units produced are more expensive and, to many, even further out of reach.

To analyze how to better serve its constituents, INFONAVIT's Center for Research for Sustainable Development launched a program to solicit new approaches to affordable housing. Former deputy director for sustainability Carlos Zedillo Velasco, who studied architecture at Yale University, commissioned 84 design firms from Mexico and the United States to design prototypes for dwelling units optimized for different states and climate zones across the country; he was assisted in his efforts by colleagues including former manager of housing quality improvement, Julia Gómez Candela. To better understand the possibilities, and to better educate developers, workers, and students about the research, INFONAVIT engaged New York–based firm MOS and its principals Michael Meredith, AIA, and Hilary Sample, AIA, to help narrow the schemes to 32, develop a master plan for a campus of built prototypes, and design an education center to promote awareness about them. The campus, in the town of Apan, about 50 miles northeast of Mexico City, was completed earlier this year. (When Andrés Manuel López Obrador defeated incumbent Enrique Peña Nieto in the 2018 presidential elections, many of the stakeholders at INFONAVIT, including Zedillo Velasco and Gómez Candela, left, either before or shortly after construction at Apan was complete.)

Developing a Research Directive

Zedillo Velasco: When I arrived at INFONAVIT, the first thing I noticed is that the institute was financing a number of homes, more than 1,500 per day, but there was no involvement with architects whatsoever. As an architect, I explained to them the importance of having architects in the discussion of low-income housing. That involvement had stopped for several years in a lot of Latin American countries, but particularly in Mexico, where only politicians and private developers were included. So we spent a lot of time talking to architects about how important design was for low-income housing.

Gómez Candela: For almost six years, we studied the state of low-income housing in Mexico. We identified that under previous housing policies, big developers or companies could build the same house in Tijuana or Oaxaca, even though the weather, lifestyle, materials, and family composition and income [in each region] were completely different. We identified a big problem with abandoned houses, housing retrofits, and a lack of appropriate spaces in housing projects in cities. And there were no policies concerning rural or self-built houses, a complete disregard for city densification, etc.

Zedillo Velasco: It was really important to show how houses should perform differently from one territory to the next. We began a project called "From the Inhabitant to the Territory," which started as a research process to understand the basic needs of people living in different towns across the country.

Commissioning Designs for Change

Zedillo Velasco: One of the big mistakes we make when talking about low-income housing is that we try to analyze it as if it is a thing all its own. But, it's actually just architecture and modifying territory. We need architects, academics, and researchers from a number of spaces to join the effort to figure out how to solve this issue. That's why, from the moment we started the research, we thought that [the schemes] should be approached by different firms. I don't believe that low-income housing can be replicated: There are things

Unlike Mexico's traditional courtyard urbanism, MOS conceived the Apan complex as an open landscape, with freestanding houses, planters, and a water tower.

in the process that can be reproduced, but the idea of replication itself has had tremendous [negative] effects over the territory, culture, and sustainability overall. That's why we reached out to many professionals, some who had past experience, and some who were on their first commission in housing. We wanted to look outside of the box. And by the time I left INFONAVIT, we had engaged with more than 700 architecture firms around the world.

Narrowing the Options to 32

Sample: The houses were originally designed with a small footprint, but the idea was that they could also be added on to and multiply themselves. We considered that in the selection. [The architects were] effectively designing a house for each state, roughly broken down to 10 different microclimates. Some houses have to really consider earthquakes, others had to think about heat and humidity. And they all had to think through conditions of culture—whether that's issues around the kitchen, how you work outside, whether you have screens, or if things are closed up.

Meredith: We tried to choose houses that could be built [on a tight budget], but that also deal with typological thinking about architecture and vernacular sensibility—that weren't trying to produce extravagant forms.

Crafting a Master Plan

Sample: INFONAVIT owns quite a bit of land in Apan, but a majority of the site relative to where we built already had housing on it. So, in a way we were somewhat limited by the shape of the rectangle. One of the things we observed was people walking across the site: It's very much a place that is traveled through by foot, and we preserved that through the different paths that run through the education center.

One of the most important and challenging parts was the organization of the houses. What we were most excited about is the way that they could interface with each other, producing social spaces in between where we designed small-scale landscape elements.

Meredith: In my mind, it's between a Weissenhof Estate model of social housing and an expo, and the approach to the urban plan was to think of it like a kind of garden. We tried to keep the north orientation of the buildings like it is in their proposals. With this project, we didn't really have to worry about property lines in the same way. Typically in Mexico the property line is marked by a fence or a wall, and then the garden inside is very inward facing. We wanted to explicitly make a focus on a shared space that's not necessarily

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the street where the cars go, but a landscape space that people share. We tried to place the houses on the site according to the states that they're designed for, so there's a rational, didactic kind of organization.

