The Ninth Annual Architect 50

ARCHITECT

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Wright at 151
How to Relocate

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Art and Industry

Barkow Leibinger's Trumpf Smart Factory Chicago

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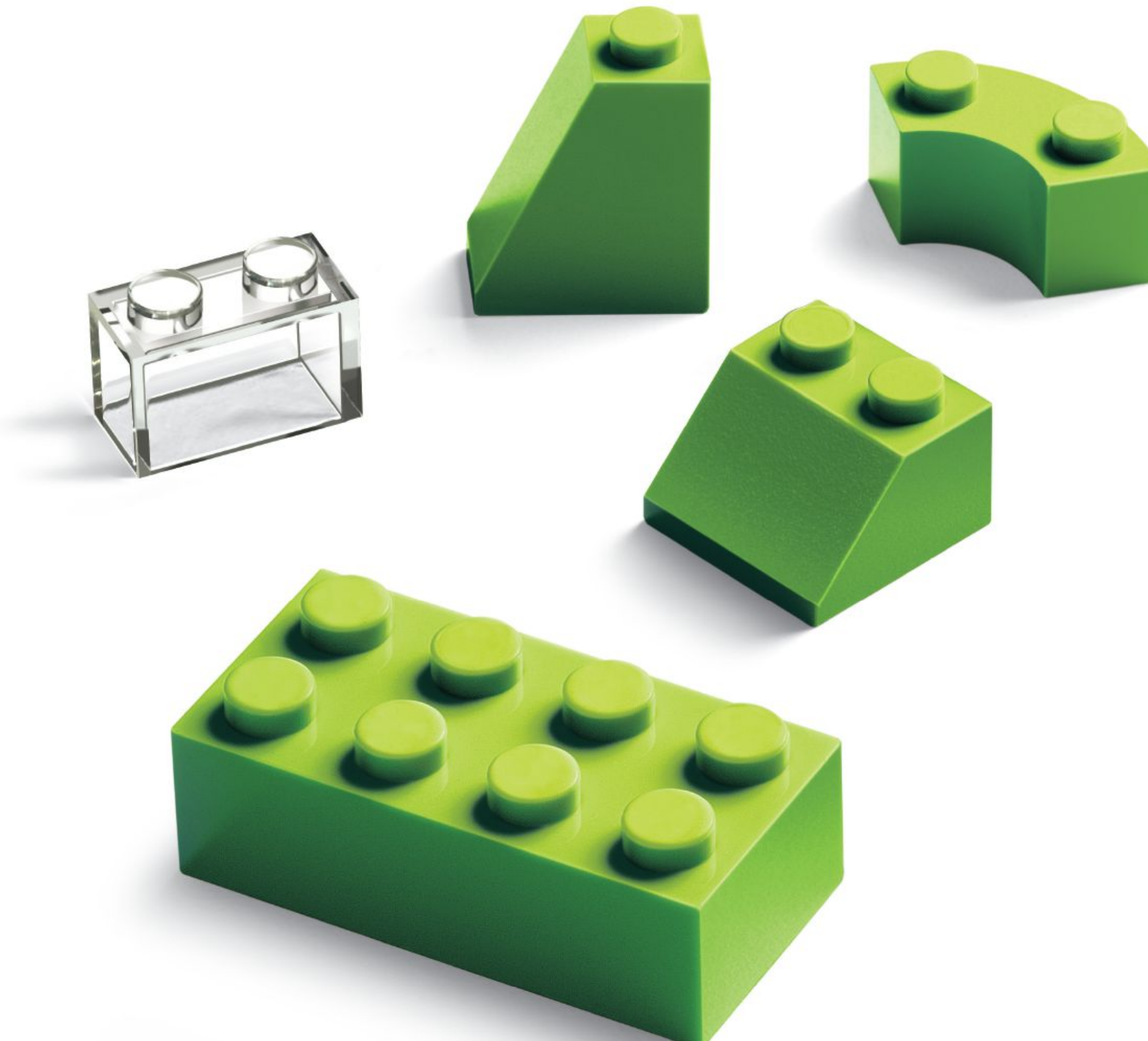


THE FUTURE

CEU LEARNING OBJECTIVES

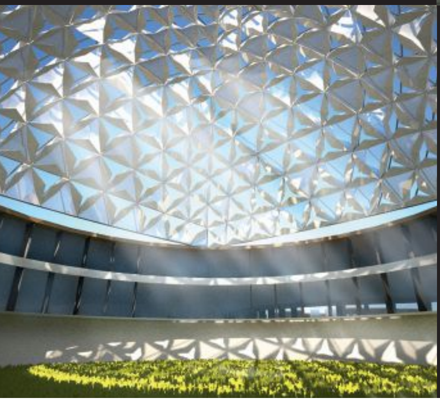
1. Discuss innovations and futuristic objectives for using shade structures constructed with fabric in commercial architecture.
2. Explain how shade structures made of fabric can add both appealing design and functionality to building structures.
3. Define the benefits of shade structures for personal health and UV protection.
4. Discuss how the use of textiles in shade structures can positively impact thermal performance and energy efficiency.
5. List LEED® V4 credits to which awnings and solar shades can contribute directly.

Learn more about the future of shade by completing this continuing education course at sunbrella.com/fosceu.

A CONTINUING EDUCATION PREVIEW SPONSORED BY SUNBRELLA®

1 AIA LU/HSW HOUR (#AEC889) OR 1 GBCI CE HOUR (#AEC889)

Responsive Shading System by Arman Hadilou is a kinetic façade composed of large strips of fabric mounted on a frame system that can open and close the fabric strips in response to existing light conditions.

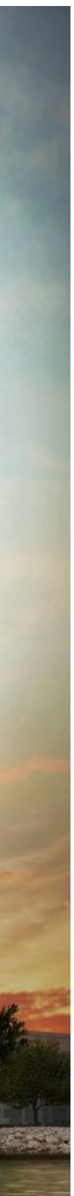


SHADE IS ARGUABLY ONE OF THE VITAL ELEMENTS IN MODERN LIFE, THOUGH NOT SOMETHING THAT TYPICALLY TAKES CENTER STAGE IN THE DESIGN DIALOGUE. UNTIL RECENTLY, FABRIC SHADE STRUCTURES WERE AN APPENDAGE TO A BUILDING, AN AFTERTHOUGHT, AN ACCESSORY.

Invertible Shade by Ehsan Fatehifar is a tensile shade system of repeating geometric shapes that can be adjusted to allow varying amounts of light inside the building.

OF SHADE

FABRIC COMPONENTS IN SUSTAINABLE ARCHITECTURAL DESIGN



Increasingly, shade structures begin the design conversation especially for commercial buildings, structures in sunny climates, those which will inhabit a warming planet (this one) and architects looking for new ways to create built environments in harmony with nature's forces. The future includes a conscious intention toward shade structures.

THE EVOLUTION OF SHADING FABRICS

In order to appreciate the future of shade and position oneself on the leading edge of this movement, it helps to review the past, the long history of using fabrics as architectural add-ons and how the practice has evolved.

Prior to the 1960s, most awnings and shading fabrics were made of cotton canvas, which the sun broke down quickly. In 1961, the owners of one of the oldest, most respected fabric brands decided to change the nature of shading materials the company had been making since the 1880s. They replaced cotton with acrylic fibers and pre-extrusion pigments and offered an unheard-of warranty of five years. They were dubbed "performance fabrics."

In the 1970s, performance fabrics got the attention of boaters, and the outdoor furnishings industry exploded with these new, long-lasting yet pliable fabrics. In 1988, BMW became the first car brand to adopt this company's fabrics for its convertible models.

By the early 2000s, as the green building movement gained momentum with the U.S. Green Building Council's LEED rating program, more attention was paid to the sustainable nature of performance fabrics. As high-performing shade fabrics last longer, people use less fabric and thus generate less waste as compared to other fabrics that might fade, lose strength or give in to mildew and atmospheric chemicals. In fact, some fabrics can be recycled through manufacturer recycling programs, reducing impact on landfills.

SIGNAGE AND BRANDING WITH FABRICS

As the use of shading fabric continues its trajectory in modern architecture, its use as a business branding strategy spans the decades. Historically, a print canvas canopy over a cigar shop or beauty parlor signaled the establishment's presence to passersby. While that design practice continues today, modern corporate branding with fabric is often spectacular, with enormous printed banners moving in the breeze. They are a signal to passersby and even passing aircraft that business or cultural events are happening there. The colors of the shading fabric convey their own branding message, tying into the corporate, company, educational or nonprofit organization's identity.

EXPANDING SPACE

Shading strategies in corporate, cultural and residential settings create copious amounts of added space for meetings, gatherings, meals and leisure. While the cost of walls and a roof could be prohibitive, and most likely exceeding a particular lot's allowable square footage of structure, the addition of shaded "rooms" becomes a possible way to expand the amount of usable space. Fabric enclosures in commercial spaces such as restaurants can help boost profits by increasing the amount of outdoor seating available year-round.

SHADE STRUCTURES FOR HEALTH AND UV PROTECTION

Protection from the sun has always been important to humanity, but never so much as it is in modern times, with holes in the ozone layer and the unprecedented speed at which our planet is warming. Whereas natural climate change occurs gradually, giving organisms the opportunity to evolve their own protections, the speed of this man-induced climate change requires man-made protections. Ideally, we don't want sunlight to be totally "on" or "off," and that is where UV-resistant shading fabric (as well as shade itself) comes into play.

Frames to Shams-Ol-Emareh by Nastaran Torabi and Zahra Noori Jamshidi is a series of orange-fabric-covered frames suspended in the forecourt of the historic Shams-ol-Emareh mansion in Tehran. The frames provide shade and seating, while also offering visitors a new framed perspective on the mansion.

Cotton Hill by Sergii Borodenko and Aljona Kolesznikova uses Sunbrella fabric to create a modular shading system that doubles as a no-soil planting system for urban areas that lack space for landscaping.

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Volume 106, number 11. November 2017.
On the cover: Trumpf Smart Factory Chicago by Barkow Leibinger; photo by Simon Menges

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The Future of Pedestrian Crossing

Commissioned by insurance company Direct Line with Saatchi & Saatchi London, the Starling Crossing (STigmergic Adaptive Responsive LearnING Crossing) is a smart pedestrian crossing system by software company Umbrellium. In October, the team installed a temporary prototype in South London. The system, which monitors movement through computer vision technology, can differentiate between cars, cyclists, and pedestrians, and the road's surface, embedded with computer-controlled LEDs, can modify the crosswalk pattern based on pedestrian trends. —AYDA AYOUBI

COURTESY DIRECT LINE

> *Read more about the Starling Crossing at bit.ly/StarlingCrossing.*

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MOHAMED SAMJI

Jean Nouvel's "Museum City" Opens in Abu Dhabi

In 2013, construction began on the Jean Nouvel, HON. FAIA–designed Louvre Abu Dhabi, and this month, the museum opens to the public. The museum, which will feature a permanent collection as well as loans from 13 partner French museums, is composed of 55 buildings topped by a 590-foot-wide steel-and-aluminum dome—punctuated in a pattern to filter light and shade visitors as they navigate the "museum city." "It is rather unusual to find a built archipelago in the sea," Nouvel writes about the project. "It is even more uncommon to see that it is protected by a parasol creating a rain of light." —SARA JOHNSON

> *For more information about the Louvre Abu Dhabi, visit bit.ly/NouvelLouvre.*

COURTESY HECTOR

Landscape Architect Kate Orff and Designer Damon Rich Named 2017 MacArthur Fellows

Among the 24 people named as 2017 fellows of the John D. and Catherine T. MacArthur Foundation are landscape architect Kate Orff and designer Damon Rich. This year's recipients of what are informally known as the MacArthur "genius grants" will receive $625,000 over five years to use at their own discretion. Orff is the founding principal of New York–based landscape architecture and urban design studio Scape and Damon Rich is a partner at Hector, an urban design, planning, and civic arts studio based in Newark, N.J. (Hector's "Broadacre 2017" at the Museum of Modern Art is shown.) —WANDA LAU

> *Read more about Kate Orff and Damon Rich at bit.ly/2017MacArthur.*


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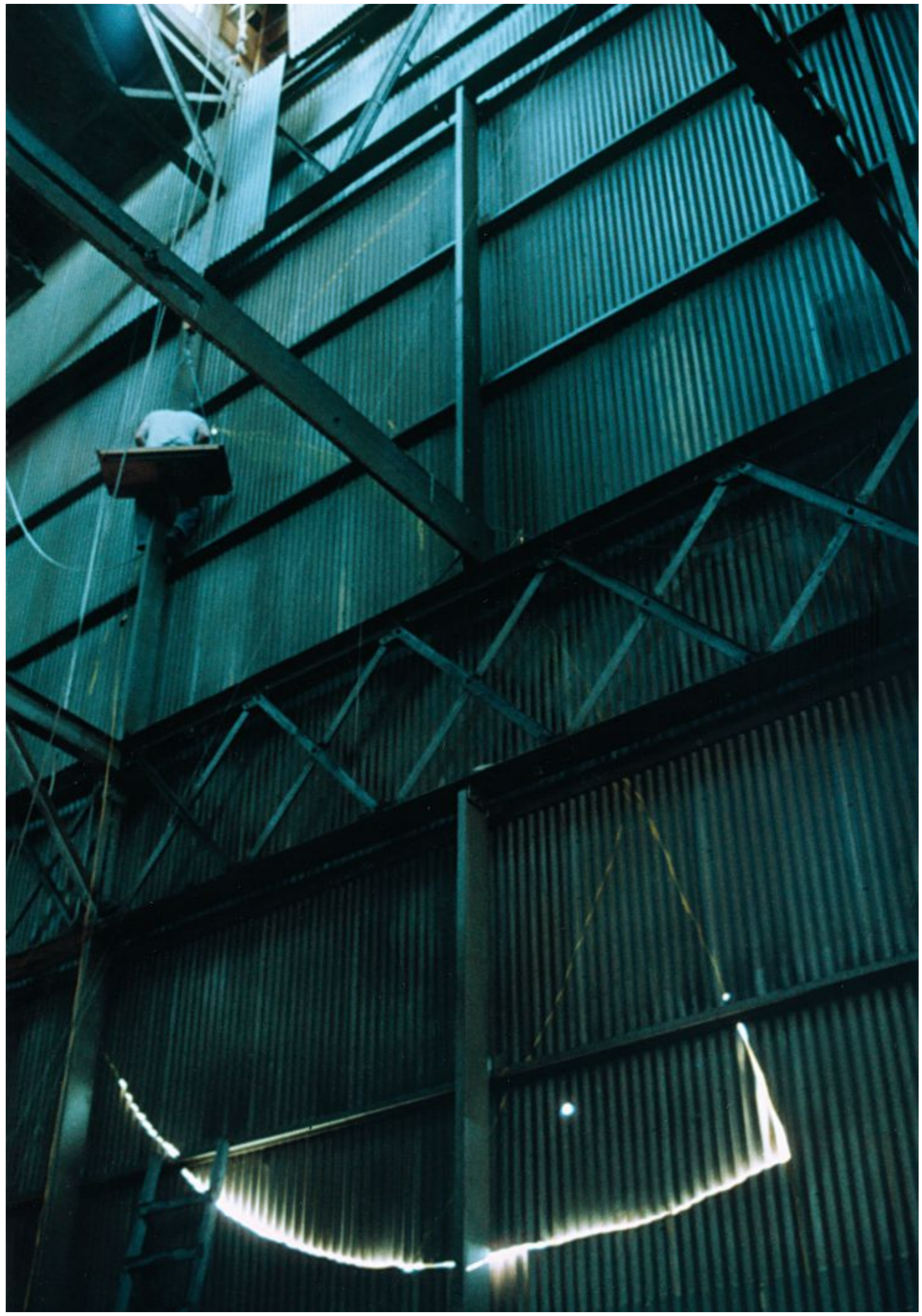
Apple Opens See-Through Riverfront Chicago Store

On Oct. 20, Apple opened its new Foster + Partners–designed Chicago store. Located just off Michigan Avenue, the store features a wraparound glass façade topped by a thin steel-framed roof clad with carbon-fiber-reinforced polymer panels and supported on four steel columns. A broad staircase runs through and around the pavilion-like structure, leading from the river to the south flank of Raymond Hood and John Mead Howells' landmark Tribune Tower. While much of the store lies below the staircase, "it unites a historic city plaza that had been cut off from the water," explained Jonathan Ive, Apple's chief design officer. —SARA JOHNSON

> *For more information about Apple Michigan Avenue, visit bit.ly/AppleMichiganAve.*


8912-NG Winter Sky Birchply



The Bronx Museum of the Arts Spotlights Gordon Matta-Clark's "Anarchitecture"

By transforming existing spaces and structures into sculpture, the late American artist Gordon Matta-Clark aimed to offer a new perspective on everyday urban scenes. His work is known for his slashes and dissections—made with power saws and carving tools—in run-down buildings in the Bronx in the 1970s. While much of Matta-Clark's physical work no longer exists, a new exhibition, "Gordon Matta-Clark: Anarchitect," at the Bronx Museum of the Arts features more than 100 photographs, films, and videos (such as this process shot of "Day's End"). The show runs through April 8 and then travels to Paris. —AYDA AYOUBI

> See more examples of Gordon Matta-Clark's work at bit.ly/MattaClarkBronx.

KEVIN G. SMITH

The Best in Alaskan Architecture

Last month at Land's End Resort in Homer, Alaska, AIA Alaska recognized the winners of the chapter's 2017 Design Awards for Excellence in Architecture. Two projects won Honor Awards: Wasilla Public Library by ECI and James C. Ryan Middle School in Fairbanks (shown) by Bettisworth North Architects and Planners with Perkins+Will. "This project is a beautiful geode," the jury noted about the school. "The abstract quality of the simple rectangular forms clad in white panels conceals a wonderfully sculptural, colorful, playful interior environment, a successful response to the daylight problem at this location." —SARA JOHNSON

> *View more images of the winning projects at bit.ly/AIAAlaska2017Awards.*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Best Practices: How to Relocate Your Firm

TEXT BY BRIAN LIBBY

Whether for personal or professional reasons, situations arise that require firm owners to move. But setting up shop in a new state or country can require more than hanging a sign on a new door. Below, practitioners and lawyers offer strategies for relocating a design studio.

Hire Professional Advisers

When business partners and spouses Vivian Lee and James Macgillivray moved from Ann Arbor, Mich., to Toronto to be closer to family, they decided to also uproot LAMAS, the firm they founded in 2008, rather than simply start a Canadian branch office. Though jumping through the bureaucratic hoops of licensure reciprocity and visas proved challenging, the logistics of moving the duo's business was relatively painless. "We are small and nimble," Lee says of their four- to six-person firm. "It was a fairly easy transition."

To get the ball rolling, Lee and Macgillivray alerted their U.S. tax accountant of their intent to relocate. He guided them in notifying the Michigan Secretary of State's office to close their business. Upon arriving in Toronto, they hired a local accountant and adviser "almost immediately," Lee says, as well as a lawyer to help them re-establish LAMAS on Canadian soil.

> "Certain states have only certain forms of entities—limited liability companies, corporations, or otherwise—that can be practicing architecture."
>
> —Stanton Beck, ALLIED AIA, attorney, Lane Powell

Consult Local Laws

Moving a business across national borders can be complicated, but transitioning from one state to another can also require a series of steps, depending on local laws. "It requires understanding of not just whether you're licensed in your new state, but what kinds of entities or companies can practice architecture," says Robert Herrmann, ALLIED AIA, partner at the New York law firm Menaker & Herrmann, and author of the book *Law for Architects* (W. W. Norton & Co., 2012).

Construction services attorney Stanton Beck, ALLIED AIA, of the Seattle-based law firm Lane Powell agrees: "Certain states have only certain forms of entities—limited liability companies, corporations, or otherwise—that can be practicing architecture," which could require a business's legal structure to be changed. In these cases, architects must close a practice in the state left behind. "Depending on how [a firm is] set up in that state, they would perhaps have to file for dissolution of their legal entity with the secretary of state, and close out their tax filings," Herrmann says.

Because laws regarding employment, ownership, and taxation differ by state, design and construction attorney Bennet Heart, a partner in Cambridge, Mass., firm Noble, Wickersham & Heart, recommends first contacting the secretary of state's office in the new state to learn its requirements, and to do the same with that state's architectural registration board.

Consider a Satellite Practice

To streamline their move, many architects and firms opt to open a satellite office in the new state while keeping their headquarters in the original location—a choice made possible with the help of technology and telecommuting.

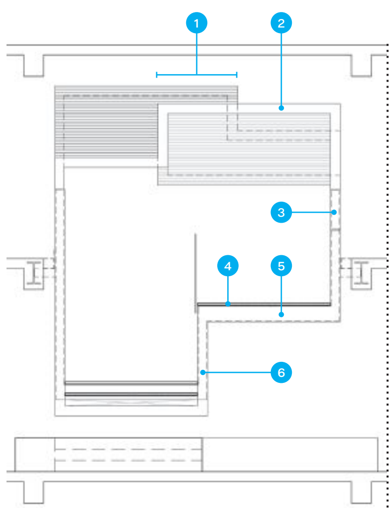
For example, when Monica Ponce de Leon, AIA, became the dean of Princeton University's School of Architecture in 2016, she did not close her eponymous architectural practice in Ann Arbor—nor had she closed her Cambridge office eight years prior when she left her faculty position at Harvard University to become the dean of the University of Michigan's Taubman College of Architecture and Urban Planning. Instead, she manages her 10 employees across four offices.

Ponce de Leon says the decision to keep her studios open was initially based on not wanting to lay off or displace employees—but now, she has found that the multistate presence has enhanced teamwork. "We have the ability to access each other's servers remotely and to [even] draw on each other's screens," she says. "We are constantly collaborating in a seamless way."

> *To read more about moving a firm, visit bit.ly/ARFirmRelocation.*

Detail:
Pinterest's Scissor Stair

TEXT BY TIMOTHY A. SCHULER



Occupying two floors of a high-rise, the New York office of Pinterest needed an element of vertical connectivity. "To have to [take] the elevator to go up one floor is not the culture that they're trying to create," says Lisa Iwamoto, principal of San Francisco–based IwamotoScott Architecture, of the online cataloging platform. "They want ... people ... flowing through the space seamlessly."

IwamotoScott created a scissor stair that could be approached from opposite directions with each stair run intersecting at a central landing. Working with the layout of the building's existing structural bays, IwamotoScott with New York–based Spector Group sited the stair at the office's center to maximize its accessibility and significance.

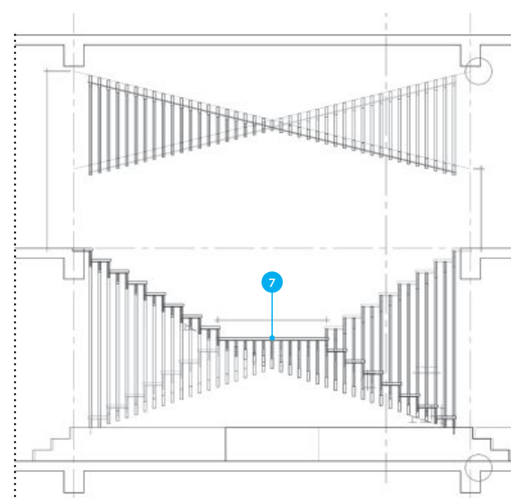
Intentionally oversized at 5.5 feet deep and about 14 feet wide, the landing encourages organic interactions among employees. However, a stair that is too open can create acoustical distractions. "We wanted to enclose it somehow and yet not enclose it so that it was a tunnel," Iwamoto says.

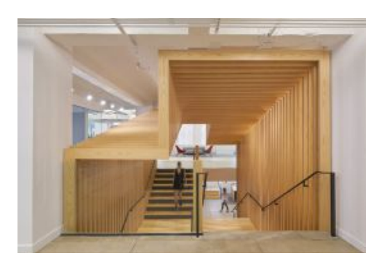
The designers decided to wrap the steel stair structure in a series of vertical and horizontal white-ash fins, creating the effect of a wooden box that's been parsed into rectangular cross-sections. The fins provide a degree of transparency and limit visual and acoustical disruptions to or from adjacent workspaces, while the use of wood adds warmth to the space.

The fins create a telescoping effect and the illusion of two intersecting volumes, 20 feet long by 16.5 feet wide and 20.5 feet tall, floating in the office. Overhead, the horizontal fins exaggerate the intersection by overlapping the complementing fins of the adjacent stairs above the central handrails.

The vertical wood fins were fabricated as L-shaped pieces and clam-shelled together over vertical steel plates, which are welded to the steel stringers. Meanwhile, the solid horizontal fins lock into the vertical fins via mortise-and-tenon joints. The fins are anchored to the steel stair stringers, which tie into the building structure at the fifth floor.

The scissor stair has become a functional centerpiece and means of communication. "It's like a crossing of paths," says principal Craig Scott, AIA. "When you go up ... or down either run, you have a choice of two ways to proceed."





BRUCE DAMONTE

1. 4' overlap between overhead fins
2. 6.25" × 1.625" white-ash horizontal fins (5.5" o.c.)
3. 6.25" × 1.625" white-ash vertical fin-cladding over steel structure (5.5" o.c.)
4. 1.5"-thick white-ash tread
5. 0.375"-thick steel plate
6. Wood-clad steel plate with handrail
7. Stair landing

> *To learn more about the Pinterest's stair design and construction, visit bit.ly/ARPintStair.*

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MID-CENTURY HYGGE

Michele Alfano

It heightens your senses, whether you're soaking in the tub, standing on the fur rug or sitting on the bench with a warm cup of coffee. That's hygge.

Copenhagen Suggesting life on a houseboat, this bathroom brings the city of Copenhagen indoors with its use of natural materials like hewn beams, water-inspired colors and a living moss wall. But the purpose is beyond a nod to nature. In the hygge modern bathroom, the sensorial design elevates the everyday.

To achieve a sense of Nordic coziness, I balanced light-colored materials with the occasional geometric pattern and pop of color. The design flexibility of the DXV Modulus Collection was a natural fit, including its looks. It's a combination of angles and organicism, a perfect match. Finally, I added a hint of luxe with a built-in towel warming drawer and coffee bar—just right for achieving hygge.

For more on Michele's room,
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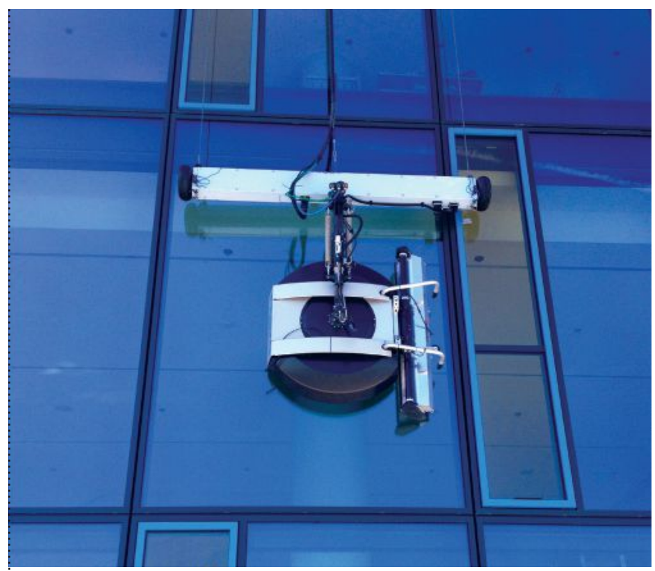
Technology: Robots and the Internet of Clean

TEXT BY BLAINE BROWNELL, AIA

The AEC industry's recent interest in robotics has focused on the automation of manufacturing and construction, but a quiet transformation is underway in the realm of building maintenance. Arguably, it is the machines designed to take over everyday chores that are the ones leading the robot revolution within the built environment.

The first and most obvious application is floor cleaning. Bedford, Mass.–based iRobot launched the Roomba in 2002 and within only two years, the company had sold 1 million robot vacuums domestically. iRobot's success fueled the rise of commercial-grade technologies, such as Utrecht, Netherlands–based cleaning solutions company Diversey, which offers industrial vacuuming and scrubbing robots for offices, hotels, and airports.

The potential for savings in labor and materials has similarly motivated a solution for another ubiquitous building maintenance task: window cleaning. Professional residential services cost an average of $266 for an entire house. In the commercial sector, these jobs can cost about $20,000 per cleaning for a 50-story high-rise. Given the general recommendation of two cleanings per year for commercial buildings, expenses can add up quickly. For this, Buochs, Switzerland–based robotics company Serbot offers the Gekko Facade Robot, which attaches via suspension cable to a building's roof and can clean up to 8,000 square meters (86,000 square feet) of glass per day.



According to its manufacturer, the fully automated Gekko dramatically outpaces hand-based cleaning.

COURTESY SERBOT

A recent Eco-Business article by Diversey's chief marketing officer and Greater China president Balakrishnan Thottikamath forecasts imminent changes to the entire cleaning industry. He credits the advancement of robots and prevalence of networking with bringing about the "Internet of Clean"—a platform that integrates maintenance-based machines with sensors, dispensers, and other smart appliances.

This vision is intriguing but raises fundamental questions. As experienced in the manufacturing and construction sectors, the future of human labor could become precarious: Will the current cleaning industry workforce simply be displaced by maintenance-based automation, or will individuals be able to find adequate training and support to move into more meaningful jobs?

Other concerns pertain to security: An eye-opening July 2017 article in *The New York Times* revealed iRobot's tentative plans to share data that its machines collect with advertisers—customers' consent permitting. Meanwhile, security company Trend Micro announced some 83,000 existing manufacturing robots are vulnerable to hacking based on outdated operating systems and limited virus protection—a risk that could also extend to cleaning robots.

Such valid anxieties reveal an element of uncertainty to an otherwise compelling trend: the burgeoning, robotic-driven disruption to the maintenance of the constructed world.

> *For more on the impact of robots on building maintenance, visit bit.ly/ARRobotsIoC.*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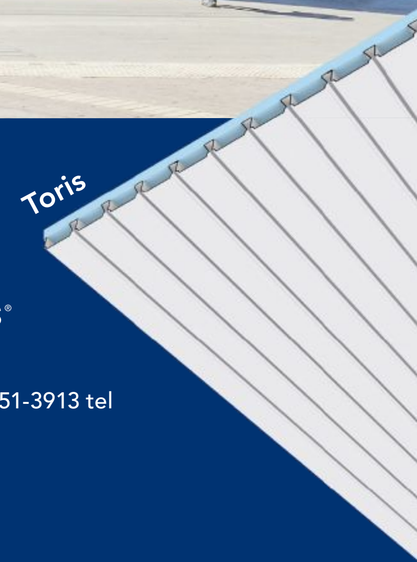

Toris

Next Progressives: MG&Co.

EDITED BY KATHARINE KEANE

Location:
Houston

Year founded:
2010

Firm leadership:
Noëmi Mollet and Reto Geiser

Education:
Mollet: Dipl. Arch., ETH Zurich; *Geiser:* Dr. Sc. and Dipl. Arch., ETH Zurich

Firm size:
Two to five designers and thinkers

Mission:
We develop spatial strategies in a range of scales from a book to a house. Our projects are located at the intersections of architecture, installation, textiles, and typography, and occupy a place between two and three dimensions.

We believe in a close exchange between the past and the present, and between theoretical inquiry and engaged practice. A decade of work in the complementary roles of designer, scholar, curator, editor, and publisher has allowed us to more deeply understand the potentials of crossing disciplinary boundaries and the advantages of collaboration.

Favorite project:
Architectural projects are like children: We don't have favorites, but are fond of them for very different reasons. The conversion of an artist's studio into a live-work space, for example, allowed us to redefine an industrial workshop through the precise placement of an inhabitable core—a "Studiolo" inspired by Antonello da Messina's circa 1475 painting "St. Jerome in His Study."

First commission:
Our first project took shape before we formally established our studio. We were asked to design a deck for a traditional lake cottage in western Switzerland. There was only one design constraint: It had to be made of stainless steel, as our client was a manufacturer of environmental technologies and the contractor for the job.

Special item in your studio space:
A bright orange, fluorescent sign that says "Migros" in all-caps Helvetica. It's the sign from the supermarket around the corner from where we used to live in Basel, Switzerland. It keeps reminding us that good design matters, no matter at what scale or in what context.

Design aggravation:
Typographic orphans and widows—lines at the beginning or end of a paragraph that are left clinging lonely at the top or bottom of a page. They hurt our eyes, yet we encounter them daily.

After Hurricane Harvey, architects should ask:
Can infrastructure reliably counter the forces of nature we are facing as some voices suggest, or might we have to approach alternative routes that will also force us to fundamentally change our habits?

The issues at hand go far beyond the reconstruction effort—even if this is one of the most immediate thoughts on everybody's mind. We have to engage in a much broader conversation that includes, but is not limited to, infrastructural, environmental, political, economical, cultural, and, of course, urban and architectural questions. As designers, we have a lot of agency, and we should decisively claim the driver's seat in this discussion.

Design tool of choice:
Our library and a Palomino Blackwing pencil.

Vice:
We accumulate way too many found objects.

Noëmi Mollet and Reto Geiser

TOBY KAMPS

> *To learn more about MG&Co.'s work and inspirations, visit bit.ly/ARMGCo.*

AMPHITHEATRE REINVENTED

SOME SAY THE CHRYSALIS IS THE REAL STAR AT COLUMBIA, MARYLAND CONCERT VENUE

What should a performing arts amphitheater look like?

It's a safe bet most answers won't come close to the striking iridescent green stage-pavilion-sculpture now dazzling concertgoers in Columbia, Maryland.

Welcome to **The Chrysalis**, a $6.6 million, 5,977 square foot masterful example of parametric modeling and design collaboration.

On paper, The Chrysalis is simple enough. It's a multi-purpose public pavilion, sculpture, and performance center. To spectators, the 79-tons of twisting, pleated steel and aluminum earns its place as a star attraction, creating a vibe and visual excitement unlike any outdoor venue.

Tight-Knit

Credit for The Chrysalis goes to a multi-disciplinary team working in exceptionally close collaboration. Michael McCall, (project producer and then-president of the non-profit **Inner Arbor Trust**), assembled teams from **Marc Forner/TheVeryMany** (digital designer), **Living Design Lab** (architect), **Arup** (structural engineer) and **Zahner** (fabricator-builder), to achieve a daring vision.

That challenge, of course, was to translate a wholly digital, parametric model into an enduring, code-compliant performance center that would serve the community for decades.

Patterning

Chief among the design issues: Coating selection for the 4,200 aluminum shingles that clad the nine-legged structure.

McCall advocated for green in accordance with the design intent—an artful integration with the surrounding Symphony Woods public park. But what shade? Davin Hong, AIA, principal of Living Design Lab, project architect, advocated for bright greens, with the emphasis on the plural. "We pushed for a patterning coloration," Hong explains. "There's a gradient of four colors as The Chrysalis goes from the bottom to the top. The patterning is gradual."

Quality First

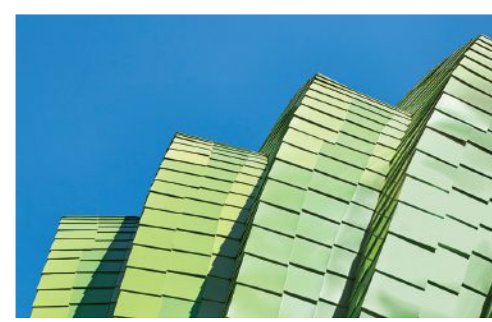
L. William Zahner III, president and CEO of Zahner, remembers the color discussion well. Zahner's firm engineered and built everything from The Chrysalis foundation up, except electrical. "We had just finished a project for Morphosis that used a Valspar product. It had a greenish tone with a secondary iridescence to it. It was really beautiful," Zahner recalls.

"We wanted a very premium prefinished material. You really can't post-paint aluminum shingles," says Zahner. "We don't always work with painted materials. We're known for working with natural metals. When we get into paint, we're very, very picky. Valspar is a premium product."

The team opted for Valspar's Fluropon® Solar Reflective (SR) exterior architectural coating. Fluropon SR is formulated with reflective pigments that mitigate ultraviolet rays. The coatings also resist weathering, chalking, fading, dirt, stains, and chemical degradation.

"Everything Worked"

For project producer, architect and builder Michael McCall, the outcome topped all expectations. "The Chrysalis is Columbia's symbol for the next 50 years," he states. Hong says "the overall effect is astounding." And Zahner's first impression? "I got out of my car, walked down the hill, and about died. I couldn't believe it. The Chrysalis was stunning. Everything worked." High praise from the man responsible for fabricating some of the world's most celebrated architectural works.



Owner Inner Arbor Trust, Columbia, Md.
Designer Marc Fornes/TheVeryMany, New York
Architect Living Design Lab, Baltimore
Specialty Fabrication Zahner, Kansas City, Mo.
Construction Manager Whiting-Turner Contracting, Baltimore
Civil Engineer Gutschick, Little and Weber, Burtonsville, Md.
Landscape Architect Mahan Rykiel Associates, Baltimore
Photography © Jeffrey Totaro, 2017

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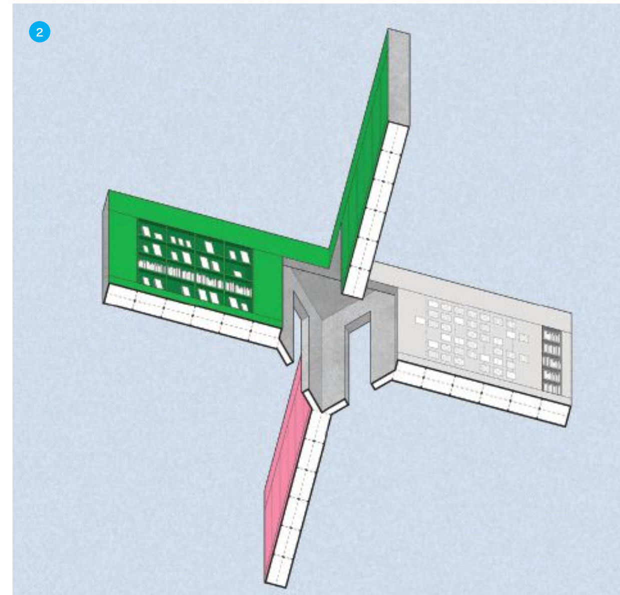
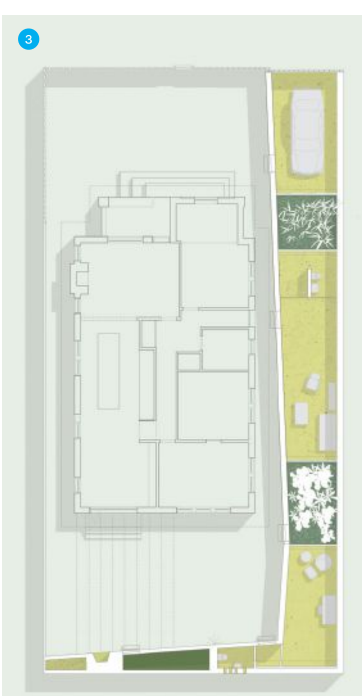
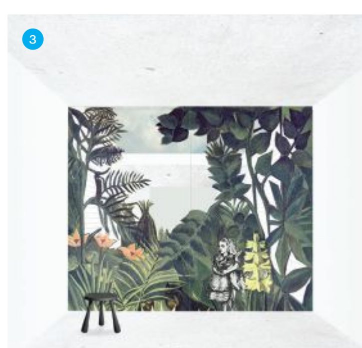
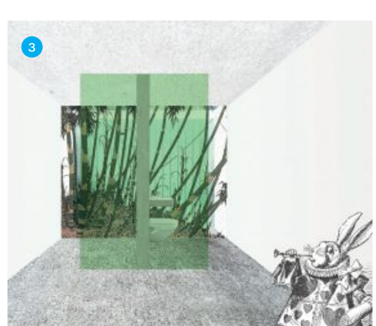
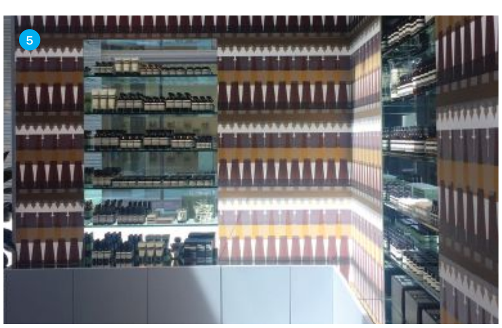


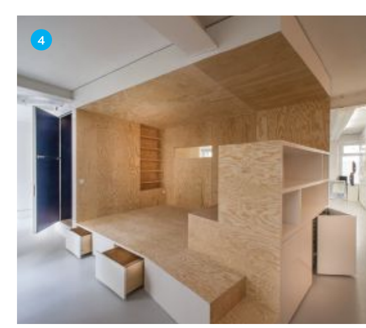






1, 3, 5: COURTESY MG&CO.; 2: KENDALL MCGAUGHERTY





1. Noëmi Mollet and Reto Geiser curated AIA Houston's 2012 "Ai Weiwei's Five Houses" exhibition and designed the pedestals as scalar representations of the artist's modular house. **2.** MG&Co.'s "Rooms for Books" installation for the 2017 Chicago Architecture Biennial subdivides a traditional bookshop into four separate spaces dedicated to the architecture book: One area showcases resources on the show participants, another is dedicated to a library, the third is a space for roundtable discussions and interviews, and the last is a pop-up bookstore run by the Graham Foundation. **3.** Mollet and Geiser's Wall House addition concept projects the illusion of a continuous brick wall. However, the designers say they have created "a pocket of inhabitable space" behind the divide, featuring two interior courtyards. **4.** Completed in 2013, the "Studiolo" is a reorganization of a traditional artist studio. This light-frame construction placed in the center of a former industrial warehouse features a kitchen, bathroom, workspace, sleeping area, and copious storage. **5.** The duo collaborated with Los Angeles architecture firm Johnston Marklee for the interior design of the Aesop store in Culver City, Calif. The team developed a silkscreened wallpaper featuring a graphic pattern that mimics the brand's cosmetic product packaging.

4: JIŘÍ VURMA


THE HEART OF SYDNEY'S NEW FINANCIAL HUB.
Containing thousands of copper pipe fittings that will ensure sustained drinking water hygiene for the future
Bangaroo, the new business district just besides the Sydney Harbour, is home to the new economic centre for the Asia-Pacific region: the International Towers Sydney. Viega ProPress Copper fittings are being used throughout to provide the 131 floors of the three towers with a reliable supply of drinking water. Not only does the system impress with its excellent hygienic properties, it is also quick and easy to install – a significant advantage for a major project like this on a tight schedule. Viega. Connected in quality.
International Towers Sydney, Sydney, Australia
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Products: How to Specify a Metal Roof

TEXT BY SELIN ASHABOGLU

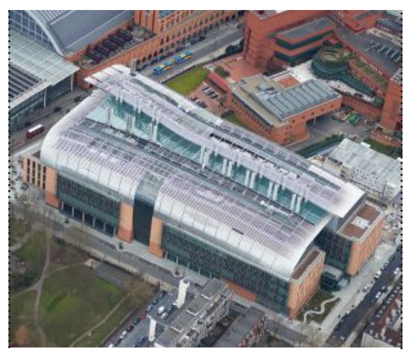
Metal makes for a durable, long-lasting roofing material. "When fabricated and installed correctly," says Steven Danielpour, AIA, principal and director of specifications at New York–based HOK, metal roofs "can outlast and outperform elastomeric roof systems, SBS-modified [styrene butadiene styrene–modified] roof systems, and single-ply roofs." Though they can be expensive, ranging from about $5 to $12 per square foot, an owner with long-term interests may be able to overlook the high first cost. "Typically [metal roofs] can last 30 to 40 years whereas other systems have a 15- to 20-year life span," Danielpour says.

When it comes to specifying metal roofing, architects must consider many factors, including the site's climate zone; the building's structure, form, and roof pitch; and local code requirements.

Picking a Metal Type

The most common metals used for roofing include steel, aluminum, copper, and zinc. Steel must be galvanized or coated for protection, while aluminum is typically painted or anodized for added resilience. Copper offers durability, a proven long life, and an aesthetic patina, while zinc is popular for its corrosion resistance and low-gloss look.

The thickness (or gauge) of the metal will also factor into the cost of the roofing system as well as the building's structural loads. Metal roofing can range anywhere from 3 to 30 gauge, which translates into an estimated $1,200 to $350 per square (100 square feet) installed. A 26-gauge metal roofing product will weigh in between 0.9 pound to 1 pound per square foot, while a 29-gauge product will be between 0.60 pound to 0.65 pound per square foot. A lower gauge—and thus greater thickness—is typically preferred for its durability. However their heavier weight can make installation more difficult, and their greater thickness can make the metal harder to bend and work.



The Francis Crick Institute in London, by HOK

Roof Configuration and Connections

Metal roofing comes in multiple forms, including vertical or horizontal sheets and panels—most common in commercial projects—as well as shingles and tiles. Connections between metal panels can be made with different profiles, which can affect the system's durability and maintenance needs. Vertical options include standing seam, through-fastened, and batten seam metal roofing panels. Standing seams join the edges of two adjacent panels in a single- or double-fold perpendicular to the roof plane. The ribs of through-fastened panels are mechanically attached with threaded fasteners and washers. Batten seam roofs use wood strips at panel joints that are then flashed with a metal cap that interlocks with the panels.

Underlayment and Insulation

Options for underlayments include synthetic sheets, self-adhering membranes, and asphalt-saturated felt—one ply when the roof slope is 18 degrees or greater, and two plies when the slope is less than 18 degrees. A slip sheet between the metal roofing and underlayment may be required to prevent the latter from sticking to the former in high temperatures.

A layer of insulation under the panels is critical for mitigating thermal bridging as well as for providing a sound barrier during rainstorms or hail. Rigid insulation boards, for installation over a solid deck substrate, include extruded polystyrene, expanded polystyrene, or fiberglass insulation panels.

Codes and Standards

For information on load-bearing requirements, panel connection and fastening requirements, thermal insulation values, roof pitch, ventilation, and flashing details, architects should refer to the applicable building code for their projects as well as guidelines offered by professional industry associations and roofing manufacturers.

COURTESY LAING O'ROURKE

> To discover more metal roofing options for commercial projects, visit bit.ly/CommMetalRoof.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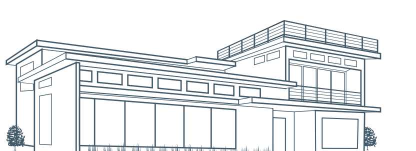
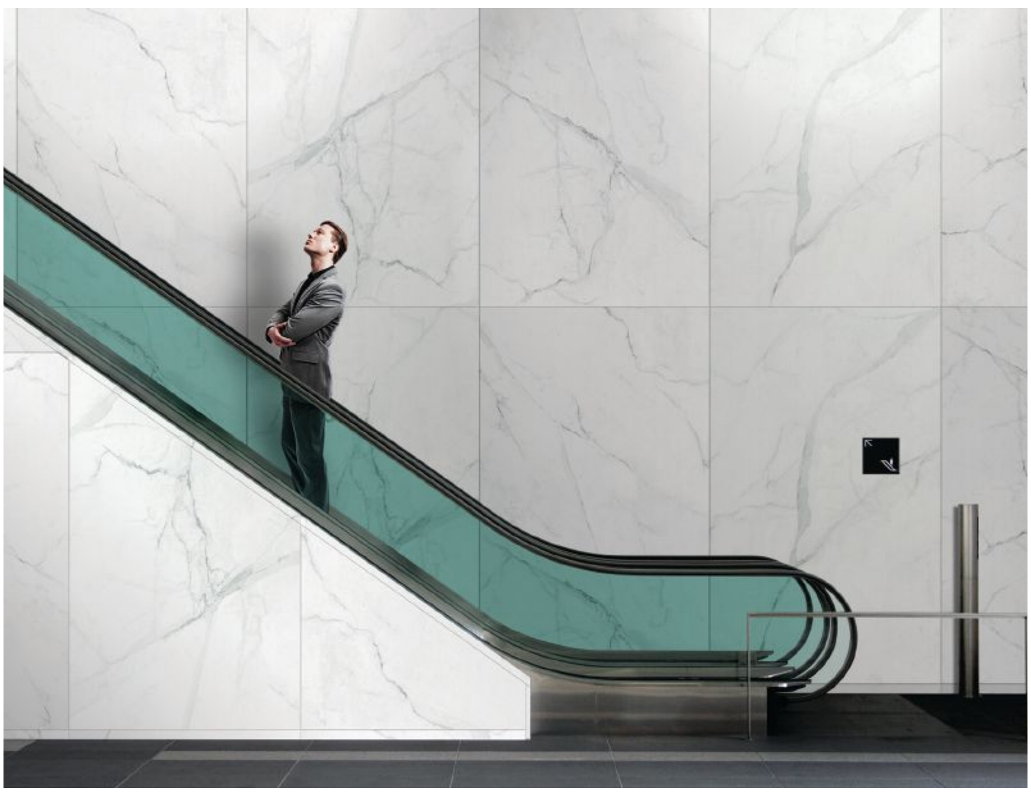


GUIDE FOR SUCCESSFUL INSTALLATION OF THIN (GAUGED) PORCELAIN TILE PANELS ON INTERIOR WALLS AND FLOORS

Presented by: Bostik smart adhesives



LEARNING OBJECTIVES

Upon completion of this course the student will be able to:

1. Examine the benefits of thin (gauged) porcelain tile panels and various installation methods
2. List surface preparation steps including how to achieve a clean and flat substrate
3. Determine which method is most appropriate for various applications
4. Understand occupant and environmental health benefits, including respirable silica, VOCs, sound abatement and recycled content

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: AR112017-7

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/AR112017-7 and complete the quiz for free as you read this article. If you are new to Hanley Wood University, create a free learner account; returning users log in as usual.

INTRODUCTION TO THIN (GAUGED) PORCELAIN TILE

Thin (gauged) porcelain tile technology is a revolutionary innovation in a centuries-old building material. They are now available in 1 meter x 3 meter (3.28' x 9.84') panels and larger, which is over 30 times the size of the largest traditional tile. Bigger tiles equate to less grouting, less labor and faster project completion. In addition, they are available as thin as 3 millimeters and can be installed over existing tile with little impact on wall thickness. This further reduces downtime, labor and waste stream impact. Thin porcelain tile panels have the same durability and ease of maintenance as traditional tile but use less material and energy to produce and require less energy to transport per square foot. These factors impact the bottom line both economically and environmentally.

The process of installing gauged porcelain tile panel technology has some similarities to traditional tile installation, but there are key differences you must be aware of as a specifier. There is now an adhesive and sound reduction membrane created specifically for thin porcelain tile panel installations. Recycled rubber crumb particles mixed into the adhesive provide the membrane's sound reduction performance. Thickness control spacer technology is built into the adhesive to ensure that proper membrane thickness is maintained between tile panels and the substrate. This ensures a flat panel edge and easy alignment.

A single layer of adhesive is troweled onto the back of the panel only, cutting the square footage necessary to trowel in half. Additionally, crewmembers dedicated to basics such as mixing, running mortar back-and-forth and similar functions, can now be redirected to work on more skilled installation procedures. In addition, new standards have been developed for gauged porcelain tile panel technology and the installation process that will affect the specification of this product.

THIN PORCELAIN TILE PANEL APPLICATIONS

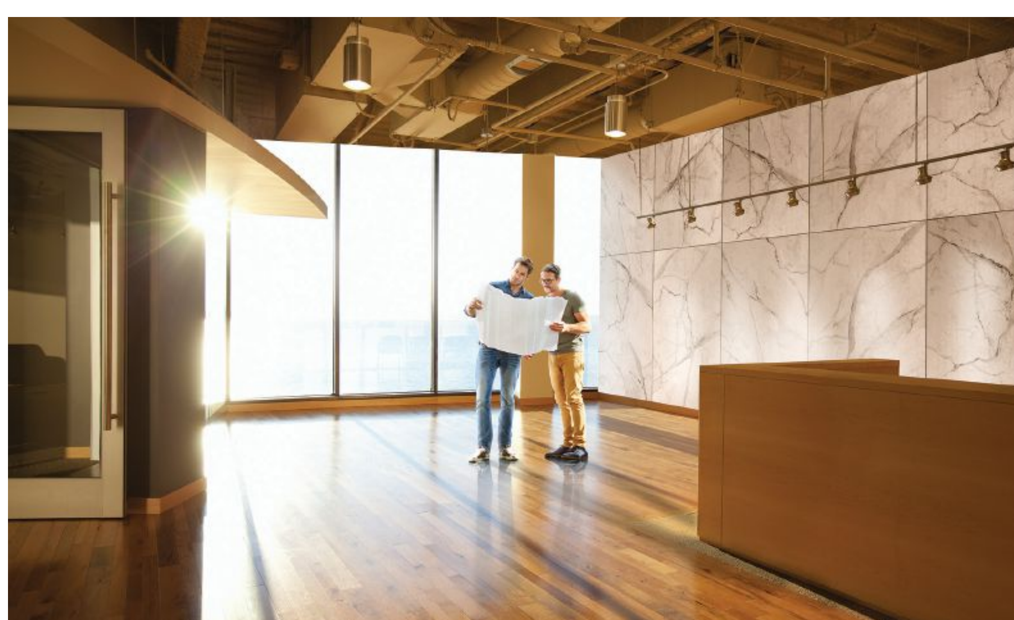
Thin porcelain tile panels can be used in a myriad of applications from commercial and institutional to residential. They are often used in lobbies and corridors, which see a great deal of traffic, for clean aesthetics and durability with fewer grout

Thin porcelain tile panels are often used in lobbies and corridors, which see a great deal of traffic, for clean aesthetics and durability with fewer grout joints.

joints. Thin porcelain tile is used in hospitals for the same reasons. In addition, the minimal grout lines are easier to clean and keep sterile. Other applications include remodeling projects where tile-over-tile or tile-over-stone is desired. Shower surrounds with few or no grout joints and countertops made of a single porcelain panel are other popular applications. Tiling curves with few or no seams is possible, as the thin product can bend slightly. Additionally, using the adhesive installation method, they may be used in transportation and related applications where vibration accommodation and structural deflection is needed such as elevator cabs, yachts, rail cars and RVs.

TRADITIONAL VS. NEW PORCELAIN TILE MANUFACTURING PROCESS

Manufacturing traditional porcelain tile entails filling a mold with powder that is then pressed to shape. Internal stresses can occur due to the mold constraining the sides of the tile. Another downside of traditional manufacturing is that the largest size available is 35 inches x 70 inches. But in the new thin porcelain tile manufacturing process, called lamina, the powder is spread loose on a belt and conveyed into a pressing machine that exerts a massive, uniform load to create tiles that are thin, flat and durable. The powder is pressed as in the traditional manner, but because there is no mold this results in less internal stress. Sometimes the tiles are reinforced with fiberglass or polymeric backing materials woven into a reinforcing mesh. When fused to the back of the tile product, the mesh allows the tiles to bend further and better resist breakage. After pressing, the belt moves the tile panel through trimming, decorating, firing and mesh mounting (if applicable).



Thin porcelain tile panels can be used in many applications on walls and floors. Acceptable uses on walls are gypsum board (drywall), concrete, cement backer board, liquid-applied waterproofing membranes, and well-bonded and sound tile.

NEW ANSI THIN PORCELAIN TILE STANDARDS

In summer 2017, more than four years of cross-disciplinary industry collaboration and 4,000-plus hours of research from the Tile Council of North America (TCNA) Laboratory Services team culminated in two new standards: ANSI A137.3, the American National Standard Specifications for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs, and its companion, ANSI A108.19, Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar. Currently known as the "thin tile" standards, the standards use the term "gauged" to cover a range of precise thicknesses that can carry different loads and be used in different ways, taking a similar approach to standardized wire gauges and gauged sheet metal.

Two classes of gauged tile products are defined:

- Products with nominal thickness from 5.0 millimeters to 6.5 millimeters for floors and walls, with or without mesh (back-layered)
- Products with nominal thickness from 3.5 millimeters to 4.9 millimeters with mesh for walls. Note that mesh (back-layered) products will also have the mesh tested for absorption (saturation).

ANSI A137.3 standardizes the minimum required properties for the products themselves and ANSI A108.19 standardizes the methodologies for installing the products in interior installations by the thin-bed method with specific mortars. These standards are the result of a multi-year consensus process of the ANSI Accredited A108 Standards Committee, which maintains a broad and diverse group of participants reflecting stakeholder interests in all aspects of the tile industry.

American National Standard Specification A137.3 describes the minimum physical properties and grading procedures for gauged porcelain tiles and gauged porcelain tile panels/slabs. It provides quality criteria for buyers, specifiers, installers, manufacturers and the public in general. "Gauged" means manufactured to a thickness that is specific and largely associated with installation and use. Tile panels/slabs are those that are one square meter in facial area or larger.

Some of the key issues addressed by this standard are:

- Floor, wall and countertop strength criteria for "Table 4" gauged products that have a declared nominal thickness within the range of 5.0 to 6.5 millimeters
- Wall and countertop strength criteria for "Table 5" gauged products that have a declared nominal thickness within the range of 3.5 to 4.9 millimeters
- Thickness accuracy and precision criteria
- Provisions for sampling and visual inspection, considering tile panels/slabs can be very large
- Provisions for gauged products with back layer reinforcing.

American National Standard A108.19 provides procedures and requirements for interior installation of gauged porcelain tiles and gauged porcelain tile panels/slabs. These products require unique installation and workmanship considerations, and some of the key issues addressed by this standard include:

- Floor and wall installation procedures for ANSI A137.3 "Table 4" gauged products
- Wall installation procedures for ANSI A137.3 "Table 5" gauged products
- Substrate requirements
- Lippage criteria and use of lippage control systems
- Unique coverage criteria and evaluation procedures
- Special floor setting provisions that involve embedding by walking.

ANSI 108.19 Section 8 Material Handling Requirements dictates that full size pieces come in over-sized crates and extended forks must be used to move them. The manufacturer must pre-plan how to deliver full size pieces to the installation site, as elevators may be too small. In addition, proper use of suction cupped frames for the larger sizes is necessary, which is especially crucial when the tiles are weakened by cutouts or holes.

ANSI 108.19 Section 10 Installing Contractor specifies that a contractor must be trained in this type of installation and have the proper equipment. They must be installers that have completed a comprehensive installation training program from a setting material or tile manufacturer, be ACT (Advanced Certification for Tile Installers) certified installers or have gone through other programs approved by the specifier.

ANSI 108.19 Section 11 General Requirements for Installation requires that thin porcelain tile panels are not installed over unsatisfactory surfaces such as defects or inadequate substrate conditions and that, if applicable, the type of membrane is qualified because some may be too compressible (such as peel and stick membranes) for loads under Robinson Floor Testing. The specifier must make sure the tile is suitable for the application, it will not encounter steel wheel traffic and all movement joints are honored.

ANSI 108.19 Section 15 Required Mortar Coverage mandates that there is 80 percent minimum mortar coverage on walls in any single square foot and 85 percent minimum mortar coverage on floors in any single square foot. There should be no voids exceeding two square inches and coverage should support all edges and corners.

TILE COUNCIL OF NORTH AMERICA (TCNA)

The Tile Council of North America (TCNA) is a trade association established in 1945 to represent manufacturers of ceramic tile, tile installation materials, tile equipment, raw materials and other tile-related products. TCNA is recognized for its leadership role in facilitating the development of North American and international industry quality standards to benefit tile consumers. Additionally, TCNA regularly conducts independent research and product testing, works with regulatory, trade and other government agencies, offers professional training and publishes industry-consensus guidelines and standards, economic reports and promotional literature.

ACCEPTABLE SUBSTRATES

Thin porcelain tile panels can be used in many applications on walls and floors. Acceptable uses on walls are gypsum board (drywall), concrete, cement backer board, liquid-applied waterproofing membranes and well-bonded and sound tile. The product can also be used on masonry, exterior grade plywood, fiberglass, stone, aluminum, steel and epoxy coated walls using manufacturer-approved adhesive systems only, not mortars.

For floors, thin porcelain tile panels can be installed on concrete (with a minimum 90-day cure), wood frame utilizing TCNA F141-15 or F-250-15 STONE, well-bonded tile and liquid-applied crack isolation membranes or waterproofing membranes. Floor systems must meet IRC for residential buildings or IBC for commercial, as well as all local building codes. The maximum allowable deflection under live load is not to exceed L/360.

Existing movement joints in substrates are to be carried through the thin porcelain tiles. Movement joints are required where the thin porcelain tiles meet restraining surfaces such as perimeter walls, curbs, columns and corners and at all changes in-plane in the tile work. Joints are to be clean and free of all contaminants. Refer to the Tile Council of North America Detail EJ-171 for further industry guidelines.

Cementitious, self-leveling underlayments are recommended to achieve flatness requirements.

SURFACE PREPARATION—FLOORS

Now that you understand the appropriate surfaces where thin porcelain tile can be installed, the most important step in installation is surface preparation. Substrates are to comply with deflection requirements called for by the International Building Code (IBC), International Residential Code (IRC), or applicable local building code. Floor surfaces must be clean, dry and flat (1/8 inch in 10 feet with no more than 1/16 inch in 2 feet) and free of voids, projections, loose materials, oil, grease, sealers and all other surface contaminants. Do not use chemical solvents for cleaning; always mechanically remove surface contaminants. To remove adhesives, sealants or coatings it is recommended to use a scraper, shot blaster or scarifier. Any paint or coating that cannot be removed must be tested to verify adhesion of the adhesive to determine the appropriate surface preparation, if needed.

Cementitious, self-leveling underlayments are recommended to achieve flatness requirements. The appropriate tools to prepare the surface for this underlayment are a diamond grinder, sander, self-leveling mixer, rake and smoother, patch mixer and trowel, as well as a dust containment device and personal protective equipment. After the surface has been prepped the appropriate final cleaning tools are simply a broom, vacuum and wet mop.

SURFACE PREPARATION—WALLS

Surface preparation of walls is equally important to that of floors. Like floors, surfaces must be clean, dry and flat (maximum allowable variation 1/8 inch in 10 feet with no more than 1/16 inch in 2 feet when measured from surface high points with a straight edge) and free of voids, projections, loose materials, oil, grease, sealers and all other surface contaminants. For surfaces other than drywall, a fast-curing cementitious patch is recommended. For drywall, drywall patching compound is acceptable.

To remove adhesive or loose material from the wall use a scraper, steamer and/or sander. To achieve flatness use a sander, patch mixer and trowel, as well as dust containment and personal protective equipment. For final cleaning use a sponge, vacuum and brush.

Flatness—Correcting High and Low Spots

Achieving flatness by correcting high and low spots, as well as gouges, voids and undulation, is very important in surface preparation. Non-flat substrates can cause inadequate coverage and voids in setting materials and weak spots in an installation that are prone to cracking, chipping and de-bonding. They also cause acoustic issues, project delays due to the need for remediation after installation and unhappy customers that can result in a damaged reputation. For these reasons, it is imperative that flatness is achieved before installing thin porcelain tile.

To limit the number of "mounds," or high spots, grind or sand the surface to an acceptable flatness tolerance. There should also be a limited number of low areas, which can be achieved by patching with a Portland cement based patch. Gouges and voids, which can be caused by impact damage or failing substrates, should also be patched with a Portland cement based patch. Undulation, which occurs in floors only, are large areas of highs and lows that can be corrected with cementitious self-leveling compound.

This article continues on http://go.hw.net/AR112017-7. Go online to read the rest of the article and complete the corresponding quiz for credit.

QUIZ

1. True or False: Manufacturing thin porcelain tile panels entails filling a mold with powder that is then pressed to shape.

2. Which new ANSI standard dictates the methodologies for installing gauged porcelain tile products in interior installations by the thin-bed method with specific mortars?
   a. ANSI A137.3
   b. ANSI A108.19

3. On which of the following wall substrates can thin porcelain tile be installed?
   a. Drywall
   b. Concrete
   c. Cement backer board
   d. Well-bonded and sound tile
   e. All of the above

4. As part of surface prep, what flatness should an installer attempt to achieve on both walls and floors?
   a. 1/8 inch in 10 feet with no more than 1/16 inch in 2 feet
   b. 1/2 inch in 10 feet with no more than 1/16 inch in 2 feet

5. True or False: Adhesives are troweled directly to the back of the thin porcelain tile panel only as opposed to the panel and wall, which makes for easier application.

6. Tile panels set with adhesive can be repositioned for ______ minutes and no blocking or shimming is needed.
   a. 10
   b. 30
   c. 60

7. Wall mortar is laid _____ thick as opposed to ______ for adhesive.
   a. 1/2 inch, 1/8 inch
   b. 1/8 inch, 1/2 inch

8. True or False: Use of a quality, flexible premixed urethane grout will enable the installation to better tolerate expansion, contraction, deflection and impact without cracking.