The understanding is that social housing is not a place for architecture, and is highly repetitive: There are acres of the same house repeated, marching along in a kind of grid—pure economics at work. The whole point of this plan is trying to present alternatives—trying to think about other possibilities for houses in general. It's very optimistic and utopian at some level.

A Place to Learn About Low-Income Housing

Meredith: The welcome and education center [at the entry to the site] needed to be a boundary and also be porous. It's really a long building, but it's broken into four pavilions, more or less, and you can move through it. It's a dashed line—almost, in a way, literally. There's a lot of connection between inside and outside in that little thin building. And we didn't want it to read as an object like all the houses are objects.

Sample: We wanted to use local materials—the block we used was from a local plant, but we worked on changing the color slightly. We also wanted to provide a range of experiences through the building—from the shaded walkway, you can walk along and see all the different rooms, but also see the houses on the other side. We have rooms that have oculus skylights as large-scale openings, and we have real openings to the sky. The roof is accessible so you can go up and see the houses and the city beyond.

One of Carlos's mandates was that we had to have space in the building for a gallery to exhibit the drawings and the models [of the house prototypes]. The idea really is to bring students and others to visit.

Designing a Living Laboratory

Zedillo Velasco: For you to be able to insert yourself into the private developer world, you have to prove that it can be done. That's why the institute began doing formal research for the private developer to actually apply [in the field]. We were teaming up with several academic institutions around the world with the idea that private developers and researchers could go and spend time at Apan to discuss what was good and bad about the projects. And it could be a lab in which new technologies could be installed. So if someone had a mechanism for water conservation, they could actually go and apply it to one of the houses and measure it in real time, so that then some of these things could be applied for built housing. The idea was that it could be used as the main spot for people to go and question the idea of housing. To stand there on a beautiful spot and see that it is possible to do things differently.

Gómez Candela: The idea was to have students and architects live there and say, "Come on, these guys didn't put something in the window and now the water comes in … so there's a problem." We wanted to make the modifications to do it better, and, if one [prototype] doesn't work, to destroy it and build another version. The idea was to start making a living project of social housing and research.

Creating an Open-Source Library of Designs

Zedillo Velasco: The project started before the earthquakes in September [2017]. After, there was a lack of projects for reconstruction, and we had already done a lot of research about how to build. I think [making the designs available for free download on INFONAVIT's website] is a perfect way to be transparent about research—just putting it on public platforms to understand that the digital object can reach people much faster, in terms of actual construction. And that was the motive behind making these prototypes. The [online] library [of designs] made INFONAVIT the biggest housing and urban library in Mexico within a couple years.

Gómez Candela: We have some examples in Durango, a state in middle of the country, of a design [that someone downloaded and built]. They sent us photos. So people are doing construction themselves, and taking part with their families—it's very, very nice.

The Apan Housing Laboratory's Legacy

Sample: It would be exciting to think about a program that they could develop that drew people for conferences, symposiums, and residencies. Being so close to Mexico City and all of the people there working on issues of housing—from the U.N., to INFONAVIT, and others—it seems apt that this would be a place for success. Time will tell.

Zedillo Velasco: I heard that [the new administration] has good plans for [the Apan site]—they are engaging a lot of universities. And I think they have the most beautiful task. We were sitting in the lab, trying to find a cure, and a lot of those houses could be the cure for a lot of cities. Now they [the new administration] have the possibility of taking the medicine to the city.

I think what this exercise proves is that housing, with basic budget restraints, could be better than what we have. And that's a beautiful proposition. I think it's a terrific start for good things to happen.

MOS's welcome and education center (at left) serves as both backdrop and gateway to the prototype houses.