9. True or False: Installing thin porcelain tile panels versus traditional 12 inch x 12 inch tiles can greatly accelerate a project's timeline, sometimes nearly double the typical installation speed.

10. Using adhesive for wall applications rather than mortar requires _______ less weight to transport and stage.
   a. 50 percent
   b. 75 percent
   c. 80 percent
   d. 90 percent

SMART BATHROOMS

HOW MATERIAL SCIENCE AND TECHNOLOGY ARE ADVANCING BATHROOM DESIGN

Presented by:

DURAVIT

LEARNING OBJECTIVES

Upon completion of this course the student will be able to:

1. Describe the advantages of well-designed bathrooms and high-quality bathroom products
2. Examine how material science and technological advancements contribute to smart bathroom design
3. Explore the four activity areas in a bathroom and how technology is making them better
4. Understand how innovative materials and technological advancements are utilized in the four activity areas

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: AR112017-8

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/AR112017-8** and complete the quiz for free as you read this article. If you are new to Hanley Wood University, create a free learner account; returning users log in as usual.

DIGITAL, EASE-OF-USE LIFESTYLE TRANSLATES TO BATHROOM DESIGN

Not so very long ago, the bathroom was a place that you designed in a sober manner and visited as briefly as possible. It was frequently referred to simply as the "wet room," and, as such, it lived up to its name. Today, things are very different and the bathroom is the place where we can be at one with ourselves, where we relish a moment away from the daily hustle and bustle. The bathroom is still a place of cleansing, but one that refreshes body and soul alike, quite as a matter of course.

Designing a bathroom may seem simple—spec a toilet, sink and tub or shower and you've hit all the marks—but due to scientific progress we have gained significant knowledge about bacteria, personal hygiene, accessibility and sustainability. Designers are now morally obligated to factor this important criteria into bathroom planning. In addition, we all find ourselves living in a tech-heavy world, with digital devices touching every aspect of our lives. The bathroom is no different, as technological advancements made in other areas of the built environment are moving into this space. With all this technology inundating our lives daily, sometimes we just need a break for relaxation. While the technological advancements in a bathroom are numerous, they are subtle, simply there to make your daily routine easier, safer and more pleasant.

OCCUPANT HEALTH, SAFETY AND WELL-BEING

Bathrooms can be one of the most dangerous rooms in a building, especially for children and the elderly, who may not have the dexterity or balance to navigate a slippery, confined space with ease. In addition, the wet environment is a breeding ground for germs, particularly around the toileting area. Therefore, it is of utmost importance to design a bathroom with high performing, hygienic and sustainable materials as well as lighting that not only helps users in performing tasks but provides relaxation.

Although we will cover the restorative qualities of a bathroom in a bit, let's start with the pure utilitarian aspect of the space—hygiene. We visit the bathroom numerous times a day to use the toilet, wash our hands, take a shower and prep for the day or before going to sleep. All of these activities (A) use water and (B) contain germs. Product manufacturers have done much research and development in recent years to study surface material technology and to manufacture bathroom products that prevent the spread of germs and simplify cleaning and maintenance.

For example,

- nanotechnology-based surface treatments have been developed for use on sanitary ceramic surfaces such as sinks, toilets and urinals;
- integrated antibacterial glazing on toilets, urinals and bidets acts quickly to arrest and kill bacteria; and
- rimless flush as well as soft-close lid systems for toilets, urinals and bidets decrease the spread of germs and make cleaning easier.

Each of these innovations make the confined space within a bathroom a great deal safer in regards to bacteria, particularly E. coli.

Another hygiene consideration is a wall-hung toilet, which saves space and leaves clear floor space for easier mopping beneath, with fewer crevices and caulk lines that typically serve as breeding ground for bacteria. Modern toilets are now more streamlined as well: They are often a contiguous smooth ceramic surface that has fewer nooks and crannies for bacteria to hide. In some of these modern toilets the fixings remain completely hidden for both aesthetics and cleanliness.

Fall Safety

Beyond hygiene, fall safety and handicap accessibility are other aspects of health, safety and welfare that bathroom designers must consider. The danger of slipping on hard, wet surfaces is paramount, as bruising, a concussion or even broken bones are possible. The danger of slipping on wet surfaces can be targeted with measures such as bath steps that enhance safety and facilitate entry and exit as well as flush shower trays and anti-slip coatings.

In showers, stepping from the floor over a threshold into the shower tray poses a tripping hazard, and the lip is hard to navigate with a wheelchair. In the past, such shower trays had a tendency to pose safety and installation challenges. Now there are flush-fitting shower trays that allow installation after floor tiles have been set. A watertight drain system prevents the possibility of water damage, and, if needed, the tray can be removed later to provide access for servicing. Be sure to specify shower trays with a transparent anti-slip coating to help feet gain a more secure hold in the shower.

Bathroom lighting is another important safety feature that is also benefitting from technological advancements. A well-lit bathroom provides important task lighting and allows those with limited vision to navigate the bathroom safely. Provide enough overhead lighting, vanity/mirror lighting and shower/tub lighting so users can easily see (and clean) spilled water and mildew, can see well to put on makeup (and look good) and can safely navigate a shower enclosure or tub.

Of utmost importance is designing a bathroom with high-performing, hygienic materials, lighting that not only helps users to perform tasks but provides relaxation and sustainability in mind.

Accessibility

The American Institute of Architects (AIA) Home Design Trends Survey (HDTS) tracks emerging trends in residential design. The quarterly surveys cover home and property design (Q1), home features (Q2), neighborhood and community design (Q3) and kitchen and bath features and products (Q4). The HDTS educates homeowners about trends they may want to explore and allows residential architects to position themselves as the most knowledgeable professionals in the home construction and remodeling industry.

According to the AIA's Q4 2016 Home Design Trends Survey, accessibility remains the leading consideration in bathroom design features. Desired bathroom features include adaptability/universal design, stall showers without a tub, larger walk-in showers and radiant heated floors. Bath products that emphasize accessibility are also key features. These include doorless/no threshold showers, water-saving toilets and upscale shower and sensor faucets.

AIA Q4 2016 Home Design Trends Survey
https://www.aia.org/resources/3436-aia-home-design-trends-survey

Sustainability

When designing smart bathrooms, sustainability is a socially and environmentally imperative goal that all bathroom designers should seek to achieve. This is especially important because

In recent years, water efficiency science has set and met the goal to advance bathroom product technology so that high-efficiency toilets, urinals, sinks, showers and bathtubs simply use less water to operate effectively.

ADA IN THE BATHROOM

The Americans with Disabilities Act (ADA) is a federal civil rights law that prohibits discrimination against people with disabilities by ensuring equal access to goods and services. The regulations for implementing the ADA include both scoping and technical specifications for new or altered state and local government facilities, public accommodations and commercial facilities to be accessible to and usable by individuals with disabilities. This means in restroom design some of each type of fixture or feature—as well as the installation location—must meet accessibility requirements contained in the 2010 ADA Standards for Accessible Design.

The needs of a person using a wheelchair and the space the wheelchair requires are used as a primary source of design information for accessible restrooms in terms of amount of space and paths of travel. The fixed nature of the equipment imposes finite space requirements and limits reach ranges of users. Therefore, clear floor space, turning radius, entryway widths and reach ranges are key considerations.

Also important to note is how ADA standards translate to the population as a whole. Even though they are mandated in certain public buildings, the idea behind the standards is to aid and assist those with limited mobility, dexterity and vision. In the interests of an even wider reach for more accommodating designs, and to extend those designs beyond accessibility minimums, the concept of universal design arose to create an environment that can be accessed, understood and used to the greatest extent possible by *all* people regardless of their age, size, ability or disability.

This table lists some general considerations when specifying bathroom products that adhere to ADA standards:

Toilets and Urinals • Height • Transfer position • Toilet compartment clearances • Wall-hung vs. wall-mounted • Grab bars • Toe clearance • Flush control	Showers or Tub/Shower Units • Curbs and thresholds • Interior dimensions • Grab bars • Control location • Handheld shower • Water containment • Seating
Lavatories • Counter height • Knee and toe clearance • Reach range • Faucet operability	Accessories and Lighting • Reach range • Mounting heights • Distance fixtures extend from wall • Operability

of the great deal of water used in bathroom fixtures. Water scarcity is a pressing issue for communities, urban planners, developers and others, particularly in arid regions and metropolitan areas across the United States.

In recent years water efficiency science has set and met the goal to advance bathroom product technology so that high-efficiency toilets, urinals, sinks, showers and bathtubs simply use less water to operate effectively. For example, the water consumption of toilets and urinals is measured in gallons per flush (gpf). The gallons of water it takes to effectively flush waste has decreased over the years from 1.6 gpf to 1.28 gpf. Then dual-flush fixtures with 1.6/0.8 gpf, creating a blended flush of 1.1 gpf, were developed. The dual-flushing technique until this point had been the best way to save water; when the bigger button is pressed, the full amount of flushing water is used. When the smaller button is pressed a smaller amount is used. The latest in the evolution of water-saving technology are 1.1 gpf toilet systems and hybrid urinals with water-free technology. All bathroom fixtures, including faucets and showerheads, have similar water consumption measurements, and all have seen incremental decreases over the years

Beyond water efficiency, it is simply smart to design with durable, classic products that will equate to a bathroom that lasts a very long time. Consider the fact that bathrooms from the 1930s are still being used today. That is because they were designed and constructed with materials that will last a lifetime. Of course, the technology wasn't available at that time (or even until very recently) to ensure these fixtures were using water wisely. Now we know and must do our due diligence to design sustainable, forward-thinking bathrooms that also will last for generations.

Resell Value

Not only will an innovative, smart bathroom last for generations, it will also help to sell the home when the time comes. Homeowners (and the hospitality industry) are increasingly seeking bathrooms that have a spa-like environment, so designing with features such as high-quality and high-performing components, scene lighting, Bluetooth connectivity and even home automation tie-ins will increase resale value.

According to Hanley Wood's "2017 Cost vs. Value Report," several of the most expensive projects, including the **upscale bathroom remodel**, saw the biggest year-over-year percentage increases in value, rising between 5.6 percent and 7.4 percent. That being said, the lowest return on investment in all of "Cost vs. Value" is a **midrange bathroom addition**, with a payback of just 53.8 percent. Not a single kitchen or bath project ranked higher than 17th out of the 29 projects. This is probably because these projects involve remodeling something to make it better, rather than replacing something that's broken. On average, the replacement projects carry a 74 percent return on investment, while remodeling projects pay back just 63.7 percent. In addition, kitchen and bath jobs are inside the home, but real estate pros tend to put more importance on "curb appeal" projects. Also, kitchen and bath jobs take a lot of skill and labor and they are very personal places where one homeowner's style may not fit a future buyer's. If a homeowner is going to invest in a new bathroom, it should be upscale in order to see a positive return on investment.

Hanley Wood "2017 Cost vs. Value Report" http://www.remodeling.hw.net/cost-vs-value/2017/key-trends-in-the-2017-cost-vs-value-report

A nanotechnology-based, easy-to-care surface remains ceramic smooth, attractive and clean for a long time. Dirt and lime don't stick to the smooth surface; rather, residue beads off and easily washes away with the water.

MATERIAL SCIENCE AND TECHNOLOGICAL ADVANCEMENTS CONTRIBUTE TO SMART BATHROOM DESIGN

Sanitary Ceramic—Nanotechnology in the Bathroom

Ceramic consists of the natural raw materials clay, kaolin, quartz and feldspar. Quartz, chalk, feldspar and the mineral stone dolomite are mixed to make the glaze. Ceramic's resistance to extreme high temperatures allows a firing temperature of approximately 1,280 degrees C (2,336 degrees F). This results in a very high level of hardness, which is particularly advantageous in public sanitary facilities. The hygienically smooth surface glaze is wear- and scratch-resistant, easy to clean, and thus ideal for use in the health care sector. Sanitary ceramic is skin friendly as well as heat and fade resistant.

There are now bathroom products utilizing a nanotechnology-based surface treatment that makes sanitary ceramic even easier to keep clean by sealing the material at the molecular level to make it 1,000 times smoother. Nanotechnology is the branch of technology that deals with dimensions and tolerances of less than 100 nanometers, especially the manipulation of individual atoms and molecules. Nanotechnology is used in many consumer products today, but bathroom products are the perfect place to see this technology realized.

This surface treatment is applied to sanitary ceramic after the first firing process. The ceramic product (typically sinks) is "dusted" with the coating and then fired in a special kiln. The easy-to-care surface remains ceramic smooth, attractive and clean for a long time. Dirt and lime don't stick to the smooth surface; rather, residue beads off and easily washes away with the water. Less dirt equates to less cleaning, which only entails a soft cloth and mild cleaning agent.

Antibacterial Glazing for Toilets and Urinals

E. coli is a huge concern in the toilet area, but there are antibacterial glazings on the market with metal ions (on a tin-zinc basis*) in the glazing that kill and/or prevent bacteria, removing their breeding ground. This is an unprecedented hygiene standard for toilets, urinals and bidets. After just six hours, 90 percent of bacteria (e.g., E. coli) are effectively killed. After 12 hours, 99.9 percent of bacteria are eradicated. After 24 hours, the glazing reaches an unprecedented level of 99.999 percent bacteria elimination. Furthermore, the glazing arrests the bacterial growth in comparison to a conventional ceramic glazing.

*Note that antibacterial silver ions often used on surfaces may be ineffective, especially in combination with additional coatings on the surface.

The glazing's manufacturing process is key to its impressive reduction in pathogens like E. coli. Integrated into the glaze and fired into the ceramics permanently, the antibacterial glazing extends from the interior of the basin to the flushing rim of the toilet or urinal, targeting the areas that are particularly common for bacteria and germ development and ensuring steady, nearly unlimited active protection. There is no coating on the surface. With this thoughtful and intuitive design, it easily tackles areas high in bacteria accumulation and swiftly kills E. coli bacteria by use of the "oligodynamic reaction," the effect of positively charged metal ions on bacteria.

This article continues on http://go.hw.net/AR112017-8. Go online to read the rest of the article and complete the corresponding quiz for credit.

QUIZ

1. True or False: According to the AIA's Q4 2016 Home Design Trends Survey, accessibility remains the leading consideration in bathroom design features.

2. True or False: The gallons of water it takes to effectively flush waste has decreased over the years from 1.6 gpf to 0.9 gpf.

3. True or False: Sanitary ceramic with a nanotechnology surface treatment causes residue to bead off and easily wash away with water.

4. The antibacterial glazing discussed in this course kills ______ percent of bacteria after 24 hours.
   a. 90 b. 99.9
   c. 99.999

5. True or False: Antibacterial glazing is integrated into the glaze and fired into ceramics permanently, ensuring steady, nearly unlimited active protection.

6. Synthetic solid surface has ____ slip resistance without further coating.
   a. Class A b. Class B
   c. Class C

7. Which of the following describes ambient luminescence?
   a. Light for seeing b. Light for looking
   c. Light to look at

8. True or False: If we want to relax in the bathroom in the evening or only need to brush our teeth before going to bed, light should be a warm or reddish light so that the body can come to rest.

9. True or False: The advantages of a lacquered surface are that there is no visible edge and there are a wide range of colors available.

10. Which of the following products belong in the washing area of a bathroom?
    a. Sink b. Shower
    c. Bathtub c. Toilet

SPONSOR INFORMATION

DURAVIT

Founded in 1817 in the heart of Germany's Black Forest, Duravit is a leading manufacturer of designer bathrooms. Duravit operates in 130 countries worldwide and has been honored with numerous national and international awards for its innovations in design and technology. The company has collaborations with internationally renowned designers such as Philippe Starck, Phoenix Design, EOOS, Cecilie Manz and sieger design.

Presented by:

BUILDING MATERIALS MATTER

LIFE-CYCLE VIEW SUPPORTS INFORMED CHOICES, CONTRIBUTES TO SUSTAINABLE DESIGN

Clay Creative | Architect: Mackenzie | Photo: Christian Columbres

LEARNING OBJECTIVES

Upon completion of this course the student will be able to:

1. Compare the life-cycle impacts of common building materials, from the extraction or harvest of raw materials through end-of-life disposal or recycling/reuse
2. Articulate the influence of wood on operational energy efficiency
3. Consider a growing body of research on the impacts of visual wood on occupant health and well-being
4. Discuss design considerations related to a building's safety, resilience and long-term durability

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
GBCI CREDIT: 1 CEU HOUR

AIA COURSE NUMBER: AR112017-5

GBCI COURSE NUMBER: 0920014303

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From an environmental perspective, it is widely known that buildings matter. Buildings consume nearly half the energy produced in the United States, use three-quarters of the electricity and account for nearly half of all carbon dioxide (CO_2) emissions.[1] The magnitude of their effects is the driving force behind many initiatives to improve tomorrow's structures—from energy regulations and government procurement policies, to green building rating systems and programs such as the Architecture 2030 Challenge. The focus on energy efficiency, in particular, has led to widespread improvements, so much so that many designers are now giving greater attention to the impacts of structural building materials.

With an abundance of information and competing environmental claims, determining a material's true impacts can be a challenge. Does wood reduce a building's carbon footprint in a meaningful way? Is it better to use recycled steel or wood from a sustainably managed forest? To what extent do structural materials impact operational performance? Does resilience depend on the material or on proper design and maintenance?

This course seeks to address these and other questions. Examining materials throughout their life cycles, it focuses on international research supporting the use of wood for its carbon and other benefits while considering some of the advantages of concrete and steel. It also touches on the efforts by all three industries to lessen their environmental impacts. The reality is that no one material is the best choice for every application. There are trade-offs associated with each, and each has benefits that could outweigh the others based on the objectives of a project.

IMPORTANCE OF A LIFE-CYCLE VIEW

Understanding a material's impact at every stage of its life is essential for designers looking to compare alternate designs or simply make informed choices about the products they use. Life-cycle assessment (LCA) is an internationally recognized method for measuring the environmental impacts of materials, assemblies or whole buildings, from extraction or harvest of raw materials through manufacturing, transportation, installation, use, maintenance, and disposal or recycling.

LCA is sometimes described as mysterious and complicated. Yet what is involved is simply a thorough accounting of resource consumption, including energy, emissions, and wastes associated with production and use of a product. For a "product" as complex as a building, this means tracking and tallying inputs and outputs for all assemblies and subassemblies—every framing member, panel, fastener, finish material, coating and so on. To ensure that results and data developed by different LCA practitioners and in different countries are consistent, LCA practitioners must adhere to a set of international guidelines set forth by the International Organization for Standardization (ISO).

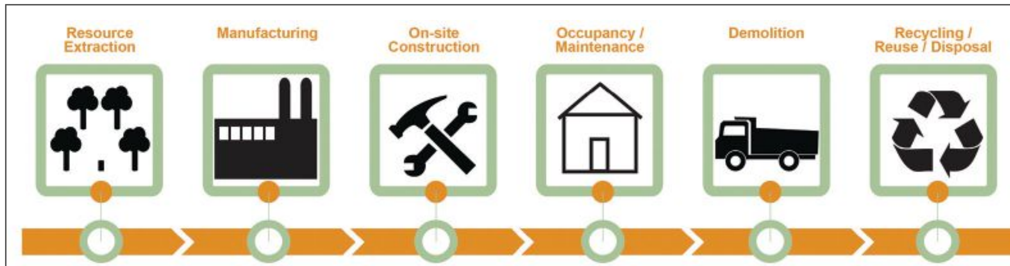
The use of LCA in North America is increasing due in part to the availability of easy-to-use and affordable tools (see sidebar, "Calculating the Impacts of Building Designs"). LCA is also included in all of the major green building rating systems, providing an alternative to the "prescriptive approach" to material selection. This approach assumes that certain prescribed practices, such as specifying products with recycled content, are better for the environment regardless of the product's manufacturing process or disposal. It was a cornerstone of early green building efforts, when there was relatively little information available on the impacts of individual products at different life-cycle stages.

LCA studies consistently demonstrate wood's environmental advantages. For example, one literature review examined all of the available research from North America, Europe and Australia pertaining to the life-cycle assessment of wood products.[2] It applied LCA criteria in accordance with ISO 14040-42 and concluded, among other things, that:

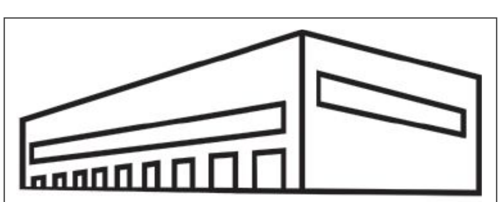
- Fossil fuel consumption, the potential contributions to the greenhouse effect and the quantities of solid waste tend to be minor for wood products compared with competing products.
- Wood products that have been installed and are used in an appropriate way tend to have a favorable environmental profile compared with functionally equivalent products made from other materials.

The table below illustrates the results of an LCA comparing a simple commercial structure designed in wood, steel and concrete. Designed for the Atlanta geographical area, the building footprint was 20,000 square feet (100 feet by 200 feet). The structure is two stories in height and 20 feet tall, with 40,000 square feet of total floor area. To simplify analysis, the theoretical building was analyzed without windows, doors or internal partitions. All three configurations were assumed to have a concrete foundation and slab.

The analysis involved systematic assessment, using life-cycle methodology, of all building assemblies beginning with raw material extraction through primary and secondary manufacturing, transport at all stages of the production chain and to the job site, and building construction. As shown in the table, impacts for the wood design are lower than either the steel or concrete design across all indicators.



Life Cycle of Building Products



TWO STORIES
200' x 100' x 20' height
20,000 ft² footprint
Total ft² = 40,000

COMPARISON OF ENVIRONMENTAL IMPACTS OF STEEL VS. WOOD DESIGN
(Values indicate magnitude of impact associated with steel design as multiple of wood design impact)

Fossil Fuel Consumption	Weighted Resource Use	Global Warming Potential	Acidification Potential	Human Health Respiratory Effects Potential	Eutrophication Potential	Ozone Depletion Potential	Smog Potential
1.4x	1.02x	1.6x	1.4x	1.3x	3.0x	1.5x	1.2x

COMPARISON OF ENVIRONMENTAL IMPACTS OF CONCRETE VS. WOOD DESIGN
(Values indicate magnitude of impact associated with concrete design as multiple of wood design impact)

Fossil Fuel Consumption	Weighted Resource Use	Global Warming Potential	Acidification Potential	Human Health Respiratory Effects Potential	Eutrophication Potential	Ozone Depletion Potential	Smog Potential
1.9x	2.3x	3.0x	2.4x	2.1x	4.7x	5.8x	2.4x

Source: Athena EcoCalculator

Wood products store carbon. In the case of wood buildings, the carbon is kept out of the atmosphere for the lifetime of the structure—or longer if the wood is reclaimed and reused or manufactured into other products.

CARBON FOOTPRINT: REDUCING GREENHOUSE GASES

Although there is growing awareness that using wood from sustainably managed forests can reduce a building's carbon footprint, only a portion of wood's benefits are recognized in an LCA. As noted, the LCA literature review concluded that fossil fuel consumption and potential contributions to the greenhouse effect tend to be minor for wood products compared with competing products. This is because wood products require less energy to manufacture than other major building materials, and most of that comes from renewable biomass (e.g., sawdust, bark and other residual fiber).[3]

The other aspect to wood's carbon footprint is that as trees grow they absorb carbon dioxide (CO_2) from the atmosphere, release the oxygen (O_2), and incorporate the carbon into their wood, leaves or needles, roots, and surrounding soil. Young, vigorously growing trees take up carbon quickly, with the rate slowing as they reach maturity (typically 60-100 years, depending on species and environmental factors). Over time, one of three things then happens:

- When the trees get older, they start to decay and slowly release the stored carbon.
- The forest succumbs to wildfire, insects or disease and releases the carbon quickly.
- The trees are harvested and manufactured into products, which continue to store much of the carbon. (Wood material is approximately 50 percent carbon by dry weight.) In the case of wood buildings, the carbon is kept out of the atmosphere for the lifetime of the structure—or longer if the wood is reclaimed at the end of the building's service life and reused or manufactured into other products.

Unless the land is converted to another use, the cycle begins again as the forest regenerates and young seedlings once again begin absorbing CO_2. For more information, the USDA Forest Service recently released an infographic illustrating the forest/carbon cycle (https://www.usda.gov/media/blog/2016/06/3/wonders-wood-buildings).

CALCULATING THE IMPACTS OF BUILDING DESIGNS

Numerous free tools are available to evaluate the environmental impacts of building designs. For example, the Athena Impact Estimator for Buildings gives users access to life-cycle data without requiring advanced skills. It can model more than 1,200 structural and envelope assembly combinations, allowing for quick and easy comparison of design options. Another free tool, the Carbon Calculator for Wood Buildings (http://cc.woodworks.org/), focuses on carbon footprint. Users input the volume of structural wood in a building, and the calculator estimates how much carbon is stored in the wood, the greenhouse gas emissions avoided by not using steel or concrete, and the amount of time it takes North American forests to grow that volume of wood.[4]

INITIAL EMBODIED IMPACTS: FROM EXTRACTION TO CONSTRUCTION

The impact of materials from extraction or harvesting through manufacturing, transportation and construction are considered initial embodied impacts. They are distinct from operational impacts, which result from a building's operation and from recurring embodied impacts, which relate to the durability of building materials, components and systems; how well they're maintained; and the service life of the building. Building materials tend to have the greatest impact from extraction through manufacturing. Within an LCA, this is also where wood's advantages are most evident.

Raw Materials

The life cycle of building products typically starts with the extraction of raw resources such as timber, iron ore, limestone and aggregates. The collection of data starts here, with the tracking of energy use and emissions to air, water and land per unit of resource. Wood's impacts during this phase are relatively low compared with concrete and steel, which are made from substances that must be mined and heated to extremely high temperatures.[5]

A typical concrete mix is about 10 to 15 percent cement, 60 to 75 percent aggregate and 15 to 20 percent water, though proportions change to achieve different requirements for strength and flexibility. While most of concrete's ingredients are themselves manufactured products or mined materials, it's the cement in concrete that has the highest embodied energy.[6] According to the U.S. Energy Information Administration, the cement industry is the most energy-intensive of all manufacturing industries. Cement is also unique in its heavy reliance on coal and petroleum coke.[7]

A major ingredient needed for cement is limestone, which is found in abundance in many places in the world. In most cases, limestone is blasted from surface mines and removed in large blocks to a crusher, mixed with other raw materials, and transferred to a rotating furnace, where it is heated to about 2,700 degrees Fahrenheit in order for the materials to coalesce. The mixture is cooled and ground to fine powder (cement), which is transported to its destination by truck, rail or ship. Fly ash, a byproduct of coal burning, can be substituted for some of the cement, as can a variety of other ingredients, with associated reductions in carbon footprint.[8,9,10,11]

Steel is an alloy consisting mainly of iron and has a carbon content between 0.2 percent and 2.1 percent by weight, depending on grade. Steel's main ingredient is iron ore, which must be extracted through open-pit mining and heated to extremely high temperatures. In surface mines, ground is removed from large areas to expose the ore. Ore is then crushed, sorted and transported by train or ship to the blast furnace, where the iron is heated to 3,000 degrees Fahrenheit, usually with charcoal or coke, and charged with the ore and limestone. The molten iron drains off, and iron ingots are formed. This pig iron, as the ingots are called, is the basis for steel.[12, 13, 14, 15, 16, 17]

For both concrete and steel there are environmental consequences from open-pit mining, and from the fossil fuels used to process the raw materials. However, both industries continue making strides to lighten their environmental footprint.[18, 19, 20]

This article continues on http://go.hw.net/AR112017-5. Go online to read the rest of the article and complete the corresponding quiz for credit.

QUIZ

1. To ensure that LCA results and data are consistent, practitioners must adhere to a set of international guidelines set forth by the:
   a. U.S. Green Building Council
   b. Federal government
   c. International Organization for Standardization
   d. American Society of Civil Engineers

2. True or False: A product traveling a long distance using a highly efficient transportation method can actually have a smaller transportation footprint than a closer product traveling inefficiently.

3. Commercial buildings represent an opportunity to reduce environmental impact by using more wood as a structural and finish material for what reason?
   a. They're built more quickly than other building types
   b. The commercial building stock is relatively old, with about half of all buildings constructed before 1980
   c. They're built for higher seismic loads
   d. All commercial buildings are currently steel or concrete

4. Which ingredient in concrete has the highest embodied energy?
   a. Limestone
   b. Aggregates
   c. Cement
   d. Fly ash

5. In both the United States and Canada, responsible forest management has resulted in how many years of net forest growth that exceeds annual forest harvests?
   a. More than 50
   b. More than 40
   c. 30
   d. 10

6. By using woody biomass (e.g., sawmill residues such as bark and sawdust) to fuel its operations, the North American lumber industry is estimated to be what percent energy self-sufficient?
   a. 20-30
   b. 30-40
   c. 50-60
   d. 100

7. Which of the following make wood-frame enclosures inherently more efficient than steel-frame or concrete construction from a thermal perspective?
   a. The insulating qualities of the wood structural elements, including studs, columns, beams and floors
   b. It's easy to add insulation to wood stud walls
   c. Options exist for insulating wood-frame buildings that aren't available for other construction types
   d. All of the above

8. Whether a building is made from concrete, steel or wood, which of the following is/are necessary for long-term durability?
   a. Proper design and detailing
   b. Quality control
   c. Maintenance
   d. All of the above

9. True or False: A recent study on steel recycling found a much greater potential for steel recovery and recycling than is currently being realized.

10. Technical innovations and the availability of next-generation lumber and mass timber systems are at the heart of an emerging movement to do what?
    a. Use more visual wood for its impacts related to health and well-being
    b. Reduce carbon footprint and other environmental impacts by using wood for larger, taller structures
    c. Improve the energy efficiency of wood buildings
    d. Leave more room for insulation in building designs

REPETITIVE ELEMENTS IN PRECAST ULTRA-HIGH PERFORMANCE CONCRETE

HOW TO INCREASE QUALITY AND DECREASE COST

Presented by:

LAFARGE Ductal® A technology of LafargeHolcim

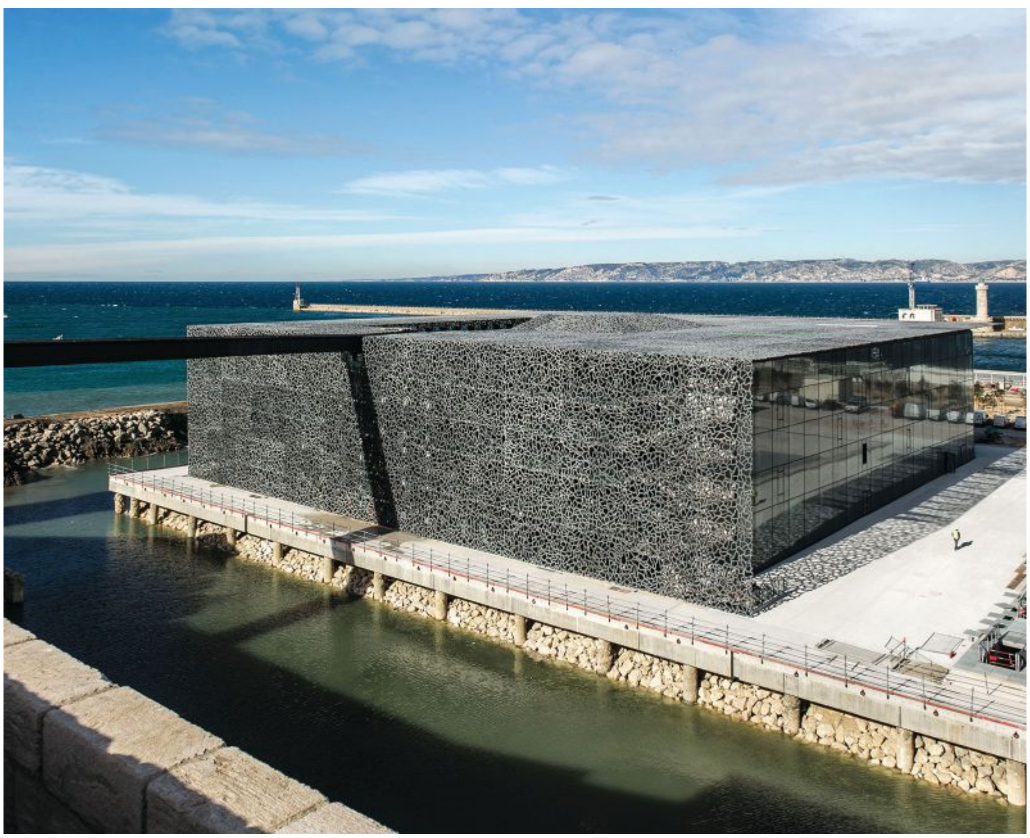


Figure 1: MuCEM, Marseille, France. A unique UHPC lattice facade, roof, columns and footbridge met rigid structural and aesthetic requirements. Architect/photo: Rudy Ricciotti

LEARNING OBJECTIVES

Upon completion of this course the student will be able to:

1. Explain why some Ultra-High Performance Concrete (UHPC) design elements may be cost prohibitive.
2. Describe how UHPC design elements may be developed in order to achieve maximum mold utilization.
3. Explain how to use small customizations in order to gain large design effects in repetitive elements.
4. Assess a project for its viability to incorporate UHPC elements.

CONTINUING EDUCATION

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By Kelly A. Henry, M.Arch, MBA, LEED AP

Ultra-High Performance Concrete (UHPC) products have a combination of superior properties including strength, durability and ductility. The material is extremely moldable and can replicate texture, form and shape with the greatest precision, thereby facilitating the ability to design and produce thin, lightweight, yet highly durable precast elements with simple or complex shapes, curvatures and customized textures.

Over the past few decades, our specific brand of UHPC has been used in hundreds of architectural and engineering projects in multiple countries. In many cases, these projects incorporated challenging, unprecedented and/or highly innovative design concepts that were previously difficult or impossible to achieve with traditional reinforced concrete elements. In France, for instance, one can visit many innovative UHPC projects including the Jean Bouin Stadium, the Museum of European and Mediterranean Civilizations (MuCEM) and the Louis Vuitton Foundation for Creation, to name a few (see Figure 1). In North America, UHPC has also been used to create unique, beautiful facades for major retail chain stores such as Louis Vuitton, Nike and Brown Jordan.

Despite successful completion of these many projects, UHPC is still considered a relatively new cladding material. In recent years however, further development has lead to significant advancements in the design and production of innovative facades and other unique architectural applications including:

- rainscreens with textures and curvatures
- curved and flat curtain walls
- decorative brise soleil with lattice-style panels
- perforated, double-skin systems
- ultra-thin, large canopy systems
- energy-efficient louvers and sunshades
- mechanically fastened restoration systems.

UHPC is typically perceived as a design material with a designer price tag. Historically, the main reason why UHPC elements could be so expensive was because of the precaster's need to develop multiple, specialized molds, in order to cast each required element in a design. However, overall project cost savings can be achieved through experience and knowledge of how the casting process works, as well as increased mold utilization rate.

For this learning unit, we will focus on the use of repetitive precast UHPC building elements which permit greater use of a single mold, and thereby result in increased quality and decreased production cost. Naturally, through repetitive production, the precaster will become well-acquainted with the mold and the process. Ultimately, personal experience and knowledge gained will attribute to increased quality of UHPC design elements at a reduced production cost.

SUPERIOR PERFORMANCE PROPERTIES

UHPC is comprised of materials that are commonly found in concrete (cement, silica fume, sand, superplasticizer and water), along with unique ingredients like ground quartz and polyvinyl alcohol (PVA) or metallic fibers, depending on the application.

PVA fibers are typically used for architectural UHPC cladding elements and steel fibers for civil or structural projects. In the case of PVA fibers, compressive strengths reach up to 17,000 psi (120 MPa) and flexural strengths reach up to 2,175 psi (15 MPa) (see Figure 2). Some steel fiber UHPC mixes can give considerably higher values at 26,000 psi (180 MPa) compression and 5000 psi (35 MPa) in flexure.

Significantly stronger than conventional concretes, UHPC elements can be smaller, with more refined details, without or with reduced passive reinforcing steel and in most applications, without prestressed or post-tensioned reinforcement.

Due to its optimized gradation of the raw material components, UHPC is 10 percent denser than conventional concrete. This density, along with nanometer-sized non-connected pores, also contributes to its remarkable imperviousness and durability against adverse conditions or aggressive agents. There are many different chemical formulations available.

TYPICAL CHARACTERISTICS FOR UHPC WITH PVA FIBERS		
STRENGTH		
Compressive	17,000 psi	120 MPa
Flexural	2,200 psi	15 MPa
Youngs Modulus (E)	6,500 ksi	45 GPa
Direct Tension	725 psi	5 MPa
Flexural value—Thin Plate	2,175 psi	15 MPa
DURABILITY		
Freeze-thaw (after 300 cycles	100%	
Salt scaling (loss of residue)	<0.013 lb/sf	
HRT cycles	100%	
Abrasion (relative volume loss index)	1.7	
Oxygen permeability	<10-9 sf	
Carbonation Depth	<0.02 in	
OTHER PROPERTIES		
Density	2.2-2.4 S.G.	
Capillary porosity	<1%	
Total porosity	3-6%	
Post-cure shrinkage	<10-5	
THERMAL PROPERTIES		
Heat transfer, insulating properties and thermal expansion coefficient are similar to normal concrete. For fire-rated structures, UHPC formula is available. Fire performance similar to normal concrete		
MOLDING		
The fineness of UHPC raw materials and fluidity of the mix facilitates the ability to replicate the micro-texture of the form surface or special mold textures.		
COLORS		
Grey or light grey; liquid or powder pigments may be added to achieve solid or blended colors.		
The values indicated above depend on the product characteristics, experimentation method, raw materials, formulas, manufacturing procedures and equipment used—all of which may vary.		

Figure 2: Typical Characteristics for UHPC with PVA Fibers

Overall, by utilizing the material’s combination of properties, designers can create thinner sections and longer spans that are lighter, more graceful and innovative, with improved durability and impermeability against corrosion, abrasion and impact. Other advantages may stem from improved site construction safety, speed of construction and extended usage life.

UHPC's superior durabilty and strength attributes to also attribute to sustainable, eco-friendly creations with extended design life. For example; the production of slender architectural UHPC elements, require substantially less material (compared to steel, other metals or conventional concrete), yet they are expected to have an extremely long, extended service life that will result in less environmental impact over time.

Based on ion transportation predictive modeling, it would take 1,000 years for UHPC to have the same level of chloride penetration as high-performance concrete would have in less than 100 years (see Figure 3). Building facades, with a possible design life of 1,000 years, significantly reduced need for maintenance, and less environmental impact over time is a huge paradigm shift from the way sustainable infrastructure is viewed today.

It is important to understand that good UHPC material is very consistent in its formulation. Once the user has determined how to predict its flow based on temperature shifts and cure times, they can cast it successfully in a repeated scenario very easily. Its consistency also lends to potential streamlining of certain processes and reduces material loss during casting. The aforementioned key factors all lead to better pricing. As well, an architect should not consider repetitive UHPC elements as "boring." Just as one must study and know the rules before breaking them, the same concept applies to repetitive elements in UHPC design. Once the standard casting procedures are understood, one or two small variations on a typical prototype can yield some very interesting and innovative customized creations, without the custom price tag.

By developing a segment of the UHPC market that removes the "you can do anything" concept and asking the architect to design within recommended parameters, they can push towards a truly inspired design and, at the same time, make it happen within a realistic budget.

REPETITIVE UHPC ELEMENTS EXISTING TODAY

Flat Panel Rainscreens

In recent years, the design community has been shifting away from the use of metal or synthetic cladding systems. Prior to development of the UHPC cladding system presented below, the only commercially available rainscreen facade product with a "natural finish" was stone. Therefore, the development of industrially produced thin, flat UHPC panels was a natural progression towards the provision of a new cladding solution that is highly suitable for the many requirements and desires of modern architects and owners.

As previously mentioned, UHPC's combination of superior characteristics facilitate the ability to design and construct innovative building facades in a vast range of aesthetics, finishes or textures that were not previously achievable. UHPC panels are thin, lightweight and easy to install (using standard attachment systems), lending to speed of construction. The surface finish exhibits extremely low porosity with high resistance to abrasion, impact and harsh environmental conditions, resulting in superior resiliency and reduced need for maintenance.

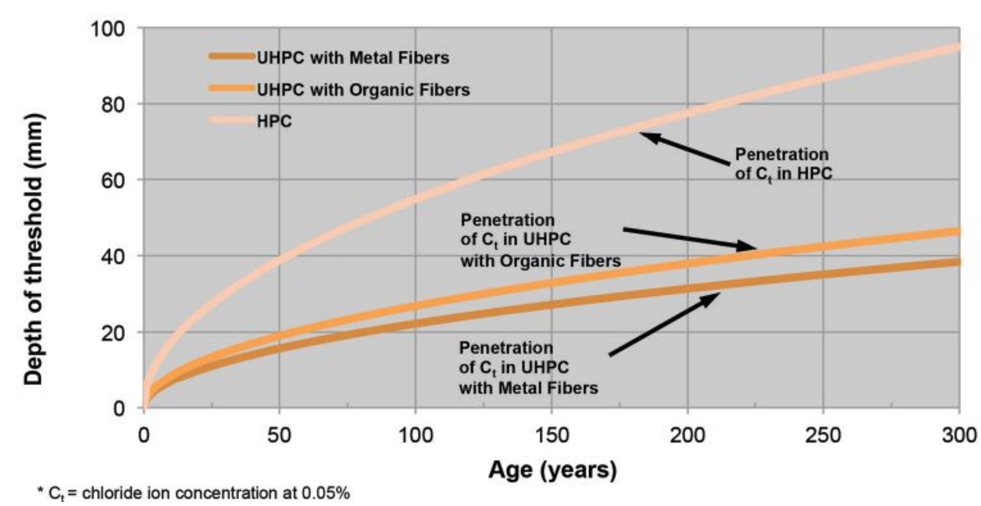

Figure 3: Predicting Service Life with Chloride Ion Transportation Predictive Modeling: Ductal® UHPC vs. High Performance Concrete. *Source: Dr. Michael Thomas, P.Eng., "*Performance of Reactive Powder Concrete in a Marine Environment*", ACI Annual Conference 2010, Chicago, IL, USA.

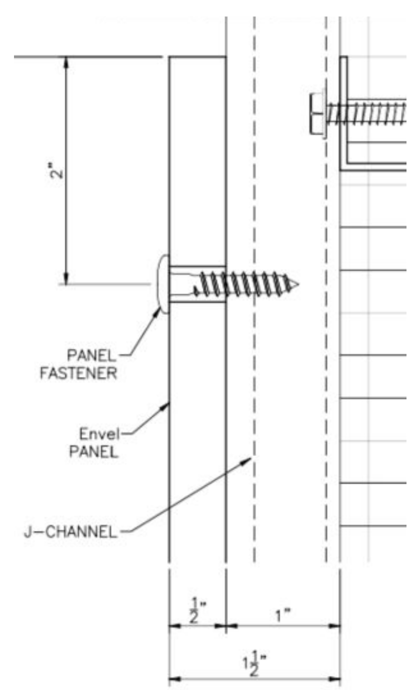

Figure 4a: Exposed, Face Fastened System

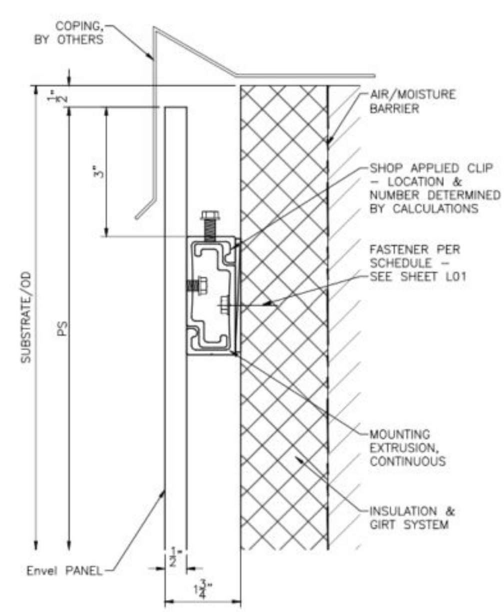

Figure 4b: Hidden Fastening System

In North America, UHPC rainscreen panels have been commercially available for a few years. This type of panel system is moderately customizable through the use of form liners and pigment color addition, and may also be produced in a range of standard textures and colors. Panel size and orientation are other important factors that must be assessed in order to meet budget.

The largest UHPC panel that may be produced at a thickness of 1/2 inch (1.3 cm) is 4 ft x 8 ft. (1.22 m x 2.4 m). Larger panels require an increased thickness of 5/8 inch (1.59 cm) or up to 1 inch (2.54 cm), depending on size. The 4 ft x 8 ft (1.22 m x 2.4 m) panels are considered to be the largest size that two people can safely place by hand without specialized hoisting equipment, which can greatly reduce the installation budget. The most economical panel size to produce and install is approximately 3 ft x 5 ft. (0.91 m x 1.52 m) In any case, it is important to assess the mother mold size with the desired final panel size in order to achieve the best possible yield out of the singular panel. The manufacturing process starts with a mother mold which is then cut into smaller panels, therefore designers should be aware that patterns may be cut anywhere off of the larger panel and have potential to not match perfectly from panel edge to panel edge, especially with large, unrepeated patterns.

The casting of specific panel sizes, in order to accommodate specialized patterns across multiple panels, is a highly customized project with a much higher price point. Considering that custom mold costs on small projects (less than 5,000 ft^2 [464 m^2]) typically represent between 5-10% of the total project cost, custom molds are better amortized on larger projects (10,000 ft^2 [929 m^2] or larger).

A final, important aspect of this system is the use of hidden fasteners versus exposed, face fasteners (see Figures 4a and 4b).

Hidden fastening systems are more economical with larger format panels, measuring 3 ft x 5 ft (.9M x 1.5M) or more. Hidden fastening systems on smaller panels consume significant, additional aluminum for the hanging system, which then drives up the price. Of course, as each project is different and presents its own challenges. It is always desirable to work with your preferred panel supplier early in the design process as they will be able to help develop a design that best suits the aesthetic and the budget. Requirements such as panel sizing, clipping systems and orientation can all attribute to a cost-conscious budget.

There are several precedent projects for this type of system; one of the largest to date is the Fulton State Hospital in Missouri. This project utilized a simple texturized panel as well, as a custom pattern to form the basis of the design for the facade. See this project in more detail below in the Project Examples Section.

This article continues on http://go.hw.net/AR112017-2. Go online to read the rest of the article and complete the corresponding quiz for credit.

QUIZ

1. When designing for Precast UHPC elements, what strategy creates the largest impact on project cost?
   a. High mold utilization rate
   b. Not using pigment
   c. Using standard textures
   d. Low mold utilization rate

2. What properties of UHPC make it so durable?
   a. Compact gradation of the materials in the matrix
   b. Low porosity due to small and disconnected air pockets
   c. Chloride penetration reduction
   d. All of the above

3. What fiber type is most typically used in architectural UHPC applications?
   a. Steel
   b. PVA (Polyvinyl Alcohol)
   c. Stainless steel
   d. Cellulose

4. What are some of the easy ways to create customization in a UHPC element?
   a. Using form liners
   b. Adding block outs to a single mold
   c. Using the same cast element but rotate for installation
   d. All of the above

5. What is the largest size of panel that can be installed by hand with out the need of lifting equipment?
   a. 4' x 12'
   b. 4' x 8'
   c. 5' x 10'
   d. 3' x 5'

6. What project size is best if you would like to create a custom pattern but not have it drive the cost of the project too high?
   a. 10,000 ft^2 or bigger
   b. 10,000 ft^2 or smaller
   c. 5,000 ft^2 or bigger
   d. 5,000 ft^2 or smaller

7. True or False: Fins and Mullions are relatively the same element, but a Mullion must be designed strong enough to hold the extra weight of glass, while a fin only needs to be designed for its self-weight.

8. What are the positive features for using UHPC in sandwich wall panels?
   a. Higher potential R-value/no need for passive reinforcing
   b. Overall panel is lighter / higher thermal mass
   c. Increased strength / lower durability
   d. Higher durability/higher thermal mass

9. In what locations can UHPC be cast and delivered?
   a. Only near major cities in the North America and abroad
   b. Within 250 miles of the precast plant
   c. Worldwide
   d. None of the above

10. True or False: Specifications should be written to describe the desired performance and finish of a UHPC element.

SPONSOR INFORMATION

DESIGNING ARCHITECTURAL WALL PANELS AS RAINSCREENS THAT ACCOUNT FOR WIND

Presented by:

NICHIHA fiber cement

LEARNING OBJECTIVES

Upon completion of this course the student will be able to:

1. Describe the cause and effect of moisture intrusion in a wall system
2. Examine the importance of rainscreens and weather barriers in water mitigation
3. Identify examples of rainscreen technology and testing standards that measure rainscreen performance
4. Discuss how some commercial architectural wall panels act as a rainscreen and review how wind loads can affect their performance

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: AR112017-6

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CAUSES OF MOISTURE INTRUSION AND RAINWATER PENETRATION

Moisture intrusion in a wall system can be the cause of building defects, as well as of health ailments for the building's occupants. Moisture sources differ depending on climate, construction practices and occupant lifestyles, but some common sources of moisture that present in all climates are construction moisture, elevated relative humidity, precipitation and groundwater sources.

Bulk moisture intrusion occurs when a significant amount of water enters a building from precipitation, often caused by wind-driven rain or groundwater sources. The cause may be faulty or non-existent flashing, poor site grading, improper or non-existent rainscreens behind exterior claddings, and non-existent or poorly maintained gutters and downspouts. Water concentrates around window and door openings, the roofline and construction joints, and the base of exterior walls. The building envelope (exterior walls and roofing) acts as the interface between the interior and exterior of buildings. To avoid moisture problems in extreme weather conditions, building envelope design must control water deriving from all of these factors.

The purpose of rainscreens, as their name implies, is to prevent rainwater penetration through walls. Rainwater penetration can be caused by any of the following conditions:

- The presence of water on the substrate (structural backup)
- Openings in the substrate of the wall that allow water penetration
- Pressure differences that force water ingress through the substrate

Air-Pressure Differences and Water Ingress

Raindrop kinetic energy propels raindrops into unprotected openings in the substructure. In hot, humid climates with air-pressure differentials—that is, where air pressures are lower inside the structure than outside it—water can be driven from the exterior to the interior of the building through microscopic holes in the building materials.

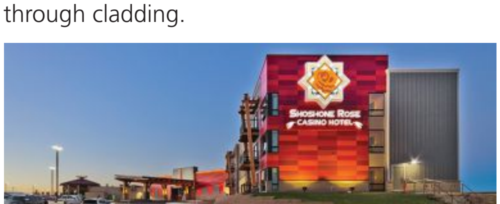
Surface tension causes water to cling to and travel along the underside of horizontal surfaces and then continue along the underside of building components such as joints and window heads. This water can be drawn into the building by gravity or unequal air pressure.

Gravity moves rainwater down the face of the cladding and into sloped openings that the water encounters on its way down. The force of water entering by gravity is greatest on improperly sloped horizontal surfaces and vertical surfaces with penetrations. These areas must remove water from envelope surfaces through adequate sloping, correct drainage and proper flashing.

"Capillary action" is a suction force that draws water into permeable materials and small openings. It is the natural upward wicking force that occurs primarily at the base of exterior walls. Building components that cannot withstand a large amount of water exposure, such as plywood or gypsum board, can create environments conducive to microbial growth and/or component failure.

During heavy rainstorms, raindrop momentum, or wind-driven rain, can force water inside the building if the envelope is not resistant to these forces. For example, window sealants and gaskets that are not properly designed to flex with the window may create air gaps that can allow water into the building.

Fortunately, there are design approaches for managing each of these water-driven forces through cladding.



Understanding how wind loads are determined for walls and siding/cladding is a very important step in the specifying phase of a design project, regardless of its intended use or location.

THE LOWDOWN ON WIND LOADS

Taking into account wind loads is naturally important for buildings in Florida and anywhere near the coastline, but wind loads are actually defined in all buildings in all geographical areas. Hurricane-prone regions, like Florida and the coastal Carolinas, have additional requirements, and even their own building codes, defining more stringent building guidelines, but wind storms, thunderstorms and tornadoes can happen throughout most of the U.S. Understanding how wind loads are determined for walls and siding/cladding is a very important step in the specifying phase of a design project, regardless of its intended use or location.

Wind loads relate to the amount of pressure wind exerts on any given zone of a building and its components. The parameters used to determine wind loads include the following:

1. Basic Wind Speed
2. Wind Directionality Factor
3. Exposure Category
4. Topographic Factor
5. Gust-Effect Factor
6. Enclosure Classification
7. Internal Pressure Coefficient

The first five parameters are completely dependent on the geographic location of the structure and its surroundings. The last two are specific to the structure design itself.

The Basic Wind Speed figure is the most important, and probably best known, parameter in determining design wind loads of structures. Basic wind speeds are further broken down into one of four possible risk categories, which relate to the structure's intended use and the number of occupants it will house. Assigning risk categories (formerly called occupancy categories) to a structure is key. The risk category takes into account how many people would be affected by a structural failure or building collapse, exit options, whether toxic chemicals would be emitted as a result of the failure, etc. The higher the risk category, the higher the basic wind speeds and the design wind loads for that particular structure.

The International Building Code and the ASCE 7-10 both publish contour basic wind speed maps by risk category, whereby each risk category has its own basic wind speed map. The Basic Wind Speed is defined by the Structural Engineering Institute as the "three-second gust speed at 33 ft. above the ground in Exposure Category C."

The parameter Exposure Category refers to the prevailing wind direction relative to the surface roughness of the terrain or landscape surrounding the structure. There are only three exposure categories: B, C and D. The fourth category, Exposure A, was deleted in the last revision of the ASCE-7 publication. The 33 feet is an arbitrary height. Wind speeds, and loads, increase with height. After 60 feet, there are additional factors affecting wind loads. The 33-feet figure aims to encompass most structures and serves as an average and easy reference point.

Commercial architectural wall panels (AWPs) are designed and intended exclusively for low- to mid-rise buildings.

DESIGN PRESSURES AND HEIGHT

How do manufacturers determine wind load capabilities for their products? And how do they make a product that can be installed in the highest of wind areas and still perform as intended? A building can be under pressure at any given time. In fact, a building is subject to pressure from both inside and outside. Design pressures are those exerted on the building envelope (or exterior surrounding wall). There are also positive pressures exerted from the inside of the building to the outer walls. Design pressure is defined as the equivalent static pressure to be used in the determination of wind loads for buildings.

Cladding manufacturers provide performance information for their siding according to design pressures so they can meet with a prescribed fastening schedule. These can be found in third-party code evaluation reports and in the manufacturer's published technical information.

Fastener Schedules and Wind Load

How does a siding manufacturer know what the fastening schedules should be in any given building?

The most widely accepted standard is ASTM E330, or Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference. The test consists of a 4-foot-by-8-foot sample assembly of the siding product that is sealed against one face of a test chamber. This creates a vacuum within the test chamber. Air is then forced behind the siding product, simulating wind suction. The pressures are increased in preset intervals, and the pressure at which failure occurs is recorded. There are displacement gauges placed in different parts of the assembly wall to determine how much the product moves during the test. Measurement of any deformation that may have occurred during the test is also required.

There is a layer of 2-millimeter-thick polyethylene film sandwiched between the sheathing and the siding material. The standard calls for the film to be applied loosely, with extra folds at each of the siding overlaps and at each corner of the assembly. The test specimen is supposed to include expansion joints or vertical joints, and to closely simulate real-world installation of the siding.

The ASTM E330 test is performed until failure. Failure can occur by two means:

- Fastener pull-out
- Fastener pull-through

Fastener pull-out occurs when the force exerted on the fastener (in this case, the wind suction pressure) exceeds the joint's maximum pull-out force. The joint is defined as the connection point between the structure and the siding. This connection is either through direct fastening of the siding to the structure or via the fastening of installation hardware that in turn secures the cladding. The strength of this joint is highly dependent on fastener withdrawal capacity with respect to the framing type and the type of fastener treatment. For example, a ring shank nail creates a stronger joint because of the added friction that must be overcome to remove the nail from the framing member. A smooth shank nail that has been hot-dipped versus electrogalvanized will yield a stronger joint because the hot-dipping process creates added friction on the nail's shank. Shank diameter is also a factor (the larger the shank diameter, the stronger the joint); in addition, the density or specific gravity of the lumber or gauge of metal used in the framing members plays a strong role in joint strength. Species of wood with higher specific gravities and higher gauge metals (18 or heavier) are best suited for these types of joints.

Fastener pull-through occurs when the loads exerted on the joint (fastener/siding/framing member) exceed the strength of the siding in the thickness direction. This type of failure is dependent mostly on the strength of the siding in the "through-the-siding" direction, and on the fastener head diameter. The thicker the siding, the stronger the joint. A larger head diameter acts like a snow shoe by covering a larger amount of surface area over the siding, increasing the strength of the joint. As siding boards are lapped, the overlap joint becomes the weakest point in the assembly. When overlaps are less than 1.5 inches, the joint is significantly weakened, making siding easier to dislodge. Similarly, with a concealed installation hardware system, the cladding fails with the fastening and hardware still secured tightly to the structure. Fastener pull-through occurs most often in steel-framed structures, as the strength of the joint is much higher into steel.

Architectural wall panels should be designed to resist strong or even severe weather events. ASCE 7 builds a high degree of safety into structures, including components and cladding, by using very rare weather extremes as a minimum basis for design. High performance attachment systems can be created to allow panels to withstand the most rigorous engineering design criteria, such as those of Miami-Dade. Short of cladding failure due to wind loads, during wind-driven rain events, wind pressures can stress cladding joints, opening up points of entry for bulk moisture. That's why the added benefit of a rainscreen, coupled with high wind resistance, is an important line of defense against moisture.

BUILDING RISK CATEGORIES

- **Risk Category I:** Buildings mostly unoccupied, such as silos or barns.
- **Risk Category II:** Encompasses the majority of structures, including residences and most commercial and light industrial buildings. In general this is the default risk category when structures do not meet the parameters of another category.
- **Risk Category III:** Structures that generally house a large gathering of people in one place. These include movie theaters, places of large assemblies and concert halls. Risk Category III also encompasses structures inhabited by people with limited ability to safely egress in the event of failure, such as correctional facilities, small hospitals and elementary schools.
- **Risk Category IV:** Emergency services structures such as police and fire stations and hospitals. When these facilities fail, there would be a large-scale state of emergency for the facility itself—for example, the hospitals in New Orleans during Hurricane Katrina and its aftermath.

Risk Category II buildings make up the majority of structures and include residences and most commercial and light industrial buildings. In general this is the default risk category when structures do not meet the parameters of another category.

BUILDING EXPOSURE CATEGORIES

- **Surface Roughness B:** Urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions the size of single-family dwellings or larger. Surface Roughness B prevails upwind for more than 2,600 feet, or 20 times the height of the building. (Exception: More than 1,500 feet if the building is less than 30 feet.)
- **Surface Roughness C:** Open terrain with scattered obstructions at heights of generally less than 30 feet. This category includes flat open country and grasslands. Applies whenever Surface Roughness B and D do not apply.
- **Surface Roughness D:** Flat, unobstructed areas and water surfaces. This category includes smooth mud flats, salt flats and unbroken ice. Surface Roughness D prevails upwind for more than 5,000 feet, or 20 times the height of the building. It is applicable 600 feet inland and at more than 10 times the building height.

BUILDING ENCLOSURE CLASSIFICATIONS

- **Open:** Has each wall at least 80 percent open (no doors); for example, a truck stop or tire barn canopy.
- **Partially enclosed:** Has two different parameters relating to pressure equalization.
- **Enclosed:** Does not fall into the above two categories.

To find out the exposure category and basic wind speeds in the area where a building is being designed:

- Determine the risk category based on occupancy for your building in order to identify the proper map to use for reference.
- Find the location on the map where your structure is situated.
- Follow the contour line with the Basic Wind Speed corresponding to the geographical location of your structure.

RAINSCREEN OVERVIEW

Now that we've covered the negative effects water can have on a building and its occupants,

Rainscreens shed most of the rain and manage the rest, preventing moisture intrusion and the resulting premature decay in buildings.

as well as the significance of calculating wind load and design pressure, let's examine the importance of rainscreen and weather barriers in water mitigation.

The rainscreen approach is a successful method for deterring rainwater intrusion into walls. Rainscreens shed most of the rain and manage the rest, preventing moisture intrusion and the resulting premature decay in buildings. Rather than attacking the symptoms of moisture intrusion, rainscreens tackle the source—the forces that drive water into the building shell. By neutralizing these forces, rainscreens can withstand extreme environments. They appear to be effective in any climate and handle any weather condition short of a disaster.

Over time, rainscreens have become defined as the exterior surface of a building (cladding) that has direct contact with the weather and elements but is not directly attached to the building substructure. A rainscreen can be described as a barrier that sheds and attempts to control (but not prevent) the majority of the rainwater intrusion into the cavity between itself and the substructure.

A rainscreen is set off from the moisture-resistant surface behind it, which leaves a cavity, or pocket of air, between the rainscreen and the surface of the substrate (structural backup). A rainscreen can loosely be called a veneer, though certain requirements must be met for the term "rainscreen" to be accurately used.

Rainscreen Wall Assembly

According to "The Rainscreen Principle" in the *National Research Council Canada's Construction Technology Update No. 9*, two exterior walls are better than one at controlling water penetration into a building. There are three required components of a rainscreen wall assembly, which offer multiple moisture-shedding pathways:

- The outer leaf or barrier is a vented or porous cladding (the rainscreen) that deters surface raindrop momentum.
- An air chamber or cavity—a few inches of depth is sufficient—separates the cladding from the support wall, reducing splashing and capillary moisture transfer. Large, protected openings (i.e. vents or weep holes) positioned at the top and bottom of the wall promote convective airflow, allowing moisture to quickly drain or evaporate from the air cavity.
- The inner leaf or barrier acts as the final moisture barrier and drainage layer that further protects against any moisture that bypasses both the cladding and air cavity. It is composed of a weather-resistive (air/water/vapor) barrier, insulation and the building structural wall.

QUIZ

1. Rainwater penetration is caused by which of the following?
   a. The presence of water on the substrate
   b. Openings in the substrate that allow water penetration
   c. Pressure differences that force water ingress through the structural backup
   d. All of the above

2. True or False: Wind loads are defined only for those buildings along a coastline in hurricane-prone regions.

3. Which of the following is the most important parameter in determining design wind loads of structures?
   a. Enclosure Classification
   b. Exposure Category
   c. Topographic Factor
   d. Basic Wind Speed

4. Which of the following refers to the prevailing wind direction relative to the surface roughness of the terrain or landscape surrounding the structure?
   a. Exposure Category
   b. Wind Directionality Factor
   c. Gust-Effect Factor
   d. Internal Pressure Coefficient

5. Which of the following describes Building Exposure Category "Surface Roughness D"?
   a. Urban and suburban areas
   b. Urban terrain with scattered obstructions
   c. Flat, unobstructed areas and water surfaces

6. Which of the following occurs when the loads exerted on the joint (fastener/siding/framing member) exceed the strength of the siding in the thickness direction?
   a. Fastener pull-out
   b. Fastener pull-through

7. In which type of rainscreen system is water *intended* to be allowed into the cavity areas between the outer wall and the substructure?
   a. D/BV rainscreen
   b. PER rainscreen
   c. Modified rainscreen

8. True or False: A water-resistive barrier (WRB) is always required when installing fiber cement architectural wall panels.

9. Which type of joint system is simpler to design and install?
   a. Open joint
   b. Closed joint

10. True or False: One example of a modified rainscreen is a paneled wall system that is installed to framing using clips that hold the panels away from the structure.

This article continues on http://go.hw.net/AR112017-6. Go online to read the rest of the article and complete the corresponding quiz for credit.

SPONSOR INFORMATION

NICHIHA fiber cement
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Nichiha is a leading manufacturer of fiber cement siding and architectural wall panels for commercial, national brand and residential applications. Nichiha is headquartered in Atlanta, with 13 plants across three countries. Nichiha offers ever-expanding finishes and textures, the most comprehensive warranty in the industry and a highly engineered installation system.

UNDERSTANDING SUSTAINABLE INSULATION AND LEED V4

Presented by:

By Gale Tedhams, Director of Sustainability, Owens Corning

GREEN BUILDING INDUSTRY DEMAND

The green building market is set to experience a 13 percent growth rate through 2020.[1] In fact, the global average of those expecting to design more than 60 percent of their projects sustainably by 2018 more than doubles the 2015 levels from 18 percent to 37 percent.[2] And design firms tell us that nearly two-thirds of their projects were sustainable by 2015 and sustainable renovations were undertaken by half of all firms worldwide. The global spread of sustainability is on FIRE!