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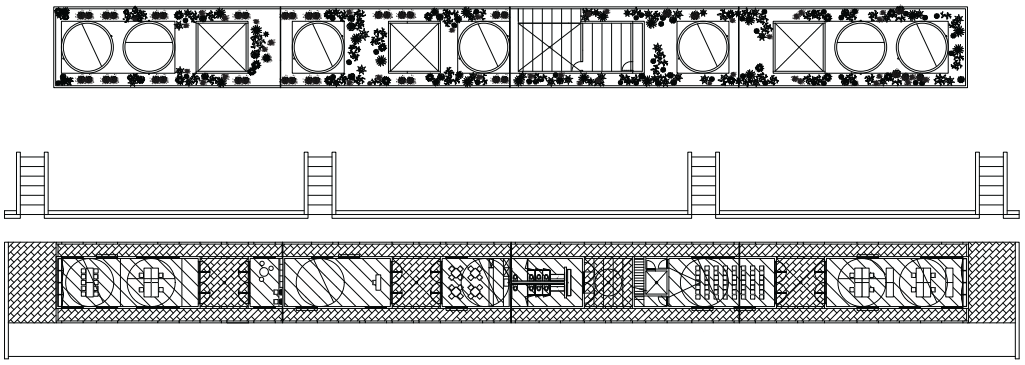
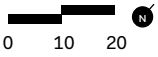
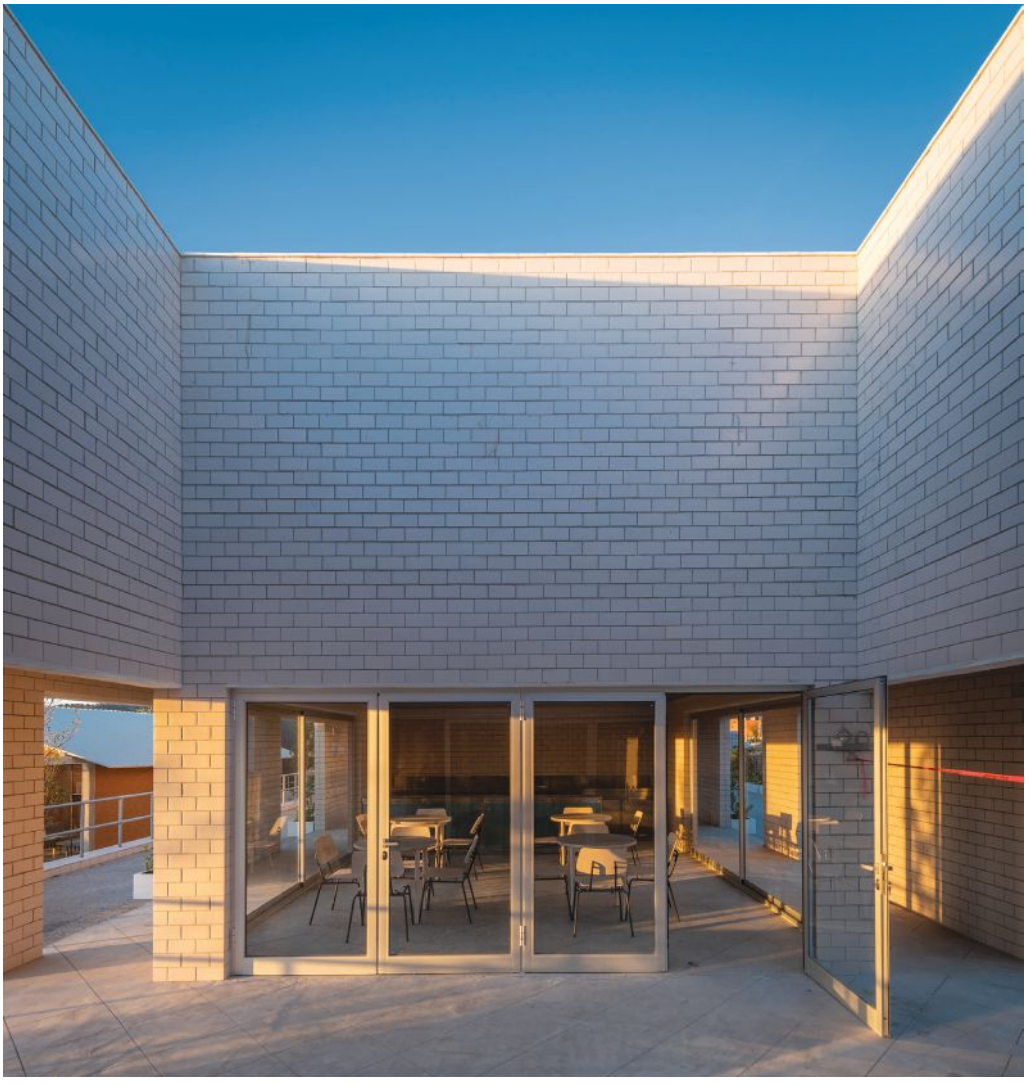
Welcome and Education Center