Strong growth is attributed in part to the rising awareness of global warming and climate change issues and the knowledge that sustainable building techniques lead to a lower level of greenhouse gas emissions. Other drivers of growth include multiple government policies supporting green building construction, growing awareness of energy efficiency and the cost-effectiveness of green buildings.

Health-related concerns are also driving product selection, especially concerns about indoor air quality and chemical content. Although energy efficiency is king in the commercial built environment, indoor air quality and water are gunning for the crown. Among B2B decision makers for product selection, the number two criteria (after energy efficiency) was: "Product contains no chemicals of concern." When architects were questioned regarding their concern about chemicals found in products coming in contact with skin, such as carpeting and electronics:

- 54 percent are concerned
- 27 percent are unconcerned
- 19 percent are undecided[3]

LEED® 2009 VS. LEED V4—WHAT'S NEW FOR SUSTAINABLE DESIGN, CONSTRUCTION AND OPERATIONS

Building materials impact both architectural performance and the human experience. The definition of sustainable design, construction and operations is using practices that significantly reduce or eliminate the

LEARNING OBJECTIVES

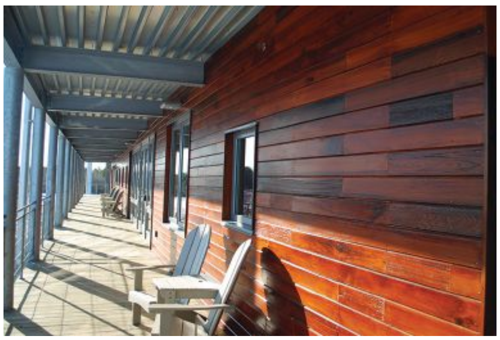
Upon completion of this course the student will be able to:

1. Review the status of the green building market
2. Understand the history of LEED and compare the differences between LEED 2009 and LEED v4
3. Describe how insulation products can contribute points to LEED v4
4. Examine case studies where insulation products were used in green buildings

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: AR112017-3

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/AR112017-3 and complete the quiz for free as you read this article. If you are new to Hanley Wood University, create a free learner account; returning users log in as usual.



The definition of sustainable design, construction and operations is using practices that significantly reduce or eliminate the negative impacts of a building on its occupants and the environment.

negative impacts of a building on its occupants and the environment.

One way to achieve sustainable design is through LEED certification. LEED has evolved since 1998 as a guide and measure for incorporating green building technologies. The pilot version, LEED New Construction (NC) v1.0, led to LEED NC v2.0, then LEED NCv2.2 in 2005 and LEED 2009 (aka LEED v3) in 2009. LEED v4 was introduced in November 2013 and as of October 31, 2016, was the only version of LEED under which new projects could register.

There were quite a few changes made to the New Construction (NC) category within the Building Design and Construction (BD+C) Rating System from LEED 2009 to LEED v4. A new credit, Integrated Process, encourages teams to plan and work together before a project starts in order to perform an early analysis of the interrelationship of systems. The Site Assessment credit is also new and awards one point for projects that assess the site's condition before design for features such as topography, hydrology, climate, vegetation, soils, human use and human health effects.

Sustainable Sites (SS)

LEED v4's Sustainable Sites credit category is similar to version 2009 and still contains credits for Construction Activity Pollution Prevention, Heat Island Reduction, Light Pollution Reduction, Protect or Restore Habitat, and Open Space. But some credits, such as Bicycle Facilities, Access to Quality Transit and Green Vehicles, have been moved to the new Location and Transportation (LT) credit category. Location and Transportation now comprises 16 percent of credits while Sustainable Sites is 10 percent.

Prior Stormwater Management credits are now referred to as Rainwater Management and are under the Sustainable Sites category. Options for credits are (1) percentile of rainfall events and (2) natural land cover conditions. For percentile of rainfall events, the project must manage the runoff on the site for a certain "percentile of regional or local rainfall events." For the natural land cover conditions option, the project must "manage on site the annual increase in runoff volume from the natural land cover condition to the post developed condition."

Location and Transportation (LT)

The new Location and Transportation credit category addresses sustainable communities and land use. Some notable new features in this category include points for projects that build on LEED for Neighborhood Development certified sites, as well as a credit for "high priority sites." New projects can earn points for building in historic districts, on brownfield remediation sites or on a site with "priority designation" such as one that is on an EPA National Priorities List or one that is sited as a Federal Empowerment Zone.

Energy and Atmosphere (EA)

The Energy and Atmosphere credit category is similar in structure to LEED 2009, as it still addresses commissioning, refrigerant management, minimum and optimized energy performance, green power, and renewable energy, but Energy and Atmosphere now requires building-energy metering in a new prerequisite. The building must install a meter (or submeters) that track the total building energy consumption at least monthly, and the project must commit to providing these data to U.S. Green Building Council (USGBC) for at least five years. A project can also earn an additional point for more rigorous metering and tracking of its energy usage. This is consistent with USGBC's increased emphasis on building performance, rather than just design.

Water Efficiency (WE)

There are some significant changes to the Water Efficiency category; the credits are now Indoor Water Use Reduction and Outdoor Water Use Reduction. The indoor water use prerequisite and credit are similar to the Water Use Reduction credit from LEED 2009 but the Outdoor Water Use Reduction is now required as a prerequisite. Water metering is perhaps the most significant update to this credit category, as building-level water metering is now required as a prerequisite. Projects can meet the requirement by installing water meters for a selection of various water subsystems, such as irrigation, domestic hot water and indoor plumbing fixtures. Projects can earn an additional point for installing more water meters on more types of subsystems.

Materials and Resources (MR) and Indoor Environmental Quality (EQ)

Materials and Resources now takes a more holistic view, integrating human health into the equation rather than only considering the materials used on a project. Similarly, the Indoor Environmental Quality credit now has more low VOC requirements, and acoustics have been added as an area where projects can gain points. Both are vital to the health of building occupants.

As you can see, LEED v4 has kept some prerequisites and credits virtually the same but has made some significant changes to nearly every major credit category. Many of these additions, such as the water and energy metering requirements, focus on the certified building's continued performance rather than just the design. LEED v4 has also made site selection and consideration an important part of the LEED decision-making process and provides extra incentive for integrated project design. As mentioned, new projects were not eligible for LEED 2009 registration as of November 1, 2016, but there are projects in progress registered before this date.

Let's delve deeper into these last two credit areas, Materials and Resources (MR) and Indoor Environmental Quality (EQ).

The new Materials and Resources category seeks to first disclose, then optimize, thereby transforming the market by driving product improvement.

MATERIALS AND RESOURCES

The Materials and Resources credit category has arguably changed the most out of all of the existing credit categories. The only prerequisites and credits that look remotely similar to the LEED 2009 version are Storage and Collection of Recyclables and Construction and Demolition Waste Management Planning. The new credits include Building Life-Cycle Impact Reduction and Building Product Disclosure

BROCK ENVIRONMENTAL CENTER

Brock Environmental Center was constructed with the goal of receiving the Net Zero Energy Building Certification™ and meeting the guidelines specified by the much more demanding Living Building Challenge™.

Sustainability in Action
Resting on 118 acres of undeveloped salt marsh land, the Brock Environmental Center was built as a regional home for the Chesapeake Bay Foundation's environmental education programs. Through student field trips and tours for the general public, the building serves as a tool to teach those within the community about the Chesapeake Bay and why its conservation is so important.

What makes the Brock Center unique is that it was constructed with the goal of receiving the Net Zero Energy Building Certification™ and meeting the guidelines specified by the much more demanding Living Building Challenge™.

To attain these goals, stringent specifications had to be followed. One requirement included using on-site renewable energy to achieve 100 percent of the building's energy needs on a net annual basis. Another important requirement was to utilize functional, efficient building materials that contributed to the sustainability of the building, such as XPS insulation, throughout the project.

Brock Environmental Center Sustainability Facts

- Uses 80 percent less energy than most office buildings[4]
- 70 percent of energy comes from photovoltaic solar panels and 30 percent comes from two residential wind turbines[4]
- Does not use any water other than what is captured on-site in rain cisterns and for all drinking needs
- Utilizes geothermal wells, composting toilets and reclaimed materials

> Many of the kids of Hampton Roads have never been on our waterways, even though they live right next to it. This is what is around us. This is the treasure we have. This is also something we need to take care of. We see this building as a model. So, when people come to the site and they see what we've done, we hope we will be able to inform them of why we did it and how important it is to change the way we build.
>
> —Christy Everett
> Hampton Roads Director, Chesapeake Bay Foundation

How to Meet Strict Material Specifications
The Living Building Challenge™ has very strict specifications when it comes to the building materials being used in construction. Beyond the consideration of energy efficiency and performance, architects and contractors must also be aware of material toxicity and sustainability. There were countless hours of research involved. "Finding materials that were compliant [with the Living Building Challenge™] was definitely the hardest thing," recounted Tyler Park of Hourigan Construction. Every product had to be closely studied and scrutinized, and thermal insulation was no different.

The Solution
One of the reasons high compressive strength rigid foam XPS insulation was chosen for the project was it had excellent insulation value and thermal break capability, as well as a recycling option for all scrap insulation that was critical to the project. "One of our mandatory goals was to limit the amount of materials going to the landfill," explained Janet Harrison, the project's green consultant. Leftover material was shipped back to the manufacturer, where it was reground to produce new insulation.

High compressive strength rigid foam XPS insulation saves energy and reduces greenhouse gas emissions by providing a durable exterior insulation that is resistant to moisture and provides an insulating value of R-5 per inch.

and Optimization for Environmental Product Declarations (EPD), Sourcing of Raw Materials and Material Ingredients.

The Building Life-Cycle Impact Reduction credit has four options: historic building reuse, renovation of abandoned or blighted buildings, building and material reuse, or a whole-building life-cycle assessment. The intention of the credit is to encourage reuse and lessen the building's environmental impact.

The Building Product Disclosure and Optimization credits aim to encourage the use of products with limited impacts throughout their lifetimes, and from manufacturers that provide transparency about their products' ingredients and manufacturing processes. Chemical transparency and disclosure is understanding materials in products and the hazards associated with those materials (pure chemical hazards, not risk as an end product). It is intended to allow for greater understanding in decision making.

In LEED 2009, these credits really focused on individual features such as Forest Stewardship Council (FSC)-certified wood or a certain percentage of recycled material, but the new credits attempt to capture a more comprehensive view of the material's sustainability throughout its life cycle. They not only encourage the project teams to use more sustainable materials, but also incentivize product manufacturers to provide better, more detailed information about where their products came from, how they were produced and what they contain. Essentially, the new Materials and Resources category seeks to first disclose, then optimize, thereby transforming the market by driving product improvement.

THE PRODUCT LIFE CYCLE

LEED v4 includes product and whole building life-cycle assessment (LCA). Life-cycle assessment is a compilation and evaluation of the inputs, outputs and potential environmental impacts of a product system throughout its life cycle. In other words, a product's cradle-to-grave environmental life cycle. ISO standards define "product" to be inclusive of a product or a service. The life-cycle assessment process can be applied to both items, and provides very good results. The term "life cycle" refers to the notion that a fair, holistic assessment of environmental impact requires the assessment of:

- Raw material production
- Product manufacturing
- Distribution
- "Use" phase

Under the Building Life-Cycle Impact Reduction credit there is also a Whole Building LCA option available for new construction only (this is one of four options).

- Disposal phase
- Impact of all transportation steps

Building Life-Cycle Impact Reduction Credit—Whole Building LCA Option

Under the Building Life-Cycle Impact Reduction credit there is also a Whole Building LCA option available for new construction only (this is one of four options). For new construction (buildings or portions of buildings), project teams should conduct a life-cycle assessment of the project's structure and enclosure that demonstrates a minimum 10 percent reduction, compared with a baseline building, in at least three of the six impact categories listed below, one of which must be global warming potential. No impact category assessed as part of the life-cycle assessment may increase by more than 5 percent compared with the baseline building. These are the impact categories:

- Global warming potential (required)
- Stratospheric ozone
- Acidification
- Eutrophication
- Smog potential
- Nonrenewable energy

LIFE CYCLE ASSESSMENT: OUTPUTS

Impact categories (based on emission factors):

- Global warming potential (greenhouse gases)
- Depletion of stratospheric ozone layer
- Acidification of land and water sources ("acid rain")
- Eutrophication (releases in water or soil)
- Formation of tropospheric ozone (smog, air pollution—ground-level ozone)
- Depletion of nonrenewable energy resources

Resource categories (computed based on actual usage):

- Energy demand (all of the energy used to make the product)
- Water consumption (total water used)
- Waste generated

QUIZ

1. The green building market is set to experience a ______ percent growth rate through 2020.
   a. 10 b. 13
   c. 24 d. 36

2. True or False: Project teams can still choose whether to use LEED 2009 or LEED v4.

3. True or False: The Brock Environmental Center was constructed with the goal of receiving the Net Zero Energy Building Certification™ and meeting the guidelines specified by the Living Building Challenge™.

4. Why was high compressive strength rigid foam XPS insulation chosen for the Brock Center project?
   a. Excellent insulation value b. Excellent thermal break capability
   c. Recycling option for scrap insulation d. All of the above

5. Which of the following new LEED v4 credits encourage disclosure and optimization?
   a. Environmental Product Declarations b. Material ingredients
   c. Sourcing of raw materials d. All of the above

6. True or False: The Building Product Disclosure and Optimization credits aim to encourage the use of products with limited impacts throughout their lifetimes, and from manufacturers that provide transparency about their products' ingredients and manufacturing processes.

7. Per ISO 14025, life-cycle assessment results or outputs are reported using which communication tool?
   a. Product Transparency Declaration b. Environmental Product Declaration
   c. Environmental reports d. None of the above

8. Which of the following is a concise two-page summary showing life-cycle impact categories for a product?
   a. Life-Cycle Assessment b. Environmental Product Declaration
   c. Transparency Brief

9. Which credit is now included in LEED v4 rating systems, affecting occupant health and learning?
   a. Design for Flexibility b. Energy Performance
   c. Sustainable Sites d. Acoustics

10. Which of the following count toward the Option 2 or the Optimization component of Raw Material Sourcing?
    a. Extended producer responsibility b. Recycled content
    c. Bio-based materials d. All of the above

PRODUCT DISCLOSURES—ENVIRONMENTAL PRODUCT DECLARATIONS

The Materials and Resources category also has a Production Disclosures credit, which can include Environmental Product Declarations (EPDs), sourcing of raw materials and material ingredients. There are both industry and product-specific EPDs.

A project seeking credits under Option 1: Environmental Product Declaration must use at least 20 different permanently installed products sourced from at least five different manufacturers that have either a Product Specific Declaration (LCA) (one-fourth of a product), a generic industry-wide EPD (one-half of a product) or a product-specific EPD (one full product). To qualify for an industry-wide EPD the manufacturer must be explicitly recognized as a participant by the program operator.

This article continues on http://go.hw.net/AR112017-3. Go online to read the rest of the article and complete the corresponding quiz for credit.

SPONSOR INFORMATION

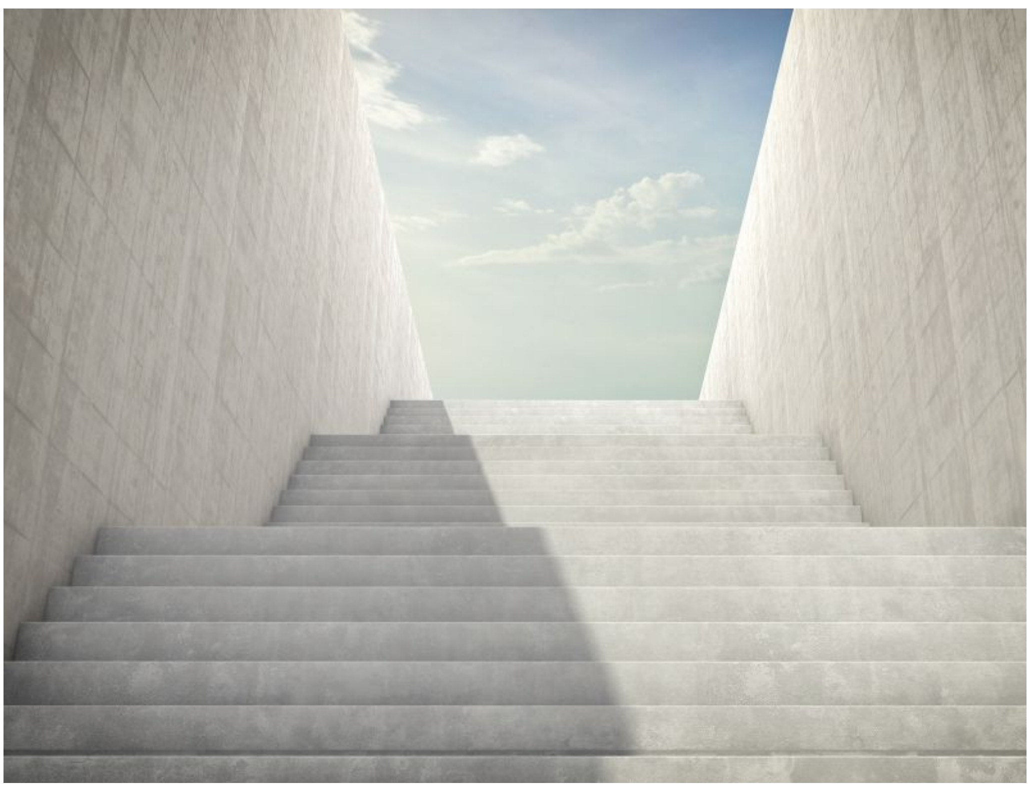
Owens Corning develops, manufactures, and markets insulation, roofing and fiberglass composites. Global in scope and human in scale, the company's market-leading businesses use their deep expertise in materials, manufacturing and building science to develop products and systems that save energy and improve comfort in commercial and residential buildings.

FUNDAMENTALS OF CONCRETE (PART 2)

MIX DESIGN AND FIELD PRACTICES

Presented by:

PCA Since 1916 America's Cement Manufacturers™



LEARNING OBJECTIVES

Upon completion of this course the student will be able to:

1. Understand the differences between prescriptive and performance specifications for ready mixed concrete
2. Learn how specifications influence field performance of fresh and hardened concrete
3. Recognize some of the fundamental aspects of placement and finishing on the long-term performance of site-cast concrete
4. Understand the importance of curing on quality during normal and adverse weather conditions

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: AR112017-4

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By David Shepherd, AIA LEED AP and David Arquette, Portland Cement Association

Concrete is an essential building material used throughout the world, providing proven performance for strong, durable and economical construction. It is used in so many applications that it is the second most consumed material on the planet, after water. Its versatility enables multiple forms of production including site-cast, pre-cast and masonry as well as specialty products such as cast stone, roof tile, concrete pavers and fiber-cement siding. Site-cast concrete is one of the few construction materials that design professionals are able to modify through specifications to accommodate a wide range of applications, performance characteristics and regional issues. However, with this versatility comes the responsibility to understand the strengths, limitations and optimization strategies to achieve the desired performance.

This article examines many of the fundamental issues required for the specification and installation of site-cast concrete as it comprises approximately 70 percent of all U.S. concrete production and is directly influenced by specifier and field inspection professionals. This is a companion piece to the Hanley Wood CEU article "*Fundamentals of Concrete—Part 1*" (*Architect* magazine, June 2017), which covers concrete's ingredients and their influences on quality concrete. The content of these two articles is derived from the Portland Cement Association's (PCA) Design and Control of Concrete Mixtures, 16th Edition (Kosmatka and Wilson 2016). For more information on Design and Control of Concrete Mixtures, visit: **cement.org/DesignandControl**

PRESCRIPTIVE VS. PERFORMANCE SPECIFICATIONS

The objective of mixture design is to determine the most economical and practical combination of readily available materials to produce a concrete that will satisfy the performance requirements under particular conditions of use. The five main ingredients in a typical concrete mixture include coarse aggregates, fine aggregates, cementitious materials (which may include both portland cement and supplementary cementitious such as fly ash, slag and silica fume), water and chemical admixtures. The specifier must consider the concrete's exposure conditions, workability, placement conditions, structural intent, appearance and economic criteria. Requirements for concrete specifications are governed by American Concrete Institute's *"Building Code Requirements for Structural Concrete"* (ACI 318).

There are two main methods for specifying a concrete mixture. A prescriptive specification is based on knowledge from past experience and the expected outcome. It will typically state the composition of the concrete mixture and may also include means and methods of construction.

Historically, the owner, owner's agent or design professional established the design requirements and provided prescriptive provisions for the proportions of the concrete order. These provisions typically include a minimum cement content, exposure conditions and performance requirements such as slump and strength. The contractors would then use this information to order the concrete mixture from a producer. This method allows for owners to control the concrete mixture, but it also comes with an inherent risk if the concrete doesn't perform up to their standards. Prescriptive requirements may conflict with the intended performance. One example could be a low water/cementitious materials ratio, intended to increase strength and reduce permeability. Without further consideration of the workability of the concrete through use of chemical admixtures, a stiff mixture might result that makes proper placement and finishing difficult.

A performance specification establishes functional requirements for fresh and hardened concrete appropriate for the application and design service life. These requirements are confirmed by performance-based tests to demonstrate compliance. This method provides flexibility to both the specifier and ready-mixed concrete producer to use locally abundant, quality materials with a variety of mixtures and placement techniques to achieve desired performance, generally resulting in economic savings and reduced environmental impact.

Typically, the specifications provide the contractor/producer with one or more options for demonstrating compliance with specification requirements. The option chosen by the contractor/producer, along with the required information that must accompany each option, is to be documented in a pre-construction submittal to the engineer of record. In this manner, the specifier is able to approve the proposed mixture before start of construction (pre-qualified), with verification by testing at point of concrete discharge.

The first step to starting the mix design process is selecting final product characteristics. These include

- Exposure conditions—freeze-thaw, soluble sulfates in soil or water, etc.
- Desired structural properties—strength, creep, modulus, etc.
- Desired physical properties—low permeability, resistance to chemical degradation
- Expected service life
- Aesthetic requirements

Additionally, consideration for site conditions and installation methods during construction are necessary. These include

- Handling and placement methods
- Weather conditions during construction
- Workability
- Finishing methods
- Construction schedule, form removal, etc.

These factors cover issues from the beginning stages of placement to the end of the service life of the structure. Concrete mixtures should be designed to ensure the mixture can be produced reliably and uniformly throughout the project.

FIELD IMPACTS OF SPECIFICATION CRITERIA FOR CONCRETE MIXTURES

Compressive Strength

In the U.S., compressive strength f'_c is the most common applicable performance metric for specifying concrete. It is typically specified in pounds per square inch (psi) at 28 days after placement and is expected to be met or exceeded by the average of a set of three consecutive strength tests (a strength test is an average of two 6 x 12 inch cylinders or three 4 x 8 inch cylinders tested in compression by ASTM C39). ACI 318 requires structural concrete to be a minimum of 2,500 psi, and modern concrete technology with conventional materials can provide compressive strengths exceeding 18,000 psi. The strength of the paste binding the aggregates together depends on the quality and quantity of the cementitious components and the degree to which the hydration reaction has progressed. Concrete continually becomes stronger over time, provided that adequate moisture and favorable temperatures are present, stressing the importance of proper and thorough curing upon placement of the concrete.

Water/Cementitious Materials Ratio

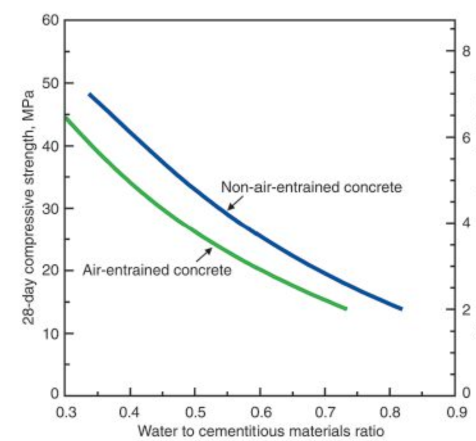

Figure 1—This graph illustrates that as the water-cementitious material ratio increases above .40, the ultimate strength of the concrete decreases.

Generally, the compressive strength of concrete is inversely related to the water-cementitious materials (w/cm) ratio, with an optimal w/cm of around .42 for strength and workability. The water-cementitious material ratio is simply the mass of water divided by the mass of total cementitious materials (portland cement and SCMs). This would point to using the least amount of water available in most settings *while maintaining workability* of the concrete for placement and finishing. When durability is not the primary design criteria, the water-cementitious materials ratio should be selected on the basis of concrete compressive strength and not necessarily included in the specifications. In all situations, the water-cementitious ratio should be determined based on thorough laboratory testing and, for new mixtures, a minimum of 30 trial batches to ensure the concrete meets the requirements set by the mixture design.

Workability

The amount of water required in a concrete mixture depends on the workability requirements of the job. Workability is improved by the use of large or rounded aggregate, an increase in air content, a reduction of the amount and fineness of cementitious materials, and a lowering of the temperature of the concrete. The water content can also be reduced by using water-reducing admixtures (plasticizers) to maintain workability. It is important to consider that adding water can create a multitude of changes by creating a different proportion of ingredients in the mixture. Adding water may increase slump to a desired level, but it will also lower the compressive strength and change the air content, paste volume and density of the concrete, among other things. This stresses the need for trial batches and testing before implementing changes to the water content of the mixture.

Cementitious Materials Content

There are a variety of cement types, each offering specific benefits to address factors such as early strength development, reduced heat of hydration and soil sulfate resistance. It is essential to account for the environment that the concrete will be placed in when specifying a cement type. Additionally, there are several SCMs such as fly ash, slag cement, silica fume and natural pozzolans that, when blended with portland cement, provide benefits to improve economy, workability, long-term strength, sulfate and chloride resistance and reduced environmental impacts. SCMs should be included in the calculations for the water-cementitious materials ratio and air content of the concrete. More details about cement types can be found in "*Fundamentals of Concrete—Part 1*" (*Architect* magazine, June 2017).

In a prescriptive specification, minimum cementitious materials contents are often established as a method of ensuring anticipated levels of durability and finishability, improved wear resistance and surface appearance. Ideally, the quantity of cement paste should be enough to wrap around each aggregate particle and still provide workability. Recognizing the strong inter-relationship between water and cementitious materials, a reduction in cement will typically lead to a reduction in water (with the possible result of a mix too stiff for placement or finishing due to the lowered paste content of the mixture. The intent is to maintain an economical and workable mix while preventing adverse effects such as plastic shrinkage and high internal heat levels during hydration.

Air Content

Entrained air should be used for all concrete that will be exposed to freeze-thaw conditions. Air-entrained concrete contains uniformly distributed microscopic air pockets, chemically induced by admixtures typically added at the ready-mixed concrete plant. While all of these minute voids do decrease compressive strength, they also significantly increase freeze-thaw durability by providing space for the water as it expands into ice. This is accomplished by providing space for moisture within the concrete to expand when it freezes, reducing internal pressure that can cause cracking and scaling. Air entrainment should not be confused with entrapped air, which are physical voids generated during the mixing process. Proper placement and consolidation (vibration) techniques should remove most of the entrapped air voids, while the microscopic bubbles of entrained air remain in place. Entrained air also has the benefit of increasing workability for the installer.

The target air content is typically calculated based on the nominal maximum size of aggregate and the class of exposure the concrete will be exposed to, ranging from mild exposure (F0) to very severe exposure (F3). The percentage of entrained air typically ranges from 1.0 percent to 6.0 percent for most concrete applications. In properly proportioned mixtures, the paste content will decrease as aggregate size increases, resulting in a lower air content. There is typically a ±1.5 percent range of target values for air-entrained concrete at job sites (± 1 percent for high-strength concrete).

Chemical Admixtures

Chemical admixtures can be used to reduce the water-cementitious materials ratio, total cementitious materials content, water content and paste content and to improve workability.. Using multiple admixtures in a concrete mixture may cause unpredictable or undesirable consequences if the admixtures are incompatible. These mixtures should always be tested in trial batches at the anticipated placement temperatures to ensure that concrete achieves the desired results and no unforeseen problems arise during the placement and finishing stages.

FIELD CONSIDERATIONS AND PROCEDURES

Batching, Mixing and Field Testing

Although the methodology of concrete production and transport are the responsibility of the producer, an understanding of the process can be helpful in the context of specification development. When ready-mixed concrete is ordered, it is essential to specify both the requirements for fresh and hardened concrete for use by the concrete producer. ASTM C94, *Standard Specification for Ready-Mixed Concrete*, provides three options for ordering concrete:

- Option A: Performance-based order where the specifier designates a given compressive strength of concrete and the producer selects the mixture proportions necessary to obtain the desired strength.
- Option B: Prescriptive-based order where the specifier selects proportions for the cementitious material, aggregates, water and admixtures.
- Option C: A combined approach where the specifier sets desired compressive strength and minimum cement content. The concrete producer selects the mixture proportions to fit the requirements of the purchaser.

For all options above, the specifications should include

- Requirements for slump
- Nominal maximum size of coarse aggregate
- Air content percentage
- Type of exposure anticipated

Batching is the process of measuring quantities of concrete mixture ingredients by either mass (typically) or volume and introducing them into the mixture. To produce concrete of uniform quality, the ingredients must be measured accurately for each batch. Variances in quantities are defined in ASTM C94, and materials being measured for individual batches must fall within the following percentages of accuracy:

- Cementitious material ±1 percent
- Aggregates ±2 percent
- Batched water ±1 percent of the total mixing water
- Admixtures ±3 percent of the desired quantity

All concrete should be mixed thoroughly until the ingredients are uniformly distributed. The best method to determine if the concrete has been adequately mixed is to take multiple samples from different portions of a batch and conduct tests. These tests are necessary as short mixing times can create problems with non-homogenous mixtures like poor distribution of air voids, poor strength gain and early stiffening. If the samples have

Figure 2—Automated batching control room in a modern ready mixed concrete batch plant.

roughly the same strength, density, air content, slump and coarse-aggregate content, the mixture can be considered uniform.

Ready-mixed concrete can be central-mixed, shrink-mixed or truck-mixed. Central-mixed concrete is mixed completely in the plant's stationary mixer and transferred to a truck for immediate delivery to the job site. This method typically produces concrete with a high degree of quality control and consistency. Shrink-mixed concrete is partially mixed in a stationary mixer and completed on a truck mixer during delivery. This method will typically provide similar performance test results to central-mixed concrete. Truck-mixed concrete ingredients are loaded into the truck, where all mixing is completed. This method is often employed on large-scale projects by allowing a high volume of trucks to load in a short time period and deliver a continuous supply at the jobsite. One specialty option is the volumetric mixer, which is a mobile batch plant. Typically employed on small or remote projects, dry ingredients and water are stored on the truck, where they are proportioned and mixed at the jobsite by volume.

Concrete should be mixed in the range of 70 to 100 revolutions of the drum or blades (at mixing speed) and placed within 90 minutes. Mixing the concrete for too long can result in excess slump, loss of strength and loss of entrained air, among other things. Once the ingredients have achieved the desired number of mixing revolutions, the drum can be slowed to an agitating speed to maintain a homogenous mixture until discharge. While these ranges provide a standard benchmark for the mixing and transport of concrete, they are not absolute. Both the purchaser and manufacturer can modify mixing time, delivery time and other parameters so long as the concrete still meets the requirements set by the specifications.

This article continues on http://go.hw.net/AR112017-4. Go online to read the rest of the article and complete the corresponding quiz for credit.

QUIZ

1. The compressive strength of concrete (f'_c) is typically specified in pounds per square inch at ______ after placement.
   a. 24 hours
   b. 7 days
   c. 28 days
   d. 90 days

2 The strength of concrete is inversely proportional to the ____________.
   a. Cement/water ratio, 2500
   b. Water/cementitious material ratio
   c. Total cement and fly ash quantity, 500 pounds per cubic yard
   d. Curing interval, 90 days

3 Entrained air in concrete:
   a. Increases the density of concrete
   b. Is generated by the tumbling of the ingredients in the concrete mixer
   c. Can increase strength
   d. Provides relief space for moisture within freezing hardened concrete to expand without damage

4 What type of joints should be cut around perimeters, columns or machine foundations?
   a. Contraction joints
   b. Isolation joints
   c. Separation joints
   d. Construction joints

5. At minimum, how deep should a joint be cut into a floor slab?
   a. 1/2 of the thickness of the slab
   b. 1/2 inch
   c. 1/4 of the thickness of the slab
   d. 1/3 of the thickness of the slab

6 A slump test is determined by measuring:
   a. The diameter of the pool of concrete once the slump cone is removed
   b. The height of the pile of concrete from the testing base
   c. How well the concrete flows into forms and around reinforcing
   d. The distance the concrete has settled from the top of the cone, once the slump cone is removed

7 To minimize random cracking for a 5" thick slab on grade:
   a. Install #4 steel reinforcing bars at 48" o.c.
   b. Use a water-cementitious material ratio of 0.5 to 0.55
   c. Space contraction joints at 10' o.c.
   d. Use aggregate smaller than 1/2"

8 Which of the following statements is false? Proper curing:
   a. Reduces internal moisture in concrete for timely installation of flooring and finishes
   b. Promotes continued hydration of cementitious materials
   c. Maintains a satisfactory moisture content and temperature after placement so that the desired physical properties may develop
   d. Influences the strength and durability of the concrete

9 Plastic shrinkage cracks can develop when:
   a. Plastic sheets for curing stick to the slab surface during removal
   b. Water evaporates from the surface faster than it can travel to the surface during the bleeding process
   c. Temperature of curing water is 30 degrees or greater than the concrete temperature
   d. Ice is used to cool concrete ingredients for placement in hot weather conditions

10 Which of the following statements is false? According to ACI 305, hot weather is any combination of:
   a. High air temperature
   b. High concrete temperature
   c. Low relative humidity
   d. Low wind velocity

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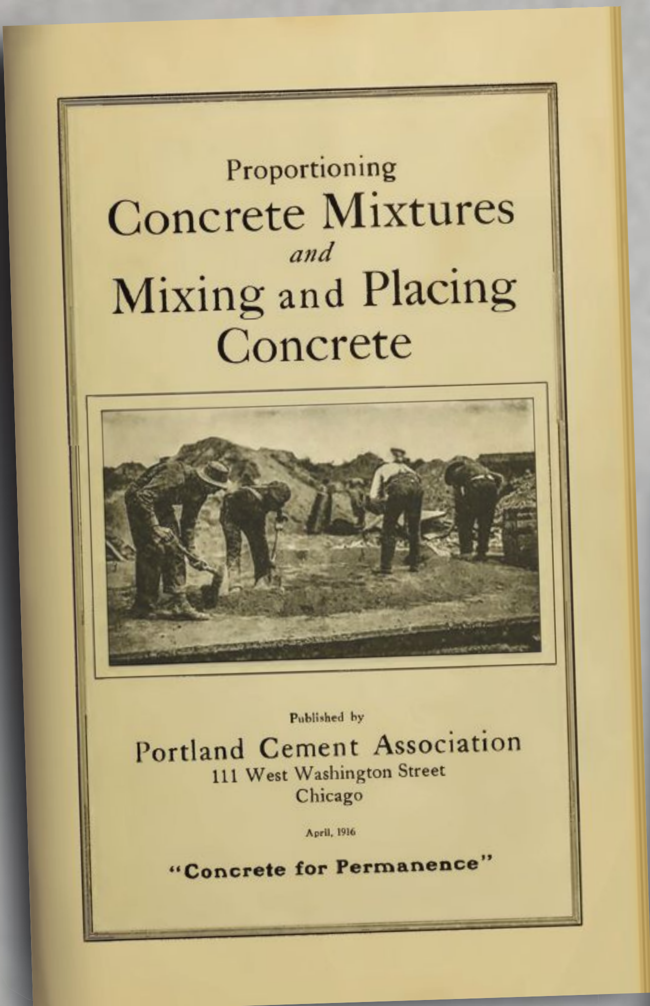
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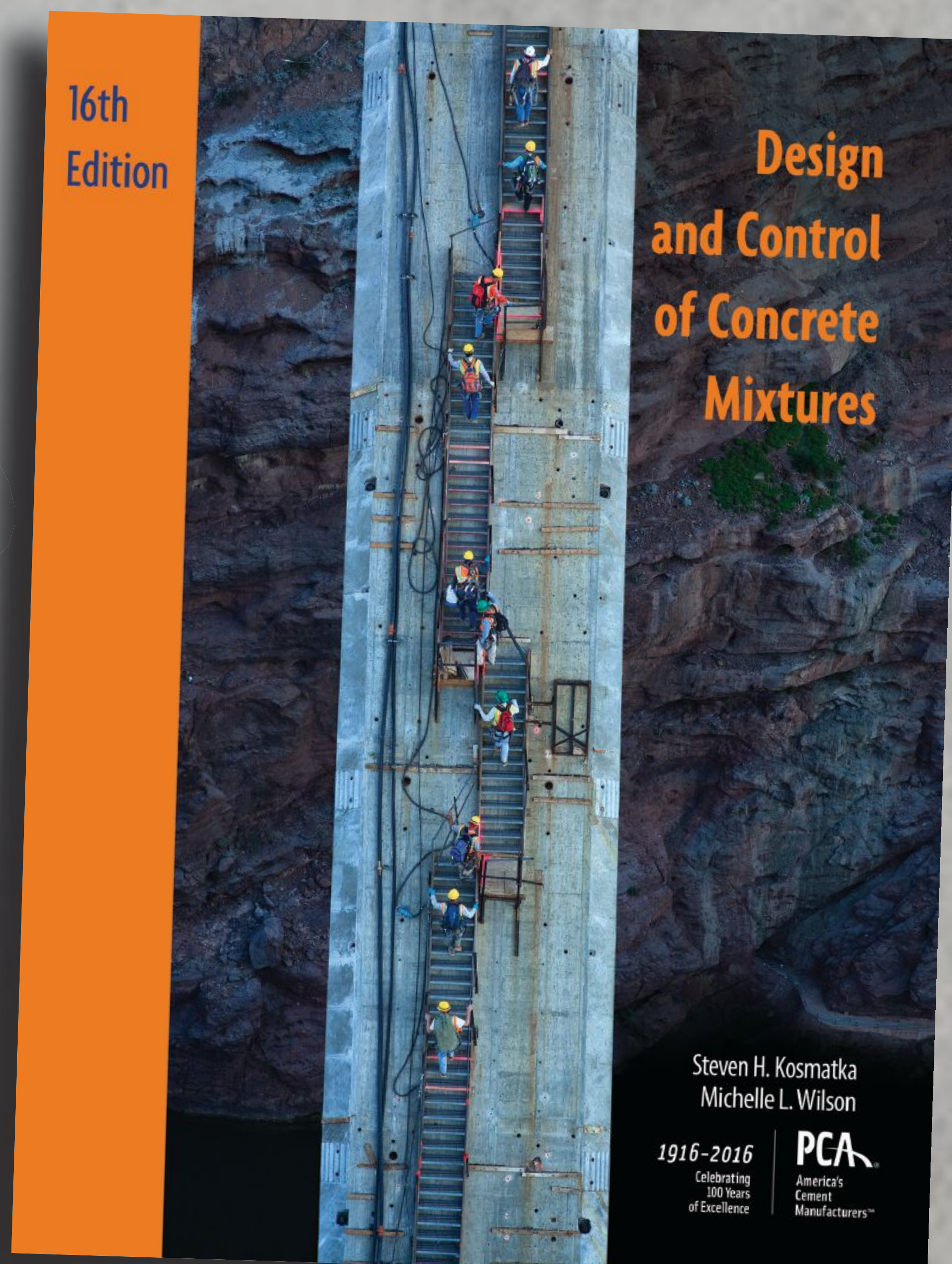
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SUSTAINABLE EXTRUDED ALUMINUM TRIM PROFILES
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LEARNING OBJECTIVES

Upon completion of this course the student will be able to:

1. Summarize the aesthetic and environmental benefits of specifying extruded aluminum architectural trim
2. Discuss moisture management and the use of aluminum flashing when designing durable sustainable moisture-free structures
3. Explore the profile and finish trim options that are available for use with fiber cement siding
4. Identify the sustainability features of extruded aluminum architectural trim

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: AR112017-9

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/AR112017-9** and complete the quiz for free as you read this article. If you are new to Hanley Wood University, create a free learner account; returning users log in as usual.

DESIGN AESTHETIC

Details are where architects can and do make a difference in building design and construction, and with today's focus on green materials, detailing needs to meet both an architectural design aesthetic and sustainability requirements. Specifying extruded aluminum trim for use with fiber cement siding is one instance where knowledge of detailing can contribute to both.

Manufactured to work as an integrated/complementary system with the major U.S. manufacturers of fiber cement siding, extruded aluminum profiles are available in a variety of options. Their design, mostly driven by architects seeking cleaner details, adds a distinctive profile to interiors and exteriors of buildings. In addition, it breaks up the monotony of flat panel walls where the same siding products are used repeatedly. Installing aluminum trim rather than using wood trim or cutting and ripping fiber cement boards or panels is more convenient and saves time.

"Using trim over panel joints becomes an architectural element and is a way of expressing the joints and defining their deliberate placement. It adds a level of architectural refinement," says Russell A. Hruska, AIA, principal and co-founder of Intexure Architects in Houston, Texas. "In our climate, stucco often requires additional oversight to be correctly executed. Aluminum trim, when used with fiber cement panels or lapped siding, is more cost effective than stucco and provides long-term durability while achieving our design aesthetic."

Constructed from 75 to 100 percent post-industrial and post-consumer scrap, extruded aluminum trim meets requirements for sustainability and can contribute to LEED® credits and Living Building Challenge certification. The product may be specified for interior or exterior use, and applications include an increasingly wide range of building types clad in fiber cement panels or lap siding. In recent years, extruded aluminum trim has begun to replace traditional wood 1x2 and 1x4 trim on single-family homes and is increasingly preferred for multi-family structures.

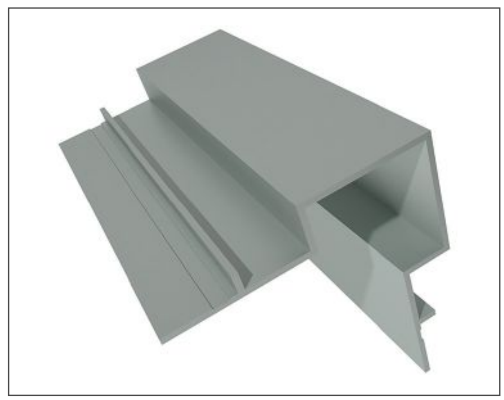
Extruded aluminum trim products are typically intended solely for aesthetics, not as part of an exterior insulation and finishing system (EIFS), a type of wall cladding system that provides exterior walls with an insulated finished surface. But, because some extruded aluminum trim products on the market do incorporate an EIFS, design professionals should note the exact description of each manufacturer's product and its performance expectations. As a general rule, extruded aluminum trim products that are not part of an EIFS system are not designed or intended to be used in conjunction with an EIFS or similar system.

Nor do architectural trim profiles form a complete moisture management system. Always a critical feature of construction, a moisture management system is the province of the architect and builder, who are responsible for designing and installing a code compliant building envelope. Again, manufacturers usually point out that extruded aluminum trim alone does not include a complete moisture management system, despite the fact that trim is designed with drain dams for vertical runs and in shingle fashion for horizontal profiles. However, some manufacturers do supply moisture management products that complement their trim line and help meet code requirements.

PREFABRICATED TRIM MATERIALS

Extruded aluminum adds durability and longevity to construction that other trim materials such as galvanized steel and polyvinyl chloride (PVC) lack (see sidebar "Characteristics of Extruded Aluminum Trim"). While initially less expensive than extruded aluminum, galvanized steel is also less durable. The use of bare mill galvanized steel and aluminum flashing in direct contact with most claddings will increase the chance of a chemical reaction, causing wear and breakdown on both products.

PVC, the third most widely produced and least expensive plastic, also has limitations compared with extruded aluminum. One manufacturer of extruded aluminum trim profiles developed and manufactured PVC trim profiles to use with fiber cement siding and soffits and still produces them. But through learned experiences and public demand, it began converting its profiles into more durable extruded aluminum. One hundred percent vinyl trim is susceptible to swelling and buckling when exposed to direct sunlight. Moreover, PVC trim painted dark colors, which is increasingly the choice of architects and developers, may cause the product to warp. This happens because excess solar heat is absorbed, particularly in hot climates, subjecting the PVC to distortion due to extremes of thermal expansion and contraction. Paint adhesion loss, blistering and peeling may also result.



Joints between materials and around windows and doors, vents, cracks and porous surfaces are all potential entry points for water, making trim a necessity. Image courtesy of Tamlyn

KEEPING MOISTURE OUT—CODE REQUIREMENTS

Walls with cladding leak just like masonry walls and must drain and dry moisture since water is the most significant factor in the premature deterioration of buildings. Leakage paths exist at any opening in the wall surface, whether intended or unintended. Joints between materials and around windows and doors, vents, cracks and porous surfaces are all potential entry points for water. As mentioned above, trim manufacturers either recommend or offer moisture management products that help meet code requirements.

According to the International Code Council (ICC) 2012 Section 1405.4 Flashing, "Flashing shall be installed in such a manner so as to prevent moisture from entering the wall or to redirect it to the exterior. Flashing shall be installed at the perimeters of exterior door and window assemblies, penetrations and terminations of exterior wall assemblies, exterior wall intersections with roofs, chimneys, porches, decks, balconies and similar projections and at built-in gutters and similar locations where moisture could enter the wall. Flashing with projecting flanges shall be installed on both sides and the ends of copings, under sills and continuously above projecting trim."

The International Residential Code (IRC) 2012 states in Wall Covering—Section R703 Exterior Covering: R703.1 General, "Exterior walls shall provide the building with a weather-resistant exterior wall envelope. The exterior wall envelope shall include flashing as described in Section R703.8. The exterior wall envelope shall be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer as required by Section R703.2 and a means of draining to the exterior water that enters the assembly."

R703.8 Flashing states, "Approved corrosion-resistant flashing shall be applied shingle-fashion in a manner to prevent entry

CHARACTERISTICS OF EXTRUDED ALUMINUM TRIM

Extruded aluminum adds durability and longevity to construction that other trim materials such as galvanized steel and polyvinyl chloride (PVC) lack. Photo courtesy of Nichiha

Extruded aluminum trim

- adds a design aesthetic to a wide range of building types,
- offers multiple profile choices,
- is typically fabricated from custom die-extruded heavy duty 6063-T5 aluminum alloy with a coating that protects against harsh weather conditions and allows for paint adhesion,
- is typically designed to match color, metal thickness and accommodate the depth dimension for panel and lap applications of the country's major cementitious siding manufacturers,
- is available in anodized standard color palettes or ready-to-paint finishes,
- is made of sustainable material, such as 75 percent to 100 percent post-industrial and post-consumer scrap, which can contribute to LEED points,
- replaces time-consuming cutting and ripping of fiber cement panels or boards for trim use,
- can be used for interior and exterior applications,
- is highly durable and will long outlast caulk,
- poses no health or physical hazard.

Note: Aluminum trim products are defined as "articles" by the Occupational Safety and Health Administration (OSHA) and are therefore exempt from the requirement of publishing material safety data sheets.

of water into the wall cavity or penetration of water to the building structural framing components. Self-adhered membranes used as flashing shall comply with AAMA (American Architectural Manufacturers Association) 711. The flashing shall extend to the surface of the exterior wall finish."

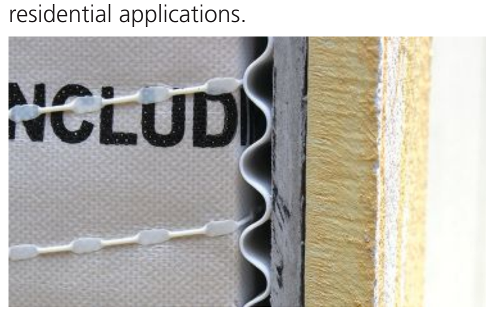
Flashing

Aluminum has long been the flashing of choice because it is widely available, inexpensive, lightweight and fairly easy to handle. A coil of aluminum trim coated on both sides with a paint system that is specifically formulated for residential applications will serve most residential and light commercial applications. Pre-cut and pre-formed profiles designed for siding, counters, brick ledges, windows and other areas have the advantage of being available in custom sizes and colors that match trim and siding.

One example of an aluminum profile newly on the market is plank flashing with strips of non-polluting EPDM (ethylene propylene diene monomer [M-class]) rubber. It reduces moisture penetration behind the joint where two planks butt together and drains water over the top edge of the last full course of siding. The puncture-resistant flashing is primed or painted on both sides in order to eliminate any reaction with the fiber cement of the siding. The coating or paint also prevents reflective mirror-like flashback as is found when traditional unfinished metal flashing is used. The stiff aluminum material helps hold a tighter seal against the siding so as not to allow water pressure to enter and wick off to the sides and find its way behind the siding. No nailing is required because the flashing slips beneath the lap siding, so no additional holes are introduced in the wall.

Aluminum flashing is preferred over using cut pieces of traditional housewrap to prevent water penetration at lap siding butt joints. The reason is that housewrap is intended to perform as an air barrier, not as flashing. Housewrap also has limited ultraviolet exposure life when uncovered during construction or when visible at butt joints. Roofing felt is another material that is less durable than aluminum flashing because it tends to weep (allow water to penetrate) and break down over time.

Manufacturers advise always applying a layer of self-stick material such as asphalt or butyl tape before installing aluminum flashing on treated lumber. This prevents a chemical reaction between the flashing and copper azole in treated lumber. Copper azole is a wood preservative replacement for chromated copper arsenate, which has been phased out for most residential applications.



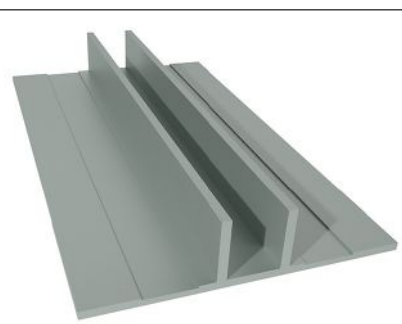
One type of housewrap on the market eliminates excess moisture from an exterior wall by providing drainage space between the housewrap and exterior sheathing. This is achieved by bonding very small spacers to the wrap. Photo courtesy of Tamlyn

Housewrap and Rainscreen

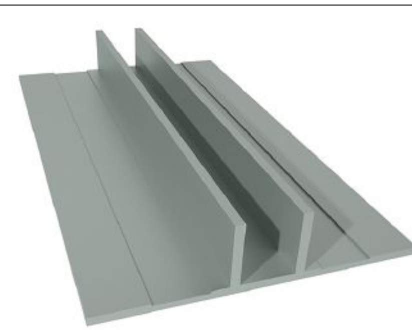
Exterior wall performance requirements are included in 2009 IBC 1403.2 Weather protection. "Exterior walls shall provide the building with a weather-resistant exterior wall envelope. The exterior wall envelope shall include flashing, as described in Section 1405.4. The exterior wall envelope shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a water-resistive barrier behind the exterior veneer, as described in Section 1404.2, and a means for draining water that enters the assembly to the exterior. Protection against condensation in the exterior wall assembly shall be provided in accordance with Section 1405.3. (1405.3 Vapor retarders. "Class I or II vapor retarders shall be provided on the interior side of frame walls in Zones 5, 6, 7, 8 and Marine 4.")

The primary insurance of moisture mitigation for the building envelope is housewrap that is specifically designed to allow water or moisture to drain. There are several advantages to using an integrated wrap/drainage product: There is one less installation step and the wall/siding assembly design does not have to change. One type of housewrap on the market eliminates excess moisture from an exterior wall by providing drainage space between the housewrap and exterior sheathing. This is achieved by bonding very small spacers to the wrap.

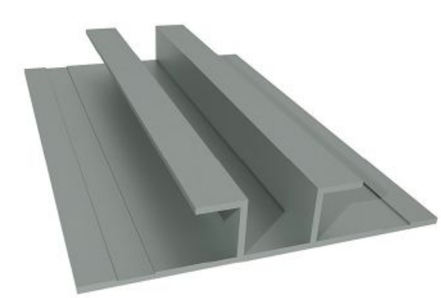
Another option for meeting code requirements is a rainscreen system. A rainscreen is a moisture management technique for controlling rain entry in an exterior wall. It generally comprises an air space immediately behind exterior cladding plus a water-resistive barrier that wraps the building wall assembly. The air space that is created by the rainscreen between the back of the cladding and the face of the water-resistive barrier is designed to reduce the forces that draw water into the assembly. Water that does reach the back of the cladding drains from the wall assembly via the space created by the rainscreen. In addition to the drainage capabilities, a rainscreen system also



Vertical and horizontal bead trim each serve as an expansion joint between panels. Image courtesy of Tamlyn



Vertical board reveal provides a broad vertical accent between siding panels while not protruding beyond the plane of the façade. Image courtesy of Tamlyn



Designed for wood and steel stud construction, panel vertical reveal provides a reveal for both plank lap and panel siding. Image courtesy of Tamlyn helps accelerate the drying of water vapor that accumulates in the interior wall assembly by moving air throughout the air space.

There are several rainscreen options available:

- Install "weeps" in masonry construction. "Weeps" or "weeper holes" are small openings left in the outer wall as an outlet for water inside a building to move outside the wall and evaporate.
- Construct a rainscreen wall using furring strips that space the cladding away from the wall. This provides a vent space that helps to dry the back of the siding. Traditionally, layered tarpaper and flashing behind the furring strips create what is called a drainage plane. Today, housewrap is more commonly used than tar paper.
- Employ rainscreen products. These can be batten strips in the form of plastic slats, pressure treated lumber or metal girts or hat channels (typically 1 1/2-inch) placed on top of the housewrap.

TRIM PROFILES

Typically fabricated from custom die-extruded heavy duty 6063-T5 aluminum alloy, trim profiles have a coating that protects against harsh weather conditions. Since siding panels will expand and contract due to changes in temperature, a 1/8-inch gap should be allowed between panels and trim.

Examples of trim profiles include

Vertical and horizontal bead trim. Vertical and horizontal bead trim each serve as an expansion joint between panels. Horizontal bead trim is designed to work as a system with vertical bead trim. Both work with all panel profiles and finishes.

Vertical board reveal. This profile provides a broad vertical accent between siding panels while not protruding beyond the plane of the façade. In addition, it serves as a rustproof flashing between the siding and the building sheathing. Typical standard length is 10 feet.

Batten corner. A batten corner trim profile can add a distinctive corner form for structures with vertical siding panels.

QUIZ

1. Constructed from ________ percent post-industrial and post-consumer scrap, extruded aluminum trim meets requirements for sustainability and can contribute to LEED credits and Living Building Challenge certification.
   a. 10 to 20 b. 50 to 60
   c. 70 to 75 d. 75 to 100

2. True or False: Extruded aluminum trim products are typically intended for aesthetics, and as part of an exterior insulation and finishing system (EIFS).

3. What type of aluminum alloy is extruded aluminum trim typically fabricated from?
   a. 3003-T3 b. 6061-T5
   c. 6063-T5 d. 7075-T6

4. True or False: The primary insurance of moisture mitigation for the building envelope is housewrap that is specifically designed to allow water or moisture to drain.

5. Which trim profile serves as an expansion joint between panels?
   a. Vertical and horizontal bead trim b. Vertical board reveal
   c. Panel inside corner d. Panel vertical reveal

6. True or False: Aluminum can be recycled indefinitely without losing any of its superior characteristics.

7. The powder coating used on extruded aluminum trim is VOC free, which can help contribute to which LEED credit?
   a. Building product disclosure and optimization: environmental product declarations b. Low-emitting materials
   c. Optimized energy performance

8. True or False: Extruded aluminum has very good thermal performance, so, when used in conjunction with other materials in the wall cladding, it can assist in optimizing energy performance.

9. Aluminum is one of the most recycled materials on the market, and producing aluminum takes just ______ percent of the energy needed to make primary aluminum.
   a. 5 b. 8
   c. 10 d. 13

10. The aluminum industry's carbon footprint has declined ______ percent since 1995 and _______ percent since 2005.
   a. 30, 20 b. 37, 19
   c. 19, 37 d. 10, 20

Panel inside corner. One manufacturer has patented a design that duplicates the look of a wood corner piece and can be used with panel siding.

Panel vertical reveal. Designed for wood and steel stud construction, the aluminum trim provides a reveal for both plank lap and panel siding. The reveal also serves as rustproof flashing between planks and panels. Plank and panel reveals should not be used for horizontal joints.

Panel open outside corner. The extruded aluminum open corner profile offers an alternative to the more familiar closed corner trim and can be used with both plank and panel siding.

This article continues on http://go.hw.net/AR112017-9. Go online to read the rest of the article and complete the corresponding quiz for credit.

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The Methodologist

Rethinking what research means.

In July, Richard Buday, FAIA, published "The Confused and Impoverished State of Architectural Research," a meditation for CommonEdge.org on why architectural research isn't really aligned with orthodox definitions of rational inquiry—despite architecture's reliance on empirical data and logic. Buday is a founder of the Houston-based digital arts studio Archimage, which counts the National Institutes of Health, IBM, Disney, and Nintendo among its clients. "As a species, we are working diligently against our existence," he says. "Buildings can play a mitigating role in our demise, which means architectural research is now more important than ever."

As told to William Richards

As architects, we should be careful about throwing around the term "research agenda." It confuses us. A real research agenda identifies the gaps in knowledge that, when filled, enrich a community and increase the common knowledge of that community. When some architects say that they have a research agenda, it means something different. It means that they subscribe to a particular theory or have an idea of where they want to go with their work. But those kinds of agendas aren't necessarily research activities.

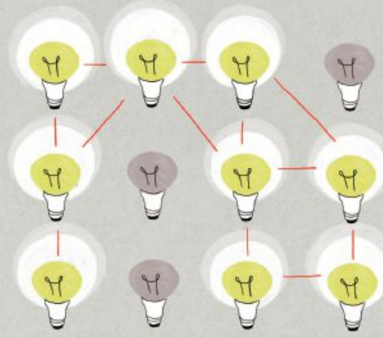
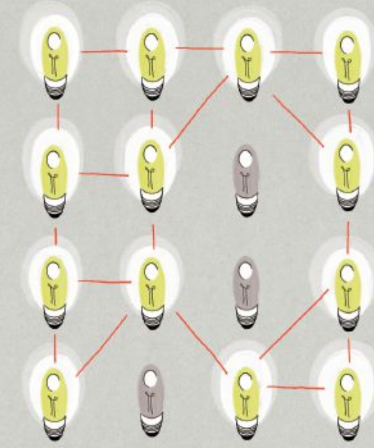
I have been embedded with science researchers for the last 20 years. It became apparent early on that what they do is substantially different from what architects often claim as research. I've been a principal investigator of around $12 million of National Institutes of Health grants, and collaborated on another $30 million in grant-based research. The goal was combating self-destructive human behavior. We used narrative immersion and video games to reduce obesity by improving children's attitudes toward nutrition and physical activity. I learned a great deal about the psychosocial aspects of persuasion, which I am now trying to translate into architectural strategies.

You have to go back to education to understand and address the confused state of architectural research. In my mind, we should be using established methodologies, rather than aimless exploration. You can't rely on getting lucky. There are a lot of proven protocols to consider, from quantitative to qualitative, from the scientific method to art-based approaches.

Unfortunately, research as a disciplined activity is rarely taught in architecture school. You are introduced to design theories, personality cults, and a language no one understands, but not how to undertake a rigorous, systematic, and verifiable inquiry. That limits the profession's opportunity to help save the human race, which is tragic. Architects have a moral obligation to do better. AIA

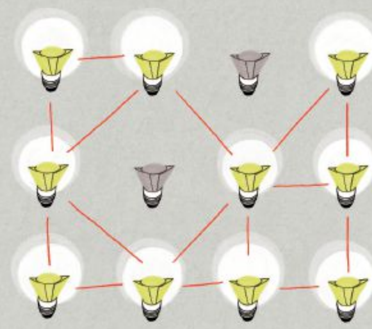
AIANow

By Steve Cimino
Art Direction by Jelena Schulz

Where Does Innovation Happen?

It's long been assumed that suburbs are for squares and all the big ideas come from the big city. But then how do we explain Silicon Valley; Redmond, Wash.; the Route 128 tech corridor outside of Boston; or the Outer Loop of Washington, D.C.? A recent study, "The Geography of Unconventional Innovation," by economists Enrico Berkes of Northwestern University and Ruben Gaetani of the University of Toronto's Rotman School of Management, might have an answer—and it has to do with density.



"The role of high-density regions as engines of innovation is smaller than commonly thought."

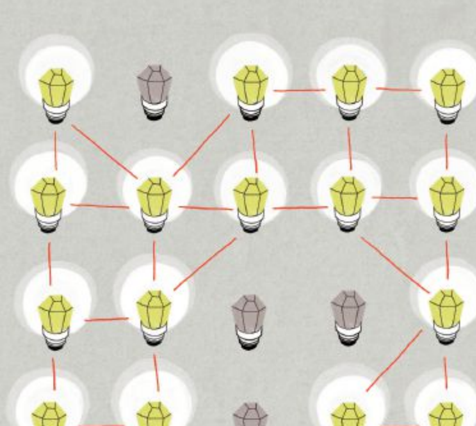
Forty percent of the patents in Berkes and Gaetani's study came from low-density areas (aka the suburbs), and they conclude that denser populations in cities lead to consistent innovation, but not what they call innovation "intensity." In other words, inventors and innovators in urban areas are more prolific in their ideas, but the ones attached to companies in the suburbs are able to develop a smaller number of ideas to greater commercial effect.

"Innovation produced in densely populated areas is more likely to be built upon unconventional combinations of prior knowledge."

What Berkes and Gaetani call "unconventional patents" (or patents that have little or no obvious economic significance) are more likely to be developed by startups located in cities rather than "large, publicly traded firms" that are often located in corporate parks in lower-density areas beyond the city.

"The local pool of ideas is a strong predictor of the technologies combined in new inventions."

In their relative isolation, the sprawling suburban offices—of, say, IBM in Armonk, N.Y., or Motorola in Schaumburg, Ill.—are designed to make scientific and creative interactions efficient (optimizing what Berkes and Gaetani call "knowledge flows"), in contrast to the looser, more "causal interactions" that cities afford. More efficiency means a faster path to market with economically significant patents.



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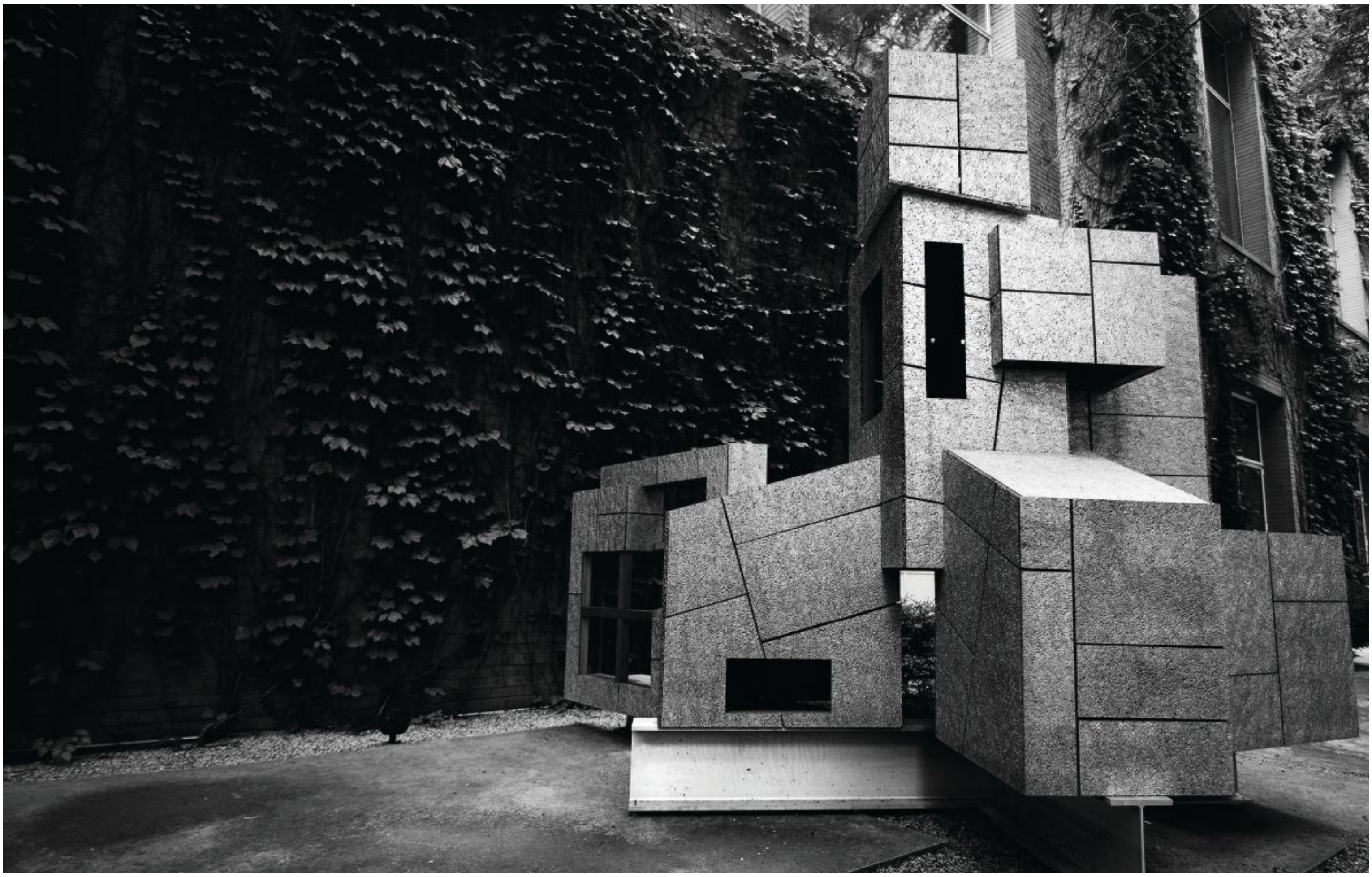

PHOTOGRAPHY: MICHAEL SULLIVAN

"Ziggurat" drew from Marshall Brown's recent collage series "Chimera," where he uses found fragments of architectural photography to create new works. For Ziggurat, a timber and aluminum structure clad in aluminum foil, buildings by the architects Frank Gehry, Peter Eisenman, and Zaha Hadid were sampled and recombined to create this installation for the Arts Club garden.