0. **MOS**, New York





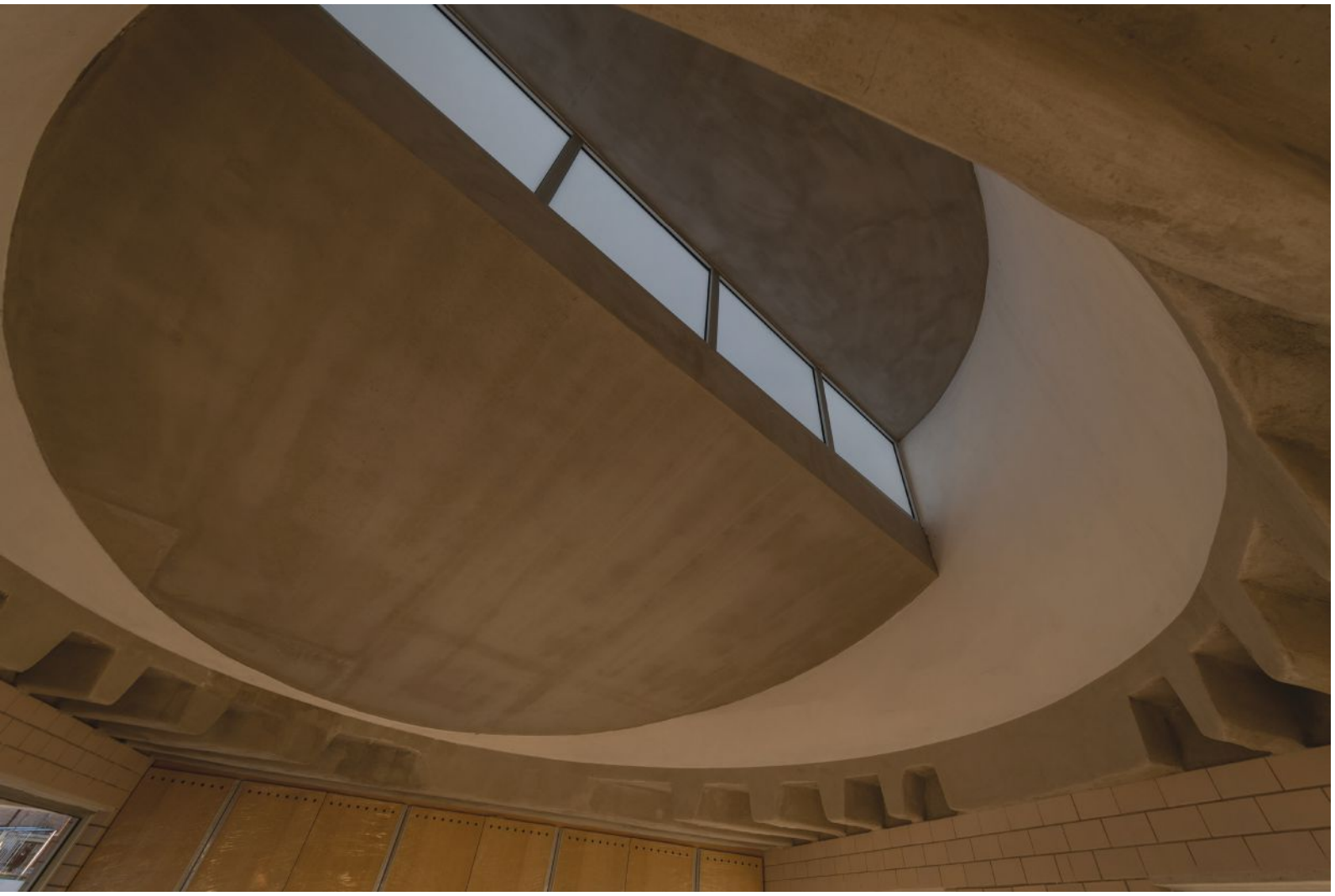
Opposite: Stairs from education center into housing campus