Marshall Brown is Putting the Pieces Together

Exploring architectural expectations at the Chicago Architecture Biennial.

The studio of Marshall Brown, AIA, is located on the South Side of Chicago in the Overton Hygienic Building, built in 1922. One of Chicago's many early-20th-century brick and terra-cotta modest masterpieces, it has survived the tides of development and disinvestment that have washed over this part of the city. It was a hub for African-American businesses in one of the pre-Civil Rights era's great black metropoles: the neighborhood of Bronzeville. On the second floor, Walter Bailey, Chicago's first black architect, had his own studio.

The studio of Marshall Brown Projects, also located on the second floor, is spacious and raw. The presence of history is there, but it's not pristine or reverent. The same can be said for Brown's exhibit for the second Chicago Architecture Biennial—"The Architecture of Creative Miscegenation"—about images that shape our expectations of how architecture is created.

"Even in a highly customized work of architecture, 99 percent of what we use as architects comes off a shelf," Brown says. "The work of an architect is about taking the found and assembling it in a new way." Making this process explicit is the goal of a series of large-scale collages, and a set of smaller ones he calls "Chimeras," after the mythical beasts that are part lion, part goat, and part dragon or snake.

Each Chimera has a cool, aloof, abstract image with references to its context, scale, or source. Taken together, Brown's Chimeras possess an intentional logic for why he chose them. One consists of a wedge of clerestory windows parked next to canted concrete, topped by triangular refractions of blue skies and clouds that appear as architectural elements unto themselves. It almost looks buildable—a new creation, formed from shards of the past, that could exist for some functional purpose.

As for the larger-scale collages, one combines the Lloyds of London building in London designed by Richard Rogers, HON. FAIA, the Institut du Monde Arabe in Paris designed by Jean Nouvel, HON. FAIA, and Eliel Saarinen's First Christian Church in Columbus, Ind., in a meditation on the role of institutional and religious architecture. Another mashes up canonical buildings by Ludwig Mies van der Rohe and Le Corbusier, two distinct and hefty branches departing the same trunk of Modernism.

Reading buildings in the most publicly explicable sense—as formal objects surrounded by clear formal precedents—is something of a cursed language within the practice. Despite the potential to communicate a vision to the public, architects prefer that each idea is translated directly from their own swirling unconscious onto a visionary napkin sketch. But evidence of the former process is everywhere.

In Chicago, to Brown's eyes, the celebrated Aqua Tower from Jeanne Gang, FAIA, is a synthesis of Mies' glass-and-steel precision with Bertrand Goldberg's proto-biomorphic Marina City. Zaha Hadid was a visionary who applied the ideals and forms of Soviet Constructivism to her own desire to innovate. "Most architects are loath to call out their references explicitly," Brown says. "but architecture that we value tends to carry heavy references to other architecture."

"'Audacity' is a really good word to describe Marshall," says Laura Miller, an architecture professor at the University of Toronto who has known him for 20 years, first teaching him as an undergraduate at Washington University in St. Louis, then as a graduate student at Harvard University. "He's able to ask those questions that are, in a way, uncomfortable."

Miller first recognized Brown's potential to disrupt assumed notions during a studio at which she asked students to find or assemble three artifacts that could be considered as "material evidence" culled from the city, and then build a container for them—addressing notions of curation and context, and staking out a position, through architectural construction, that framed questions about their reading of the city.

Instead, Brown "made himself the artifact," she says, creating and affixing objects including a cast-plaster weight and shackles to his body, making broad critiques of race and agency. He "became a character in his own series of interrogations into what the urban realm was, [and] what his role was or should be."

As part of the U.S. pavilion design team at the 2016 Venice Biennale, Brown was asking the same sorts of meta-disciplinary questions that defined "The Architectural Imagination" that served Detroit's identity while suggesting broader applications in other cities. And despite his presence in a Chicago biennal committed to a vision of design as a tool for remedying inequity, Brown has a moderate stance on architecture's social utility. "Architecture is immersed in social conditions," he says. "It doesn't necessarily produce them."

For a designer who rejects the "napkin-sketch auteur" vision of practice, Brown still creates a lot of work by hand. He embraces seams and the imperfections that come with paper and an X-Acto knife. Unlike Photoshop, "There is no 'Undo' [button]. There's no 'Ctrl-Z,'" he says.

His Chimeras are made by hand, using images of only three buildings each. It's a breezy, informal process. "It's more like a card game," Brown says. "I'm rifling through the magazines, and whatever comes up in the deck, I try to figure out how to play it."

It's a playful approach, but Brown sees it as a continuation of Mies' and the Bauhaus' own experiments with collage. Though he seldom saw architecture as anything close to a card game, Mies' collages do share with Brown's Chimeras a richness of expression achieved through a minimal number of elements, like his rendering of a new Chicago convention center in swirling green marble, a honeycomb network of ceiling trusses, and a sepia-toned sea of conventioneers cut from newspaper photos.

Brown's collages are distillations of Chicago Architecture Biennial artistic directors Sharon Johnston, FAIA, and Mark Lee's vision for the event's theme: "Make New History." It's not about any wholesale re-evaluation of the postmodernist tradition, or a reverent look at Craftsman-style homes. The new history Johnston and Lee are looking for—and have found with Brown—is a more freehand alchemical look at dead ends, orphans, and moral victories that become doomed experiments. Brown isn't trying to make buildings more like collages. He's trying to get us to acknowledge that buildings *are* collages, and that the future of "making new history" comes from reassembling the pieces of the old. **AIA**

Zach Mortice

"The work of an architect is about taking the found and assembling it in a new way."
—Marshall Brown, AIA

The Vanderbilt Tower is the tallest building from Brown's Unity Plan for the Atlantic Yards in Brooklyn, N.Y., which challenged the original master plan put forth by Frank Gehry in 2003. Positioned at the intersection of Atlantic and Vanderbilt Avenues, it portrays a hybrid building composed of fragments from Ludwig Mies van der Rohe's Seagram Building and Le Corbusier's chapel in Ronchamp, France. (2009, Collage on inkjet print, 51 x 40 inches)

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PHOTOGRAPHY: MATTHEW ANDERSON

Stanford's Central Energy Facility, designed by ZGF Architects, replaces a gas-driven plant with one that combines different production methods.

An Education in Energy Efficiency

Colleges and universities are investing in energy-saving strategies fueled by well-designed buildings.

As colleges and universities grapple with a changing landscape of energy sources, some are taking the long view and investing in energy infrastructure that will provide substantial savings through the years. Other schools are taking a piecemeal approach and modernizing one building at a time to improve overall efficiency. Either way, hiring an architect for new or renovation projects will ensure that your campus is not only practical and cost-effective but as beautiful as ever.

Collegiate campuses often function as their own cities, with dedicated police, residential quarters, and even facilities for energy production. While most colleges and universities are not-for-profit institutions, they can all appreciate their respective bottom lines, especially when utility bills come due. Stanford University in Palo Alto, Calif., has installed a new energy facility that will not only reduce long-term energy costs but also signals a commitment to responsible energy use by celebrating back-of-house operations with award-winning architecture.

The university's Central Energy Facility, which was designed by ZGF Architects and won a 2017 AIA Institute Honor Award for Architecture, replaces the campus's former gas-driven plant with one that instead utilizes a combination of innovative energy production methods to generate environmentally friendly power as part of the Stanford Energy System Innovation Initiative. The 125,614-square-foot facility consolidates five distinct components: a teaching lab, an electrical substation, a plant for the California Office of Statewide Health Planning and Development, a utility yard, and cold-water storage tanks for the university's heat-recovery chiller system. The heat-recovery loop enables the university to capitalize on what would otherwise be wasted energy: Up to two-thirds of the heat generated through

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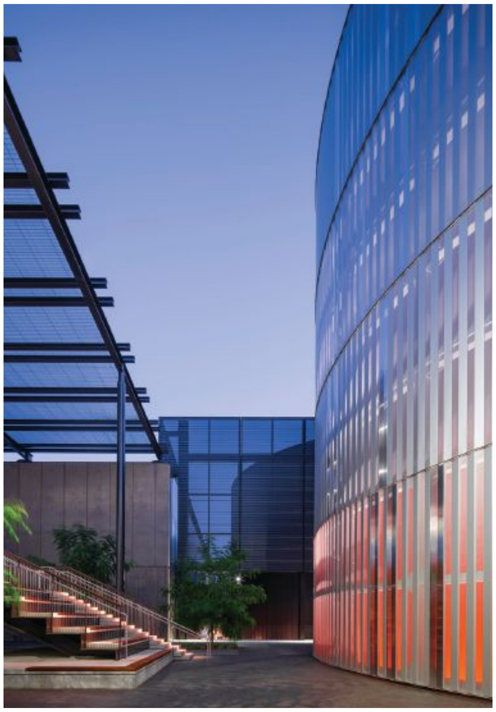
campus-wide cooling systems can be reclaimed and used toward its heating systems. Yet its architecture hardly seems in keeping with that of a power plant: Sleek and modern, the set of buildings look every bit like technology labs—which they also are.

Stanford could have simply renovated its central plant to be more efficient, but—recognizing that a fossil fuel–based system might already be obsolete—the university instead chose a more forward-thinking approach that will ensure its viability well into the future. Because of the way school campuses function as a collection of buildings usually reliant upon centralized infrastructure, the way infrastructure operates can have an outsized impact on overall costs. The new Central Energy Facility, combined with energy production from 150,000 high-efficiency photovoltaic panels sited at an off-site solar farm, will reduce greenhouse-gas production by 68 percent, making Stanford a leader in environmental stewardship. As a related benefit, long-term projections estimate that Stanford will enjoy $425 million of savings related to energy over the next 35 years.

Although Stanford's plant replacement represents a holistic overhaul, many universities are confronting similar challenges on the individual building level as older facilities face the need to modernize. One

PHOTOGRAPHY: MATTHEW ANDERSON (THIS PAGE)

The building's 150,000 high-efficiency photovoltaic panels and an off-site solar farm reduces greenhouse gas production by 68 percent, making the school a leader in sustainable energy.



The Central Energy Facility serves as the heart of Stanford University's transformational campus-wide energy system.

opposite-coast example of an aging facility's rehabilitation is the Boston University School of Law's Law Tower, which was designed by Josep Lluís Sert in 1962 and which underwent a restoration, renovation, and addition in 2015 by Bruner/Cott & Associates as part of its master plan for the complex. Recognizing the importance of this iconic tower perched at the bank of the Charles River, preservation-minded Bruner/Cott encouraged the university to maintain the tower's structure through considered reimagining of its function, along with the addition of the new Sumner M. Redstone Building.

The architectural team re-examined the school's patterns of use and sought out design solutions that would allow for updating the architecture to match its occupants' needs without compromising Sert's original tower. The BU building's height had also posed problems to students trying to make it to class on time, with inefficient small elevators shuttling them to upper-level classrooms; these upper levels were transformed into faculty offices, mock courtrooms, and conference rooms with magnificent views of the river. The larger classrooms were relocated to the lower levels of the new Redstone Building addition, making them much more readily accessible.

Whether schools take a building-by-building approach, like that of BU's Law Tower, or the whole-campus approach, such as that of Stanford's Central Energy Plant, an investment now in efficiency improvements will have long-term benefits both in energy consumption and cost savings. Enlisting architects early in the planning process can ensure that existing assets are used to their best potential, that students are in their seats on time, and that new power plants don't have to look like power plants. AIA

Deane Madsen, ASSOC. AIA

→ For more on how architects and design can improve communities, visit topicarchitecture.com.

AIAKnowledge

ILLUSTRATION: SHONAGH RAE

The Value of Environmental Care

Can daylighting increase the well-being of memory-care patients? A recent AIA Upjohn grant supported research into how the built environment impacts human health.

Kyle Konis, AIA, assistant professor of architecture at the University of Southern California, approaches his research with a simple question: How do people experience buildings in use?

This tactile inquiry informs Konis' study of how the built environment impacts human health. Konis has used this framework to examine the effects of daylighting as a sustainable strategy that can increase well-being among vulnerable populations, particularly those afflicted with Alzheimer's disease and related memory impairments.

His work, as presented in the paper "Daylighting Design Performance Criteria for Alzheimer Care Facilities: Towards Evidence-Based Practices for Improved Care," was the recipient of the 2013 AIA Upjohn Research Initiative grant. The grant provides material support of up to $30,000 for projects that "enhance the value of design and professional practice knowledge."

Konis began studying the effect of daylighting in assisted memory-care facilities because they are places "where people have less agency over their own environments," he says. Konis, who moved to USC in 2012 after having developed an interest in daylighting solutions through his graduate research at the University of California, Berkeley's Lawrence Berkeley National Laboratory, teamed up with Dr. Edward Schneider, emeritus dean of the Andrus Gerontology Center at the USC Leonard Davis School of Gerontology, to look at ways to lessen dependency on drug treatments for memory-care patients by using increased daylight exposure to mitigate symptoms of depression.

"People get confused; they don't know whether it's day or night in nursing home communities," Schneider says. "The question is, how can you improve the qualities of care through the environment?"

Konis developed the study in collaboration with Schneider and Wendy Mack, a professor of preventive medicine at USC. Participants from select dementia-care communities were exposed to "active light immersion" over a three-month period by increasing their daylight intake for two hours each morning. Though the sample size was small—only 21 people in the initial study—both the intervention and control group reported a decrease in depression symptoms after taking part, prompting Konis to repeat the study with a few refinements and a larger study population.

He did so with the support of the National Investment Center for Senior Housing and Care and Silverado Senior Living, increasing the pool of participants to 79 individuals across eight dementia-care communities. For the second pilot study, Konis used survey scores—collected using the Cornell Scale for Depression in Dementia and the Neuropsychiatric Inventory—to measure

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the effect on the depressive and behavioral symptoms of participants. "The Upjohn grant was the foundation for us to run the field study that followed," Konis says.

Konis is contributing to a body of evidence demonstrating the positive impact of daylight access on health outcomes. As an architect, he is simultaneously exploring how to translate emerging evidence into an architectural prescription that could reduce the need for drugs to treat depression and negative behaviors. This requires "new tools to spatially map the daily and seasonal changes in daylight exposure and identify where a 'daylight dosage' should be orchestrated by the design," he says. As the initial study proposed, this could manifest in a parametric design tool that can analyze and evaluate the daylighting performance of a given scheme and assist architects to design daylighting solutions that are informed by knowledge emerging from direct response to clinical trials.

The study could also codify a daylighting recommendation—a "compliance threshold"—to be incorporated into the WELL Building Standard, a proprietary scale from consulting firm Delos that proclaims itself "the world's first building standard focused exclusively on human health and wellness."

"Kyle's work represents what could be a first step toward integrating tunable LED and advanced lighting technology into our therapeutic design standards," says Paul Mullin, senior vice president of development for Silverado Senior Living. Silverado, which actively manages 36 memory-care communities across the country, has taken an interest in how Konis' research can be incorporated into quality-of-care initiatives for its patients. "We are constantly affiliating with the best teaching and research institutions to implement and install therapeutic advances into our facilities for care," Mullin says.

Building off the 2013 Upjohn grant, Konis recently received another one in 2016 to create a design assist tool to incorporate emerging health-based daylight performance requirements in actual buildings. It's all part of Konis' process, in which the AIA has been an essential partner.

The "AIA was the first to fund us, and that made it possible for other partners to get involved," Konis says. "These higher-performance expectations will help serve the public interest for buildings that actively support the health and well-being of their inhabitants." AIA

Ben Schulman

AIAPerspective

PHOTOGRAPHY: CARL BOWER

Minding the Store

Architecture is the bridge between healthy commerce and good design.

Healthy cities, and the ones we seem to like best, tend to have ample and varied commerce. Most of the stuff of quotidian need is abundant and within easy reach. We certainly know the signs of troubled communities, the ones we try to avoid: empty shops, boarded-up windows, "for rent" signs everywhere, and lifeless streets and sidewalks. Essentially, no commerce.

Main Street has suffered from big-box stores and strip developments on the exurban periphery, but that tide seems to be turning. As with the advent of online retailers, the fact that people want more out of life than simply to fill grocery carts may account for the apparent demise of big-box stores. People respond well to retail environments that include restaurants, specialty shops, cinemas, and other recreational outlets.

Commerce needs greater focus as a target—and beneficiary—of good design. We say that architecture promotes commerce and propels economic vitality, but can we prove it? Can we demonstrate that well-designed commercial projects spur sales? Surprisingly, there seems to be little factual data upon which to draw.

This May, *Le Monde* published an article entitled "Bilbao Profits from the Success of the Guggenheim," which cited 20 years of positive economic impacts on the area from the Guggenheim Museum, designed by Frank Gehry, FAIA. The museum, which has become as much of an economic engine as a cultural space, brought 19.2 million visitors to the Basque city. In 2016 alone, the museum earned €485 million (about $580 million) in revenues for local shops, restaurants, and services, accounting for some 6,000 jobs in the local economy.

The "Bilbao effect" has its skeptics, but the figures cited in *Le Monde* uphold the idea that architecture and great design can elevate the ordinary, enhancing the quality of life and spurring commerce. Investment in good design can earn economic dividends. In general, Europe seems to pay more attention than we do to commercial architecture, with programs like the Prix Versailles (prix-versailles.com) spotlighting retail projects—hotels, stores, and restaurants—and elevating their importance in the public eye and in the world of architecture and design.

Commerce is an essential ingredient of strong urban culture, a vital element of the quality of life. It is important to recognize buildings and developments that exalt the ordinary retail experience—to reward projects that go beyond the ordinary in meeting basic needs. AIA

Thomas Vonier, FAIA, 2017 AIA President

“If he was not to be an artist, he would settle for being an architect. And that was that.”

Excerpts from *Michael Graves: Design For Life* by Ian Volner

A series of interviews with Michael Graves for an undefined memoir project became, after the architect's death in 2015, the basis for a new biography: Michael Graves: Design for Life *(Princeton Architectural Press, 2017). In the book, author and* ARCHITECT *contributing editor Ian Volner chronicles the personal and professional life of the famed postmodernist. For* ARCHITECT*, Volner identified three pivotal moments, excerpted below, that show the influences that shaped Graves' career and singular style.*

Graves, 12, in a toy car he kept into adulthood

Choosing Architecture

[T]here was only one thing, from as early as he or anyone who knew him in Broad Ripple Village could recall, that Michael was absolutely certain he wanted to do. It was by no means something that seemed likely, in itself, to satisfy his mother's strict, utilitarian standard. But it was something he felt compelled to do: he wanted to draw.

Sitting by the window, Erma would look out in muted bemusement as the eight-, nine-, or ten-year-old Michael wandered through the front and back yards and along the sidewalk, drawing everything in sight. Indianola Avenue was lined with tall maples and oaks; overhead the power lines stretched from post to post, bowing deeply in between, and the houses, seen obliquely, produced a muddle of overlaid figures trooping one after another as far as the banks of the White River. Michael took it down as best he could with the pencils and loose-leaf paper his mother allowed him to keep. She could tell he had promise, but the situation was not to her liking. Tom excelled at math and science; why couldn't Michael be more like his older brother?

Besides the notebooks, the only real indulgence of Michael's artistic talent that Erma ever permitted was during a single summer when he was a child, when she signed him up for a painting class at the Indianapolis Museum of Art. It lasted one afternoon, and its sole product was a painting of a papier-mâché tiger that Michael had seen in the museum's collection. Years later Ada Louise Huxtable—the *New York Times*'s first architecture critic (and still the most powerful one in its history)—asked him about his "artistic education," and he mentioned briefly this one-day intensive seminar in Indianapolis. Huxtable, apparently deeming this a sufficient pedigree, went on to claim in print that Michael Graves was "a painter before he was an architect." No copy of the painting exists to vouch for Michael's early academic bona fides.

The tiger, however, was all Erma was prepared to tolerate. One day, not long thereafter, she made her feelings plain to her younger son.

"I'm tired of you telling all my friends that you're going to be an artist," he remembered her saying. "Unless you're as good as Picasso, you'll starve. What you should do is find a life's work that uses art, but that's a real profession."

"Like what?" Michael asked.

"I don't know. Like engineering, or architecture."

Unfamiliar with either trade, Michael asked first what engineers do. Erma explained in a hazy way the process of preparing schematic drawings, resolving the technical problems of construction, figuring out how to make buildings stand up, and so forth.

It sounded complicated. "Alright then," said Michael. "I'll be an architect."

"But," Erma pointed out, "I haven't told you what an architect does yet."

Michael said he didn't need to know; he just knew he didn't want to be an engineer. If he was not to be an artist, he would settle for being an architect.

And that was that.

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Studying at Harvard Graduate School of Design

Owing to his six-year-long spell as an undergraduate, Michael was allowed by GSD to compress the usually eight-term master of architecture program into a single year. His longer-than-usual college experience also meant that Michael was older than most of the new students at GSD, save for those who had not failed their fitness exams and had been conscripted into the military. Many of the students in his own year were products of Cambridge itself, having gone through Harvard's own undergraduate program, and several shared a scrap of advice with their new classmate, a message that distilled (at least in Michael's memory) to a simple warning:

"This is bullshit."

In his adult career, Michael never bore Cincinnati any ill will, even coming back decades later to design a building for his alma mater. He felt nothing but gratitude for Carl Strauss and an immense affection for Ray Roush. But for GSD, and for Harvard in general, he carried a flame of contempt so bright and so assiduously maintained over the years that it must have been a source of authentic pleasure.

At the University of Cincinnati, though some of his teachers had been products of GSD, theirs had been a different GSD—back when Walter Gropius was at the helm. [... B]ut Hudnut, Breuer, and Gropius were all long gone by the time Michael arrived in Cambridge. Dean Josep Lluís Sert was now in charge. Barcelonan by birth, living in exile in the United States since the end of the Spanish Civil War, Sert was a true believer in a specific genre of architectural Modernism, and he imposed his preferences upon faculty and students alike with a force that belied his remarkably short stature. Behind his back, Michael and his friends referred to him as "the Teeny-Weeny Deany."

Within the limited menu of Modernism then available in the United States, there were a still a few selections on offer. Miesian Modernism Michael had already learned at the University of Cincinnati; thanks to Roush, he could also bring in a bit of Breuer to add a homey touch. At Harvard, on the other hand, all this was in poor taste. As his classmates told him, "You better do Corb."

Michael had seen enough of Le Corbusier's work in college to know what that meant. Favoring white exteriors with occasional washes of color within and asymmetrical massing of pure geometries in artful juxtapositions, Le Corbusier's was a looser, more self-consciously poetic approach than that of either the stringent Mies or the humbly antimonumental Breuer. Unafraid of a certain quantum of symbolic resonance, Corb's definition of architecture as "the masterful, correct, and magnificent play of volumes brought together in light" wasn't quite in tune with the more functionally inclined Gropius, either. Sert's importation of the Corbusian strain signaled a changing of the guard at GSD. [...]

"One of the strongest proponents of the Mediterranean mentality," as the eminent historian Sigfried Giedion called him, Sert was in many ways a superlative designer. His own country home on Long Island included an astonishingly beautiful lofted living room with a herringbone brick floor—"a town square in Catalonia," as the artist Saul Steinberg once described it. He had been a champion of the Republican cause in his home country and a fearless opponent of Fascism everywhere—despite the pro–Francisco Franco sympathies of his famous painter uncle Josep Maria Sert. But Sert could also be philosophically straightjacketed, and he could be a bully.

A mutual antagonism between him and the new midwestern transplant took hold early. In his first semester, as Michael recalled, students were tasked with designing a museum; for the interior sections, Michael drew wooden walls with a texture indistinguishable from maple, while in his bird's-eye plan of the building's front terrace he rendered a brick patio in such minute detail that every individual brick was outlined. He had done it, in truth, because he could—a bit of shameless, if harmless, showboating.

A model of Graves' undergraduate thesis, "Amenable House"

MICHAEL GRAVES ARCHITECTURE & DESIGN; PRINCETON ARCHITECTURAL PRESS


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If Sert liked bricks, Michael would give him bricks.

At the end-of-term charrette, when the students presented their work, Sert made his way around to Michael's station. Before he launched into his critique, the dean leaned in to examine the drawings Michael had so carefully prepared, and without saying a word he started scratching them vigorously with his forefinger. "He was thinking it was some film I'd put down," Michael remembered. Sert believed the detail was fake, a decal applied to the paper. Far from impressing him, Michael's facility had merely aroused Sert's suspicion, and suspicion swiftly escalated into hostility. [...]

Michael recalled how once, early in his first semester in Cambridge, he had been sitting with a book open to an image of the Palais Garnier, the Paris opera house completed in 1875 and known to the world by the name of its architect, Charles Garnier. The building, its extravagant front foyer graced by a richly ornamented, delicately contoured grand staircase, was a high point of Second Empire design, an impressive if slightly gaudy instance of the French Beaux Arts style. Sert walked into the room and approached him.

"What are you looking at?" he asked.

Michael showed him.

"You won't need that here," Sert said, and snapped the book closed. Art history belonged to the art historians; GSD students were to keep their heads down and deal with the real, the here and the now. [...]

In his second semester, Michael took a studio with the dean himself. At the time, Sert was becoming interested in new techniques in concrete construction; a decade later, he'd deploy an inventive semitubular system for the roof of his Fundació Joan Miró, the museum in Barcelona built and named in honor of the painter who had been Sert's friend since the early 1930s. To acquaint his students with the process of mixing and molding in cement and aggregate, the dean sent Michael and a couple of other students down to the school workshop, charging them with making some concrete and pouring it into inverted forms like those Sert would later use for his museum.

"I thought, my god," Michael said, "I've been on construction sites all my life, for six years. I don't want to do this." Finding that some of his colleagues felt the same, Michael proceeded to lead a small mutiny. The group demanded another, less menial assignment, and though their insubordination must have galled him, Sert finally conceded. They could design a house, he told them, provided that it too used inverted concrete shells. They accepted.

But Michael's budding interest in the history of art wormed in, and once again he and Sert were at

A referential sketch from Graves' 1977 notebook

MICHAEL GRAVES ARCHITECTURE & DESIGN; PRINCETON ARCHITECTURAL PRESS

loggerheads. In conceiving his house, Michael did exactly as he knew Sert would want him to, devising an asymmetrical plan, as in a Le Corbusier house, and giving the exterior walls a slight sculptural wave in deference to Sert's repeated exhortations to "animate the facade! Animate the facade!" But Michael added one tiny detail that spoiled the whole effect.

On a long wall in one of the perspective drawings of the house's interior, he pasted a photo of a painting that he'd cut out of a magazine. (He might as easily have drawn a sketch of it, but he'd learned that that would avail him nothing with the dean.) The painting, Michael recalled, was the work of Nicolas Poussin, the early nineteenth-century French artist who had forged

the bridge between the baroque and the classical in French art. The piece was one of his enchantingly enigmatic landscapes: tunic-bedecked shepherds and tall cypresses under a cobalt-blue sky. It was not, in other words, anything like the work of Joan Miró, Alexander Calder, or the other contemporary artists Sert favored.

Michael remembered watching Sert as he first espied the painting in the interior and then abruptly launched into a stream of richly accented invective. "I've spent my entire life getting rid of that shit," Sert exclaimed, "and you bring this into my school willy-nilly!"

But the student pleaded his innocence. "I didn't do it," Michael told him. "The painting is in the collection of my client."

As Michael related, the Fictional Client Defense only fanned the flames of Sert's anger. He threatened to flunk Michael for the course and was dissuaded only when a sympathetic faculty member [...] persuaded him to fail the student for the project but pass him for the semester as a whole.

When Graves Became Graves

Days after arriving in Princeton from MIT in 1977, newly minted firm associate Karen Nichols (then Karen Wheeler) went with Michael to see the just-finished Claghorn House as it was being set for a shoot by the architectural photographer Yukio Futagawa. As they walked through the house, Michael showed Nichols how the design had come together—how it functioned as a Cubist assemblage, how its quotidian materials resonated with ideas of place and entry, of the private and the public spheres.

Nichols [...] didn't get it.

Finally, Michael took her by the shoulders and stood her square in front of the terrace, aiming her directly at the latticed facade of the terrace wall. "Can't you see it?" he said.

"See what?"

"There's a picture plane!"

He then proceeded to show her how the puzzle fit together: how the diagonal cutaway of the lattice shaped the space before it; how the lattice blended with the big post-and-beam structure to create the appearance of a trellis; how the trellis, the horizontal courses, and the doorjamb all framed the kitchen, pointing the way toward the entrance. It was all perfectly clear, Michael insisted, once you looked at it the right way, as a frontal tableau.

All at once, it clicked. "Before that," recalled Nichols, "I had understood it in three dimensions." [...]

Michael's design process during these years began


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to place more and more emphasis on elevations. In good Corbusian fashion, he had usually begun with the plan—a more than adequate template for his painterly skills, Corb himself having proven their compositional potential. But as Michael wrote at the time: Plan is seen as a conceptual tool, a two-dimensional diagram or notational device with limited capacity to express the perceptual elements. … Plans are experienced only in perspective as opposed to the vertical surfaces of a building which are perceived in a frontal manner.

No one, in other words, can appreciate the artistic merit of a plan except insofar as the elevation bears it out. Floors are mute. Walls can speak.

With elevations taking center stage, Michael began to rely heavily on large format yellow tracing paper to render them. Painting, which he continued to do off and on, was never used as a medium for developing specific designs, though his artistic work always took place in parallel with his architectural activity. ("I use the same formal ensemble of objects in my paintings that I use in my architecture," he put it.) Likewise his habit of creating what he termed "referential sketches": scribbled in small notebooks, sometimes on loose pieces of paper, often in the margins of larger drawings or even next to student work, these were strictly mental musings, intended as his visual "diary," as he described it. They would serve as background material for "preparatory" and finally "definitive" drawings, where facade treatments could be worked out at length in the open space of the large yellow sheets, to be handed off later to his associates for detailing and coloring and then returned to him.

Such would remain the standard procedure at Michael Graves Architect for decades. But during this pivotal stage in his career—the moment, it might be said, when Michael Graves became Michael Graves—there was a special importance to his private sketching and painting.