Top: Entry plaza

Bottom: Open-air courtyard

TOP: IWAN BAAN



Opposite, Top Left: Shaded walkway along length of education center

Opposite, Top Right: Courtyard

Opposite, Bottom: Multipurpose classroom

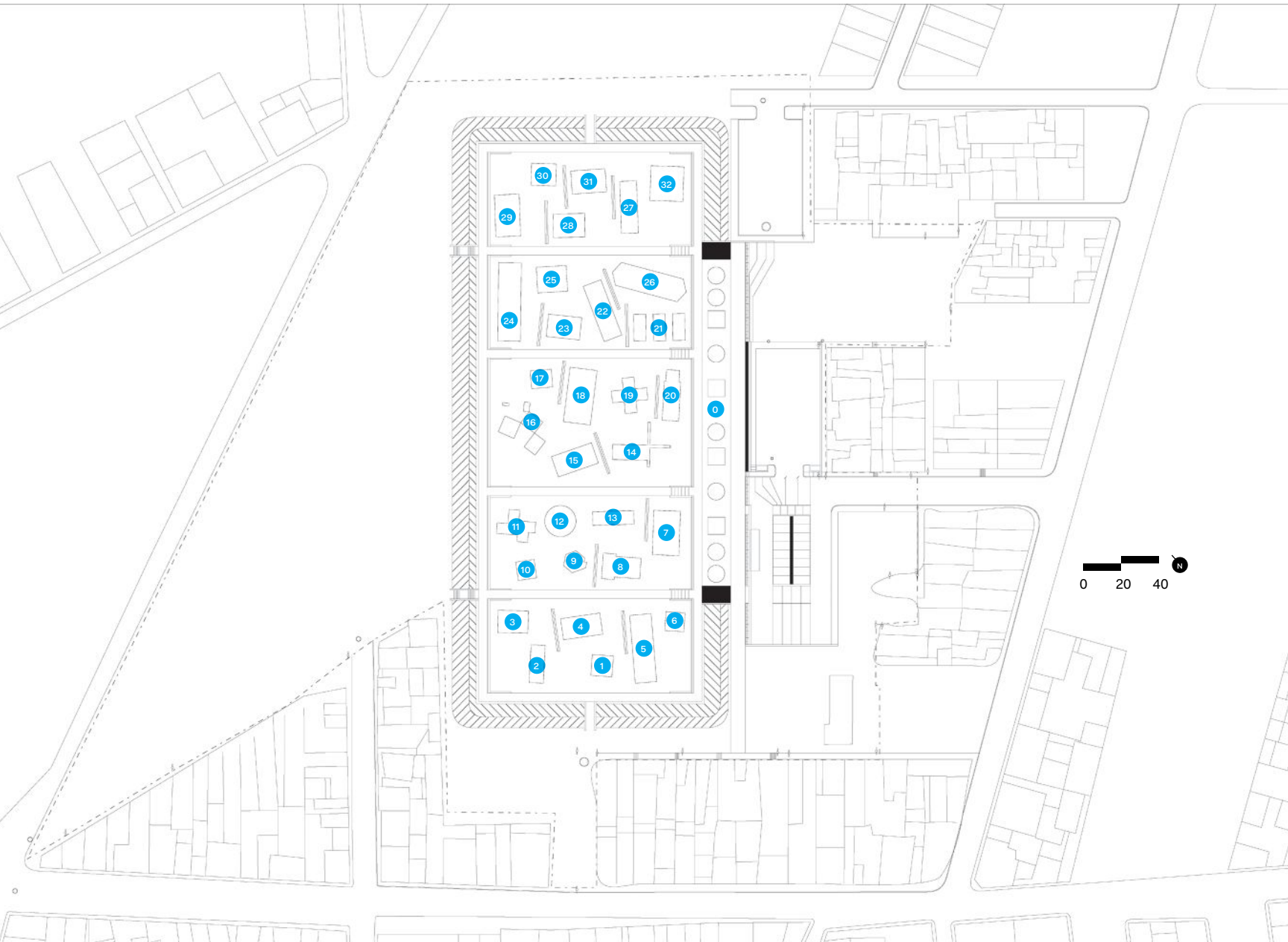
Above: Oculus in classroom

Project Credits
Project: Housing No. 8 (Laboratorio de Vivienda)
Location: Apan, Hidalgo, Mexico
Client: Instituto del Fondo Nacional de la Vivienda para los Trabajadores (INFONAVIT) / Centro de Investigación para el Desarrollo Sostenible (CIDS)
Architect: MOS, New York · Michael Meredith, AIA, Hilary Sample, AIA (principals); Cyrus Dochow, Paul Ruppert (project architects); Fancheng Fei, Michael Abel, Mark Acciari, Lafina Eptaminitaki, Mark Kamish (project team)
Signage: Studio Lin
Size: 8,600 square feet (education and welcome center); 9 acres (master plan)
Cost: Withheld

Climate Zones

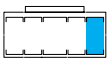
- Warm Humid
- Warm Dry
- Warm Extremely Dry
- Warm Semihumid
- Semicold
- Semicold Humid
- Semicold Dry
- Temperate
- Temperate Humid
- Temperate Dry

Site Plan



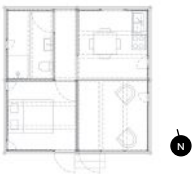
LEGEND

#. **Firm Name,** Firm Location · State · Climate Zone · Structure · Construction Cost in USD

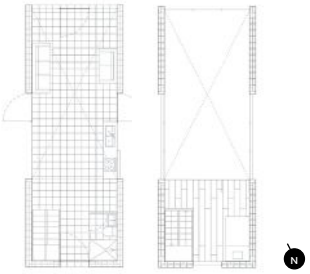


Bay 1

1. **De Villar-Chacón Arquitectos,** Mexico City · Oaxaca · Temperate dry · Galvanized-steel scaffolding; foundation in cement-filled water bottles · $15,361



2. **Frida Escobedo,** Mexico City · Guerrero · Warm semihumid · Pine framing · $15,077



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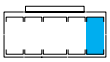
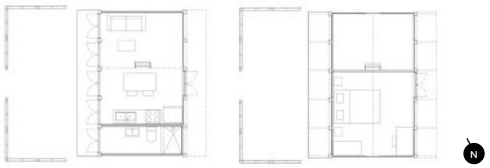
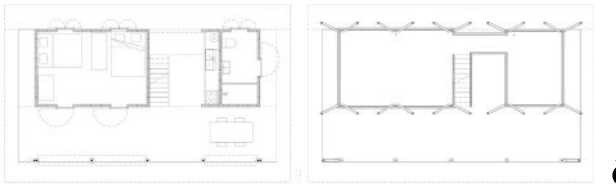


Bay 1

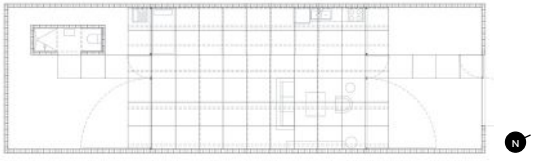
3. Dellekamp + Schleich, Mexico City · Michoacán de Ocampo · Temperate · Pine framing · $15,077



4. Rozana Montiel Estudio de Arquitectura, Mexico City · Morelos · Temperate humid · Bamboo members and panels · $14,492



5. Ambrosi | Etchegaray, Mexico City · Chiapas · Warm semihumid · CMU · $11,454



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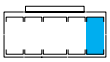
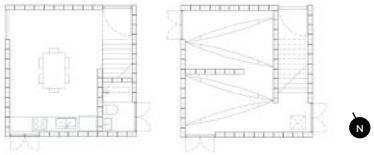
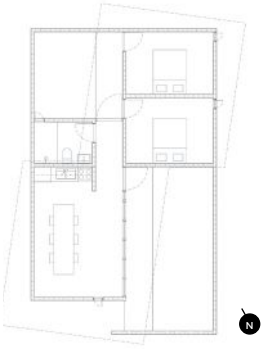


Bay 1

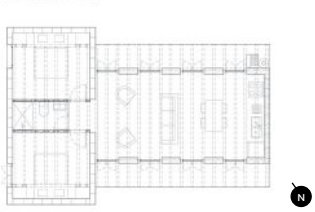
6. Zooburbia, Mexico City · Campeche · Warm humid · CMU; concrete slab and joists · $16,867



7. Zago Architecture, Los Angeles · Tlaxcala · Temperate · CMU · Withheld

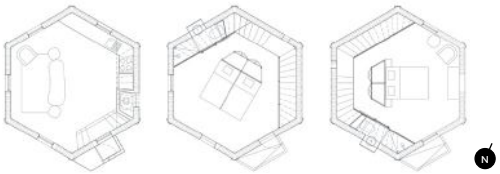


8. Taller | Mauricio Rocha + Gabriela Carrillo, Mexico City · Tlaxcala · Temperate · Adobe and CMU walls; stone foundation · $9,039

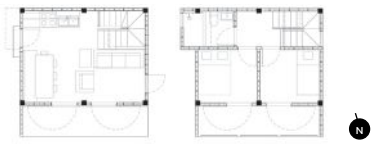


Bay 2

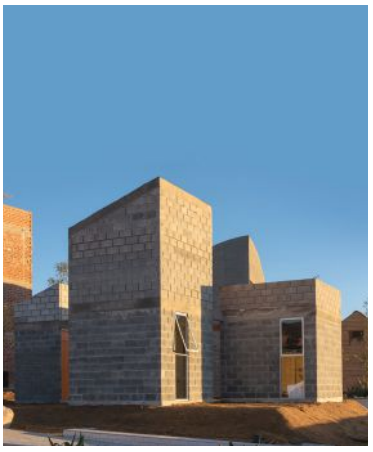
9. **Taller de Arquitectura X,** Mexico City · Ciudad de México · Semicold · Concrete beams and vaulted slab · $12,356



10. **Griffin Enright Architects,** Los Angeles · Estado de México · Temperate · Reinforced-concrete frame and slab · $11,487

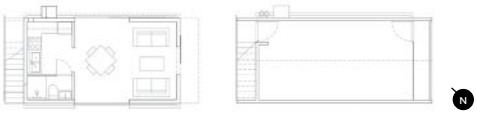


11. **Tatiana Bilbao Estudio,** Mexico City · Estado de México · Temperate · CMU; concrete slab and column · $11,025



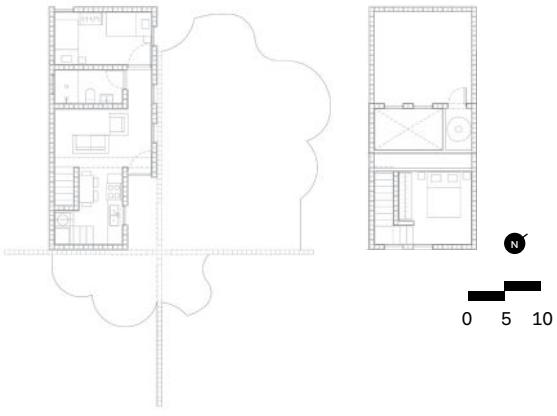
Bay 2

12. **Francisco Pardo Arquitecto,** Mexico City · Tlaxcala · Temperate · Reinforced concrete · $7,147



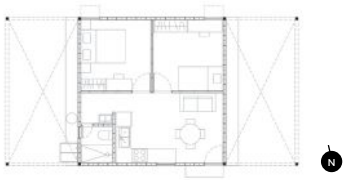
13. **TEN Arquitectos,** Mexico City · Ciudad de México · Temperate humid · Concrete footings and metal frame · Withheld

14. **Pita & Bloom,** Los Angeles · Tlaxcala · Semicold · Typical wood framing; prefabricated wood beams · Withheld

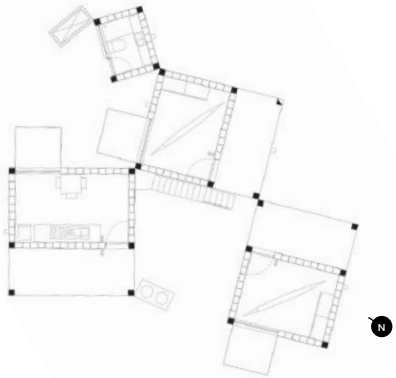


Bay 3

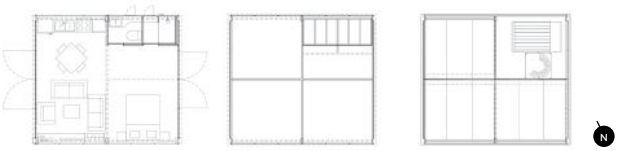
15. **BGP Arquitectura,** Mexico City · Estado de México · Temperate · Stone foundation; concrete slab and columns; reinforced concrete block; reinforced concrete beams · $10,243



16. **Zeller & Moye,** Mexico City · Colima · Warm semihumid · Reinforced concrete slabs and columns · $9,727



17. **Accidental Estudio de Arquitectura,** Mexico City · Michoacán de Ocampo · Temperate · Concrete foundation and slab; columns and light beams · $11,506



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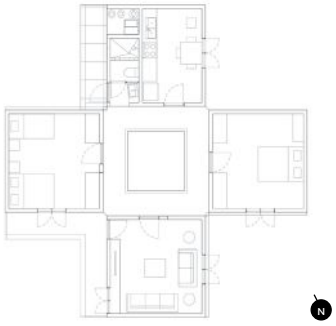
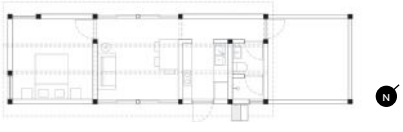
Bay 3

18. **Nuño MacGregor De Buen Arquitectos,** Mexico City · Michoacán de Ocampo · Temperate · Typical wood framing; prefabricated wood beams · $14,724

19. **SAYA + Arquitectos,** Mexico City · Estado de México · Temperate dry · Cyclopean concrete foundation · $9,436



20. **Cano|Vera Arquitectura,** Mexico City · Hidalgo · Semicold dry · Stone foundation; concrete slab and columns; reinforced concrete block and beams · $10,648



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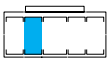
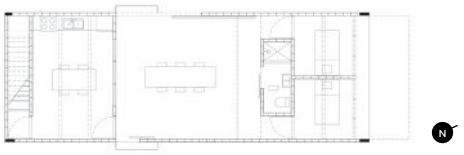


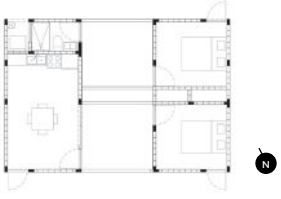
Bay 4

21. **Fernanda Canales,** Mexico City · Querétaro · Temperate dry · Concrete foundation and columns · $11,262

22. **RNThomsen Architecture,** Los Angeles · Querétaro · Temperate dry · Concrete frame and CMU walls · $10,296



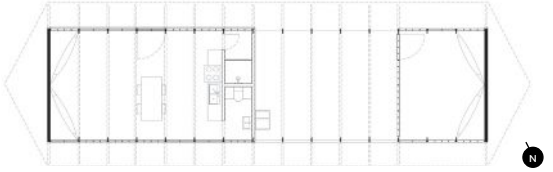
23. **Productora,** Mexico City · Guanajuato · Temperate dry · Reinforced concrete slab; reinforced masonry load-bearing walls · $11,463



24. **Agraz Arquitectos,** Guadalajara · Jalisco · Warm semihumid · Reinforced concrete foundation · $11,772

25. **Rojkind Arquitectos,** Mexico City · Aguascalientes · Temperate dry · Concrete foundation; load-bearing brick retaining wall · Withheld

26. **Tactic-A,** León · San Luis Potosí · Warm semihumid · Wood frame and plywood · $12,044



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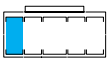
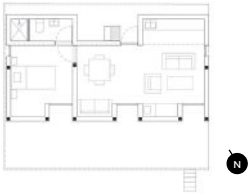


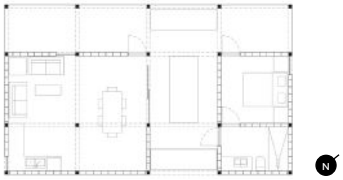
Bay 5

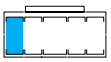
27. **Gaeta-Springall Arquitectos,** Mexico City · Tamaulipas · Warm dry · Reinforced-concrete columns, beams, and foundation · $11,518

28. **Taller ADG,** Mexico City · Nayarit · Warm semihumid · $27,593



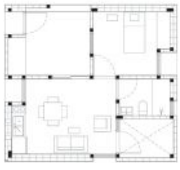
29. **Taller 4:00 A.M.,** Mexico City · Baja California Sur · Warm dry · Timber and reinforced concrete frame · $14,685



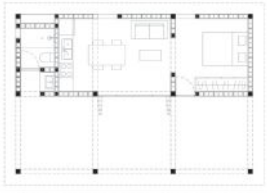


Bay 5

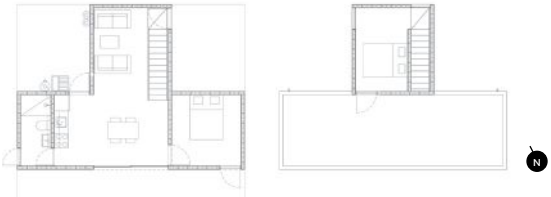
30. **CRO Studio,** San Diego, Calif. · Baja California · Temperate dry · Concrete columns; joist-and-beam slabs; ceramic brick walls · $8,811



31. **JC Arquitectura,** Cancún · Chihuahua · Warm extremely dry · Reinforced-concrete columns, frame, and slab; compressed-earth block · $13,354



32. **DCPP Arquitectos,** Mexico City · Coahuila · Warm dry · Adoblock (rammed-earth block) walls with concrete · $16,568



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Editorial: Bracing for Economic Impact

If you're remotely like me, which is to say a worrier, you've been wondering when the next recession is going to hit. And if you're a lot like me, which is to say the kind of worrier who makes Woody Allen seem mellow, you've also been wondering whether it's a good idea to even mention the economy out loud. Because simply discussing the possibility of a downturn increases the likelihood of one occurring (in part, apparently, by hurting consumer confidence), and I haven't wanted to jinx it.

Then the AIA released its June Architecture Billings Index statement, which points back to five consecutive months of declining or flat billings and a 10-year low in project inquiries. Gulp. AIA's Consensus Construction Forecast came out five days later with far nicer news, predicting that while a few sectors (religious, for instance) will decline over the next 18 months, overall nonresidential will continue to grow (albeit more slowly next year than this year). A reprieve? Let's hope. Nonetheless, I decided it was time to exorcise my fears by giving voice to them.

The news that a recession may be in the works—whether tomorrow or two years from now—shouldn't come as a surprise to anyone. The current expansion began in 2009, and last month it officially became the longest in U.S. history. Until the Reagan era, the average boom period lasted less than four years, so one could safely argue that we're overdue—and many in the know are saying just that. In a 2018 survey of chief financial officers, two thirds of them expected the economy to falter by the end of 2020.

Even the most out-of-touch practitioners ought to be aware that real estate development is a cyclical business, subject to unusually extreme ups and downs. And every adult should know that a recession is always waiting around the corner.

So what's an architect to do?

Get educated, for starters. Proper preparation prevents poor performance, they say. You don't have to read the *Financial Times* front to back every day. Just pay a bit of attention. Try listening to *Marketplace* on NPR occasionally, following *Bloomberg* on Twitter (appropriately, the handle is @business), or checking the major economic indicators and indexes from time to time.

The AIA Billings Index and Consensus Construction Forecast are superior tools, and alone worth the price of membership. There are dozens of others out there—the S&P 500, the Consumer Confidence Index, World Economic Outlook, our own Meyers Index—and trying to make sense of them all can be mind-bending. So we'll be publishing a guide later this year. Indeed, moving forward, our Best Practices column will offer lots of ideas on how to prep for and get through a downturn, from the perspective of both firms and individuals. And we will monitor economic and political headwinds that threaten to blow us over the proverbial fiscal cliff: immigration and the labor market, trade wars and consumer prices, the maturing of the Chinese economy, and so forth.

The intention here isn't to stoke fear. It is possible to anticipate a recession without darting back and forth, limbs flailing and hair on fire, shouting, "We're all going to die!" The best way to manage a crisis is to prepare for it, calmly.

STEPHEN VOSS

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