A set of maroon-bound sketchbooks, kept by Michael over an approximately seven-year timeframe starting in 1975, affords a unique glimpse into his design approach as it was then evolving. Different versions and views of both the Schulman and Crooks fireplaces turn up in these pages, alongside countless other "referential" caprices floating through his architectural subconscious: churches and landscapes, some recalled from his time in Europe; drawings of John Hejduk's "Wall House" proposals; images culled from books of architectural history, including a phantasmagorical temple by the eighteenth-century Frenchman Jean-Jacques Lequeu; and a remarkable quantity of interior fixtures, sconces, chairs, and other details, some of them ones he was considering for


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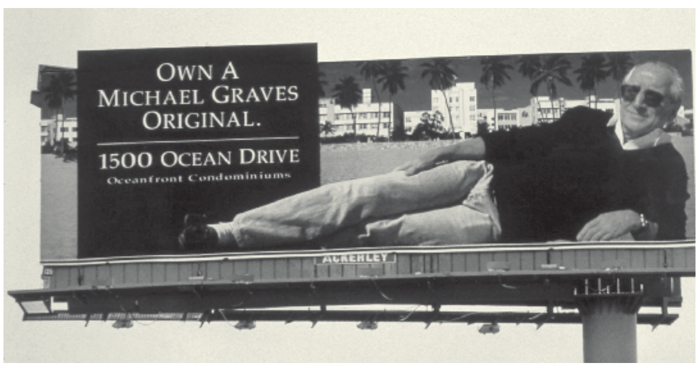
purchase whenever (or if ever) he had the money. Of his day-to-day life he sketched nothing, except once—a tiny, exquisite portrait, marked “ESLG,” which he dashed off on a visit to Indianapolis. It is the only known picture he ever drew of his mother, Erma, and one of very few images he ever created of any family member. […]

This artistic insight had been acting on Michael’s mind for some time, and his architectural production had always had a compressive quality [… b]ut what he



A 1993 billboard shows Graves at the height of his commercial success

MICHAEL GRAVES ARCHITECTURE & DESIGN; PRINCETON ARCHITECTURAL PRESS

had discovered at Claghorn was that basic functional accommodations were better handled by a plain box. That left him free to make his exteriors more like two-dimensional projections: a convenient solution, since that was more or less how he’d always seen buildings to begin with.

Here the matter of Michael’s ocular defect is impossible to ignore. “I thought for years that he didn’t see the way other people did,” said Karen Nichols, who went on to spend the next four decades (and counting) with the firm. As she witnessed at Claghorn in the very beginning, Michael could discern continuities—between, for example, a structure that sat in front of a wall and the wall itself—that were all but invisible even to trained architects. Frustrated, and more eager than ever to make himself understood, Michael’s response was to make his work even flatter, eliminating the likelihood of misinterpretation by doing in two dimensions what he had nominally done in three. To his mind and, more importantly, to his eye, nothing would be lost in this translation. Just as his strabismus collapsed spatial arrangements into planar ones, he could sense a dynamism in planar surfaces that most viewers would experience only in perceiving and moving through space. Of course, this is as much to say that what made Michael able to see things other people couldn’t also made him unable to see things other people could.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“We’re not saying Prora can’t be used. It wasn’t a concentration camp, or a Gestapo prison. But its past needs to be talked about honestly.”

The Rebirth of a Nazi Resort by Andrew Curry

For the last decade, Ulrich Stuke, an architect with a residential practice based in Berlin, has become skilled at modernizing the city's high-ceilinged turn-of-the century apartment buildings, making the most of historic materials and updating original floor plans. But on a recent windy and rainy afternoon, Stuke is pacing the half-finished hallways of a very different sort of project. Six stories high, nearly 1,650 feet long, and 387,000 square feet in total, the building is part of a vast vacation complex constructed by the Nazis on the island of Rügen, along Germany's Baltic Coast. Called Prora and designed in 1936, the project was slated to include eight buildings that would have stretched for 2.8 miles along the island's wind-blown, white-sand beaches. Every one of the 10,000 rooms would have featured a view of the sea. The vast beachfront complex, only partially completed before the start of World War II, nevertheless became a mainstay of Third Reich propaganda, which promised affordable seaside vacations for loyal German workers.

Today, Prora is the second-largest architectural remnant of the Third Reich, after Albert Speer's rally grounds at Nuremberg. Abandoned for decades, the mile-long oceanfront ruins have slowly been carved up, sold off to investors and, during the last five years, redeveloped for sale as vacation apartments and rentals. So far, architects have renovated or rebuilt the concrete and brick skeletons of three of the original buildings, with two of those projects opening in stages over the last two years. Drebing Ehmke Architekten, a Greifswald, Germany–based firm, oversaw the conversion of one section into apartments and a hotel; a fourth building was turned into a youth hostel.

Critics have argued that developers are using Prora's historic status—the site was given a preservation designation in 1992—as a tax dodge, and ignoring or suppressing efforts to remember its dark past in order to sell apartments. A "ghetto on the beach only fascists could have come up with," is how the German newsweekly *Stern* described the project in May. Locals have complained that the site is being sold off to rich investors, gentrifying a sleepy part of what is a popular summer vacation destination.

Stuke sees it differently. "Hitler was never here. It's not a Nazi building, any more than the Volkswagen Beetle is a Nazi car, or the Olympic Stadium in Berlin was a Nazi stadium," the architect says, carefully wiping his feet before stepping into a top-floor penthouse that is tastefully decorated in seaside-cottage tones of white and gray. "Here we have a chance to make something good out of bad ideology. What's so terrible about people using the place for vacations?"

"Seaside Resort of the 20,000"

Prora was designed by Clemens Klotz, a Cologne-based architect who received several prestigious commissions from Hitler's National Socialist regime. Klotz's proposal for the resort was the winning entry in a competition organized by the German Labor Front, a Nazi trade union. The project was part of the Kraft durch Freude (KdF), or "Strength through Joy," program, a scheme to reward working-class members of the Nazi party with affordable vacations and leisure activities like concerts, plays, and libraries.

By 1939, KdF was the world's largest tourism operator—millions of Germans participated in the program's trips each year—and Prora was designed to be the crown jewel. Propaganda films dubbed the project the "Seaside Resort of the 20,000." There, the masses "shall find relaxation and the strength to continue working," as one film claimed. Writing in the *Berliner Zeitung* last year, the German historian Götz Aly called Prora "propaganda written in stone, a promise to German workers that a brighter future was on its way."

Work underway and completed at Prora

HANS SEHRINGER

The plans for the project were ambitious, even by the standards of the Third Reich. The design called for a hotel complex with two curving wings, each more than a mile long, flanking a 4.3 million-plus-square-foot central square, which was anchored by a central auditorium big enough to accommodate all 20,000 vacationers at once. Klotz designed reception halls capable of handling 3,000 arrivals and departures of passengers each day. Docks were to extend about a half mile out into the Baltic to welcome cruise ships packed with vacationers.

In case of rainy days, the design of the complex included a movie theater, bowling alleys, indoor swimming pools, theaters, cafés, and "reclining halls,"

buildings with open floor plans and floor-to-ceiling windows where guests could get fresh air without stepping outside. The rooms themselves were Spartan by modern standards: Each double unit measured about 8 by 16 feet and was to be outfitted with identical furnishings. Toilets and showers were communal.

In 1937, two years before Germany invaded Poland and set World War II in motion, Prora's design was awarded a "Grand Prix" at the Paris World Expo. Unlike many of the building projects championed by Hitler, the design was clean and modern; it was inspired by Germany's "New Building" movement, which rejected Expressionism in favor of more functional design.

In fact, the project owed much to a Le Corbusier proposal (never realized) for reshaping the North African city of Algiers. Le Corbusier imagined a long, snaking residential complex along the city's waterfront—a project that clearly inspired Klotz. "What's special about [Prora] is that it's not classic Nazi architecture," says Katja Lucke, a historian who runs

"It's not a Nazi building, any more than the Volkswagen Beetle is a Nazi car, or the Olympic Stadium in Berlin was a Nazi stadium. Here we have a chance to make something good out of bad ideology. What's so terrible about people using the place for vacations?"

—Ulrich Stuke, architect, Stuke Architekten

SEAN GALLUP/GETTY IMAGES

Prora in June

Renderings of Stuke's Prora project

the Prora Documentation Center on Rügen, which chronicles the history of the complex. "Its architectural style has more to do with the Bauhaus."

"It's neither barracks architecture nor Nazi architecture," writes architect and historian Jürgen Rostock in his book *Paradise/Ruins: The KdF Resort of the 20,000 on Rügen*. "It comes more from classical modernism, and from design that's oriented strictly towards function."

Still, the scale of the project unmistakably bears the ideological imprint of the Nazi regime. "When you're in a reception hall with ceilings 60 feet high, surrounded by 2,000 other people, you're intimidated," Lucke says. "It's clear you're just a small part of a larger mass, with no individual voice. ... The way it was built, the way it was planned, the way it looks is all because of Nazi ideology."

Even after construction was halted in 1939, Prora remained a useful tool to the Nazi regime. It was promoted in propaganda throughout World War II, "advertised so heavily some people thought it actually existed," according to Lucke.

During the war, the site was used for a variety of purposes, many of them grim. Military police battalions that trained there were deployed to the Eastern Front and participated in the deportation and murder of hundreds of thousands of Jews. Polish forced laborers and Soviet POWs were imprisoned in Prora's half-finished structures. When German cities were set aflame by Allied bombs late in the war, refugees from Hamburg and elsewhere were housed inside. Later, during the Cold War, it became a retreat for members of the East German secret police and a secretive training ground for "allies" from Cuba, Yemen, and the Palestine Liberation Organization.

Shortly after German reunification, the government contemplated turning Prora into a massive barracks and training center. A few years later, in 1996, a local university commission suggested transforming the site into a multi-use complex, with a senior center, youth hostels, apartments, and shops. Instead, local authorities abandoned Prora, and for almost 20 years it slowly decayed. Curious beachgoers explored the empty hallways and concrete stairwells. Locals moved in, squatting in the best-preserved parts of the complex and opening ceramics workshops, art studios, and other small shops. An ad hoc museum dedicated to the East German army took hold in one wing; in another, activists founded the Prora Documentation Center.

A One-Dimensional Tourist Development?

Today, the complex's Bauhaus inspirations are a key selling point for the renovated apartments. One radio ad describes Prora as "inspired by the vision

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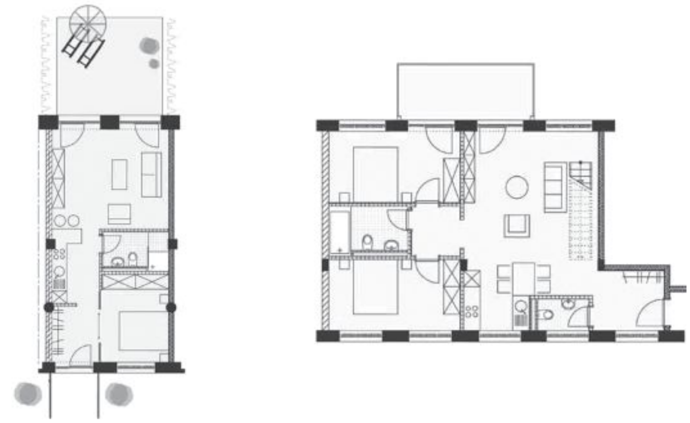
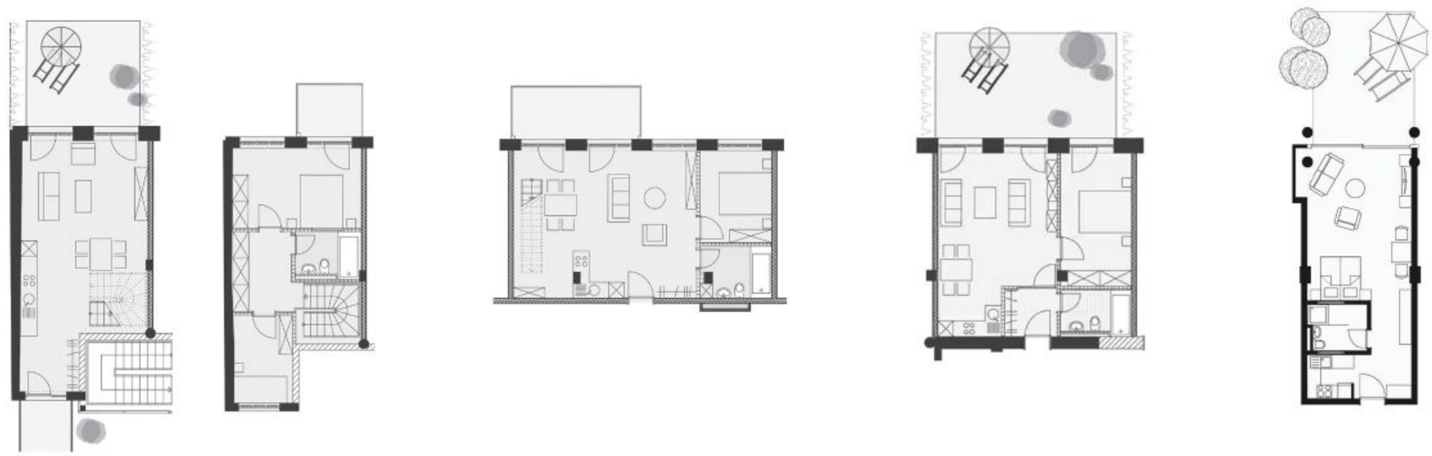
of architect Le Corbusier, with timeless modernist lines," neglecting any mention of Klotz, KdF, or the Nazis. "Of course they don't want to make a big deal of the Nazi era, because they want to sell houses," says Lucke. "They're being coy and refusing to treat the history critically."

Several parts of the buildings were purchased by a local investor for €500,000 in 2006, then parceled out and resold to at least four developers. What started modestly in 2011 when the youth hostel opened has since become decidedly high-end: Because of the project's historic designation, apartment buyers get tax breaks, and sales—units start around €150,000 and run upwards of €600,000 for the penthouses—have been brisk. The target market is middle-to-upper class Germans looking for investment opportunities and vacation homes. As far as Lucke's concerned, that's a shame. "Now it's a one-dimensional tourist development," she says. "There's no residential element at all."

Critics also complain the clean lines of the original



COURTESY METROPOLE MARKETING



From left to right: Prora Solitaire floor plans for a loft, two-bedroom suite, two-story suite, one-bedroom suite, loft, and studio design have been all but erased by the hodgepodge development: Each hall now looks a little different, with mismatched balconies that weren't part of the original design interrupting the sweeping seafront curves Klotz had envisioned.

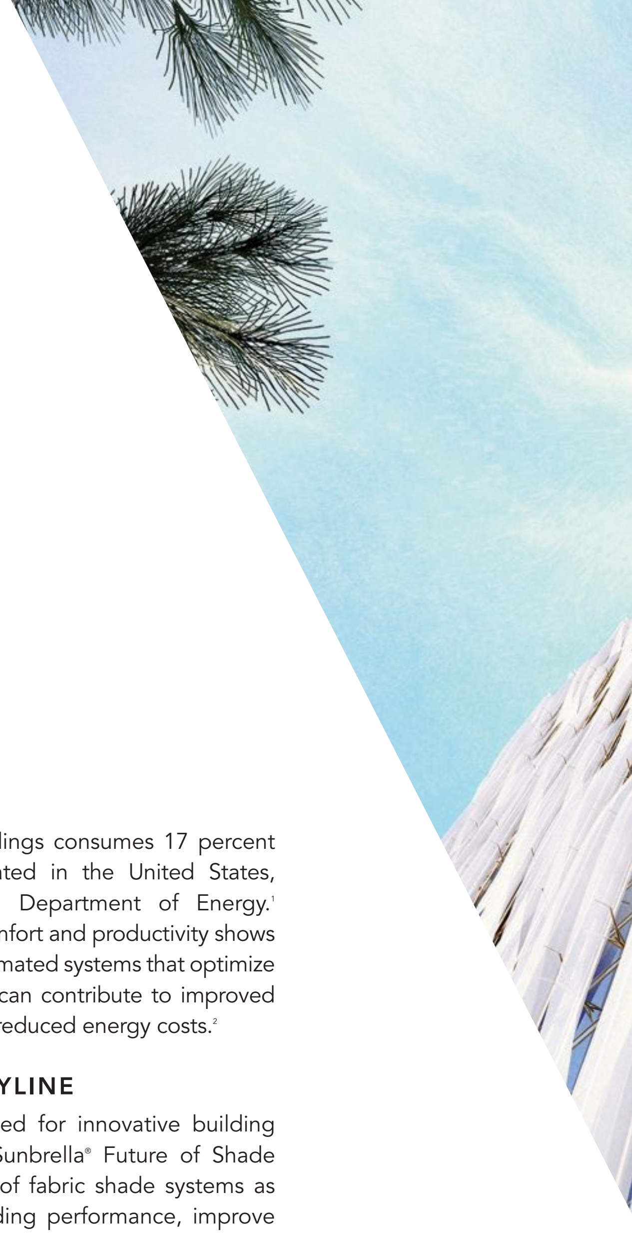
Stuke bristles at the accusations, pointing out that before the developers arrived Prora's buildings were being left to decay. When he started his €76 million renovation project in 2013, located on the southernmost part of the complex, he felt the weight of history—and expected scrutiny and pressure from the public. "It's a huge challenge. It's a historic building, and everyone knows it," he says. "Getting it from those times to modern standards—that's the complicated part."

The major problem was how to bring the apartments into line with modern fire, safety, and noise insulation standards, as well as how to add elevators, ventilation, and heating without sacrificing too much square footage. Because the original ceiling height was under 8 feet, wiring and piping had to be run through walls. Stuke drew up new floor plans for studios and one-bedroom units on the lower floors, and penthouses with roof decks on the top of the building. He designed floating balconies to keep the façade as clean as possible, a compromise with the historic preservation office. Visually there's almost nothing left of the original building on the inside, save for the brick and ironwork in the staircases.

The success of the redevelopment so far has increased interest in the last available building, where the Prora Documentation Center, staffed mainly by local volunteers, has been housed on two sparsely decorated floors since 2000. Several long-term tenants have already been forced out, and the future of the center is now threatened. Lucke hopes to strike a deal with local politicians to make sure any potential development includes plans—and funding—for a museum. "We're not saying Prora can't be used. It wasn't a concentration camp, or a Gestapo prison," she says. "But its past needs to be talked about honestly."

The Prora Documentation Center

BILDAGENTUR-ONLINE/SCHOENING



THE FUTURE *of* SHADE IS NOW

Architects play a unique role in shaping our world: Each design decision influences how people perceive where they live, work and play. But steel, stone, brick and wood aren't the only materials in an architect's toolkit. Intangibles, such as light, air and temperature, also affect the way people feel in a space.

Shaping light through the use of shading devices should be central to the design process because without shade, life can quickly become unbearable. Think of the worker whose office suffers from overheating and glare. Or the retailer whose customers don't linger because the pedestrian-oriented shopping district is too hot. Or the restauranteur who can't fill her patio seating because it's totally exposed to the sun.

Shade can boost commerce and improve worker productivity, not to mention it can protect people from health risks related to UV exposure. Shade design should be a priority whether the project is a streetscape, shopping area or high-rise office building.

LIGHT CONTROL = COST SAVINGS

Building energy efficiency and worker productivity can be tied directly to effective shading systems in office structures. People need natural light for emotional and physical health, but researchers are finding that control of these daylighting features is a key element in the performance of buildings and the people who work in them.

Electric lighting in buildings consumes 17 percent of all electricity generated in the United States, according to the U.S. Department of Energy.[1] Research into worker comfort and productivity shows glare reduction and automated systems that optimize shade and natural light can contribute to improved worker productivity and reduced energy costs.[2]

DRESS UP THE SKYLINE

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Puerto Rico-based architect and industrial designer Doel Fresse saw a need for automated shade in glass façade high-rise buildings, especially those located in the Caribbean. His conceptual design, "Helicon," is inspired by the shape of heliconia flowers ubiquitous to the island nation. Helicon's fabric panels create an intriguing geometric pattern on the building's exterior. The panels can be adjusted to create interior shade, reduce glare or allow more light into the building when desired.

Helicon, which is designed as a retrofit shade solution for existing glass façade buildings, improves the building's overall energy performance by blocking light before it enters the building. The system can also be flattened to the building's exterior to prevent damage during hurricanes or tropical storms.

Responsive Shading System by Arman Hadilou – United States

Helicon by Doel Fresse – Germany

For architect Arman Hadilou, the intense summer heat in Austin, Texas, spurred him to conceptualize the "Responsive Shading System," a kinetic façade of massive strips of fabric mounted on adjustable arms on the building's exterior. The system responds to the elements, twisting the strips to create bigger or smaller openings depending on the angle of the sun and the time of year. In this way, Responsive Shading System balances building energy efficiency with the need to maintain views.

The air gap between the building's glass façade and the fabric façade allows for ventilation created by natural convection.

CONCLUSION

Given rising global temperatures, creating energy-efficient buildings is more important than ever before. With shade at the center of the design process, architects can ensure energy efficiency is a priority, while also creating aesthetically pleasing buildings that promote occupant comfort.

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[1] *"Trends in Lighting in Commercial Buildings." EIA, U.S. Energy Information Administration - EIA - Independent Statistics and Analysis, 17 May 2017.*
[2] *L Roche, "Summertime Performance of an Automated Lighting and Blinds Control System," Lighting Research & Technology, vol. 34, Issue No. 1 (2002) 11-25. Ossama A. Abdou, "Effects of Luminous Environment on Worker Productivity in Building Spaces," Journal of Architectural Engineering, vol. 3, Issue No. 3 (1997).*

“The architect I picture when I think of Wright now, deep into this anniversary year, is a more complicated and in certain ways more impressive figure—and one more relevant to contemporary debates.”

Coming Around to Frank Lloyd Wright by Christopher Hawthorne

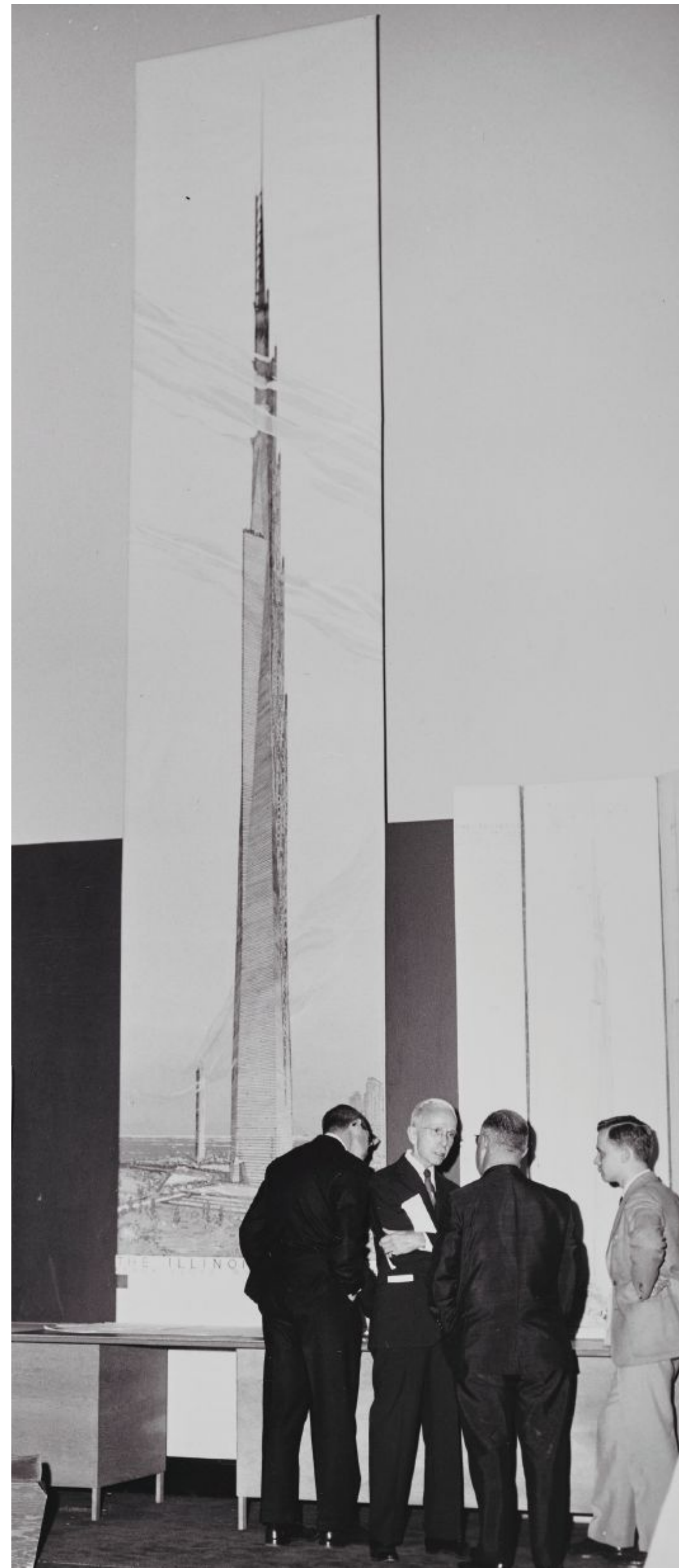
After spending much of 2017 reading, thinking, and writing about Frank Lloyd Wright—and directing an hour-long television documentary about his Los Angeles houses to be broadcast next year—there is at least one thing I can say I've learned for sure: Wright at 151 is a whole lot more interesting, surprising, and compelling than Wright at 150.

By that I mean simply that the exhibitions, public events, and publications marking the 150th anniversary of the architect's birth, on June 8, 1867, have been more revealing than I might have guessed—both about Wright and about us. The architect I picture when I think of Wright now, deep into this anniversary year, is a more complicated and in certain ways more impressive figure—and one more relevant to contemporary debates in the profession—than the one I would have pictured in the run-up to his big birthday.

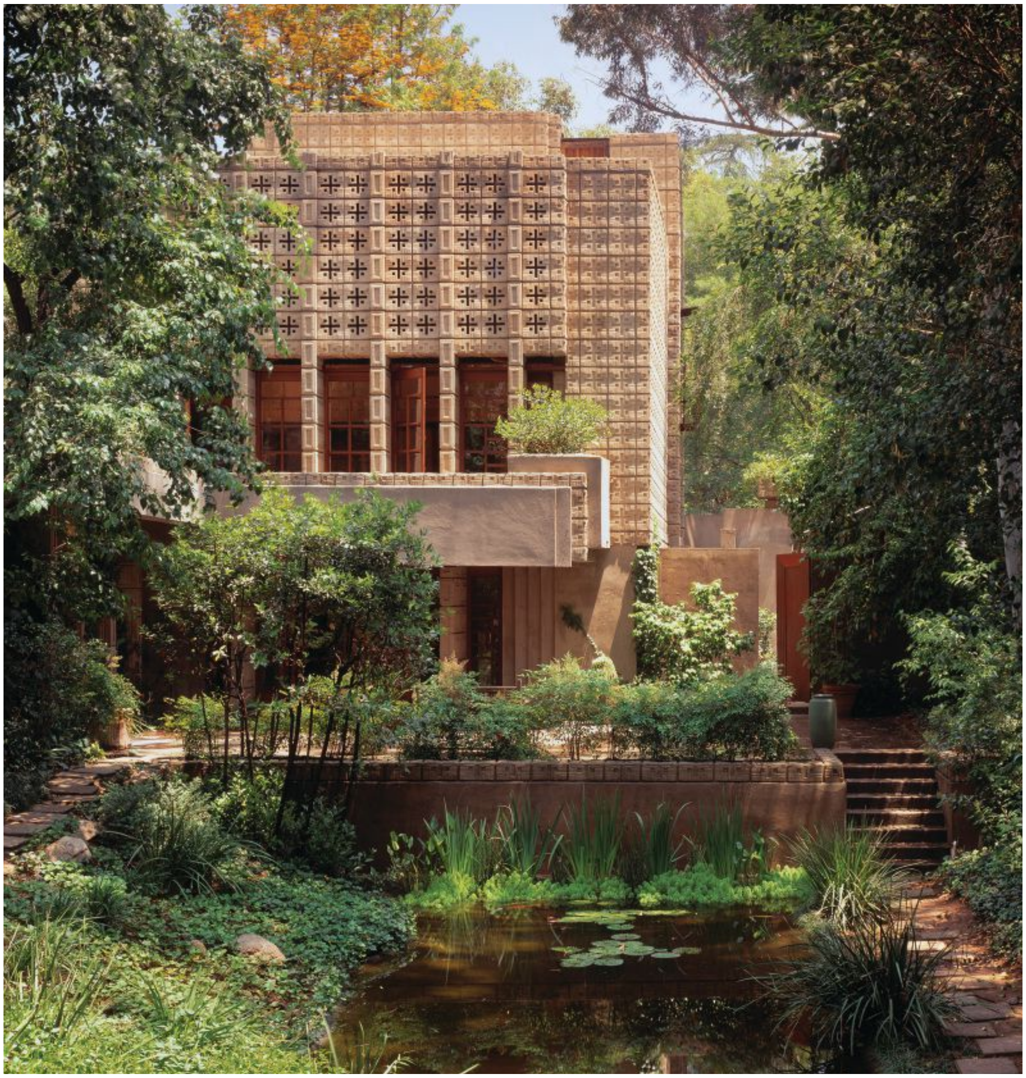
The most consequential of these Frank-Lloyd-Wright-is-turning-150 events, without question, was held at the Museum of Modern Art. "Unpacking the Archive," an exhibition organized by Barry Bergdoll and Jennifer Gray and featuring a hydra-headed curatorial team of more than a dozen scholars, few of whom are Wright specialists, ran from June 12 through Oct. 1 in third-floor galleries freshly remade by New York–based Diller, Scofidio + Renfro. Marking both the 150th milestone and the fact that MoMA and Columbia University's Avery Architectural & Fine Arts Library have acquired the massive Wright archive, it was a show simultaneously ambitious and dutiful, surprising and rote.

An Ambivalent Relationship

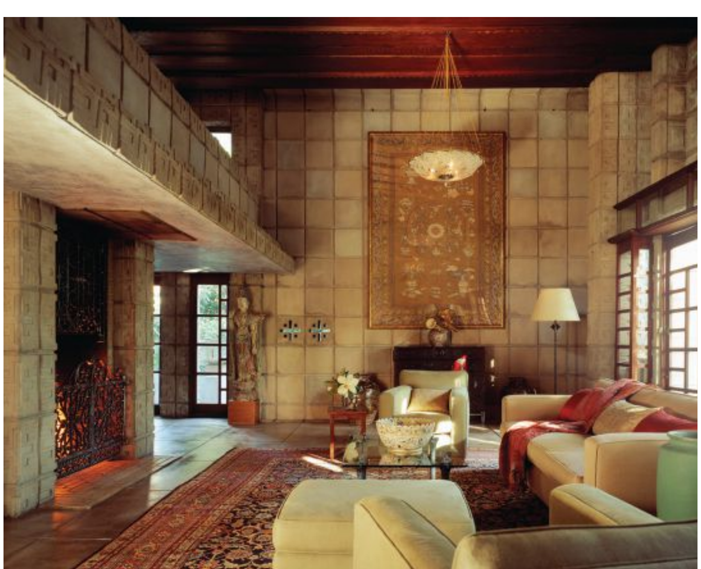
The show's structure and curatorial approach say as much about how MoMA sees itself in 2017 as how it sees Wright. Bergdoll, a prominent Columbia architectural historian and from 2007 to 2013 chief curator of the museum's architecture and design department, essentially outsourced the job of analyzing Wright instead of attempting the admittedly giant task of presenting a unified picture of his work and legacy. (Each guest curator was asked to pick from the archive a single project and build a room around it.) This is in large part, surely, a reflection of a culture rightly suspicious of confidently comprehensive summaries of important histories, architectural or otherwise, especially when they are delivered by middle-aged white males like Bergdoll at pillars of the establishment like MoMA. The approach paid some clear dividends; the sections on the relationship between Wright's architecture and race, labor, and landscape were especially strong.



A 22-foot-tall visualization of Wright's Mile High Illinois tower unveiled at a 1956 press conference in Chicago



Wright's La Miniatura, also known as the Millard House, which was built in Pasadena in 1923



Notably, Bergdoll decided to include a central gallery, a sort of spine, featuring exquisite presentation drawings of many of Wright's most famous projects, including the Guggenheim and Fallingwater, that didn't appear elsewhere. This clearly seemed an effort by MoMA to have its cake and eat it, too, or at least give the public what the museum assumed they came to see: namely, Wright's greatest hits along with the b-sides, the overlooked but still somehow emblematic projects that Bergdoll's team were specifically keen to focus on. Bergdoll did keep one room in "Unpacking the Archive" for himself, using it to analyze Wright's 1956 design for a mile-high skyscraper, the Illinois, and how the architect, always a self-promoter and publicity hound, discovered his love for television around the same time. (The architect's late-career interviews with Hugh Downs and a young Mike Wallace are worth tracking down on YouTube.) Yet even here Bergdoll barely tried to obscure his feeling that Wright could

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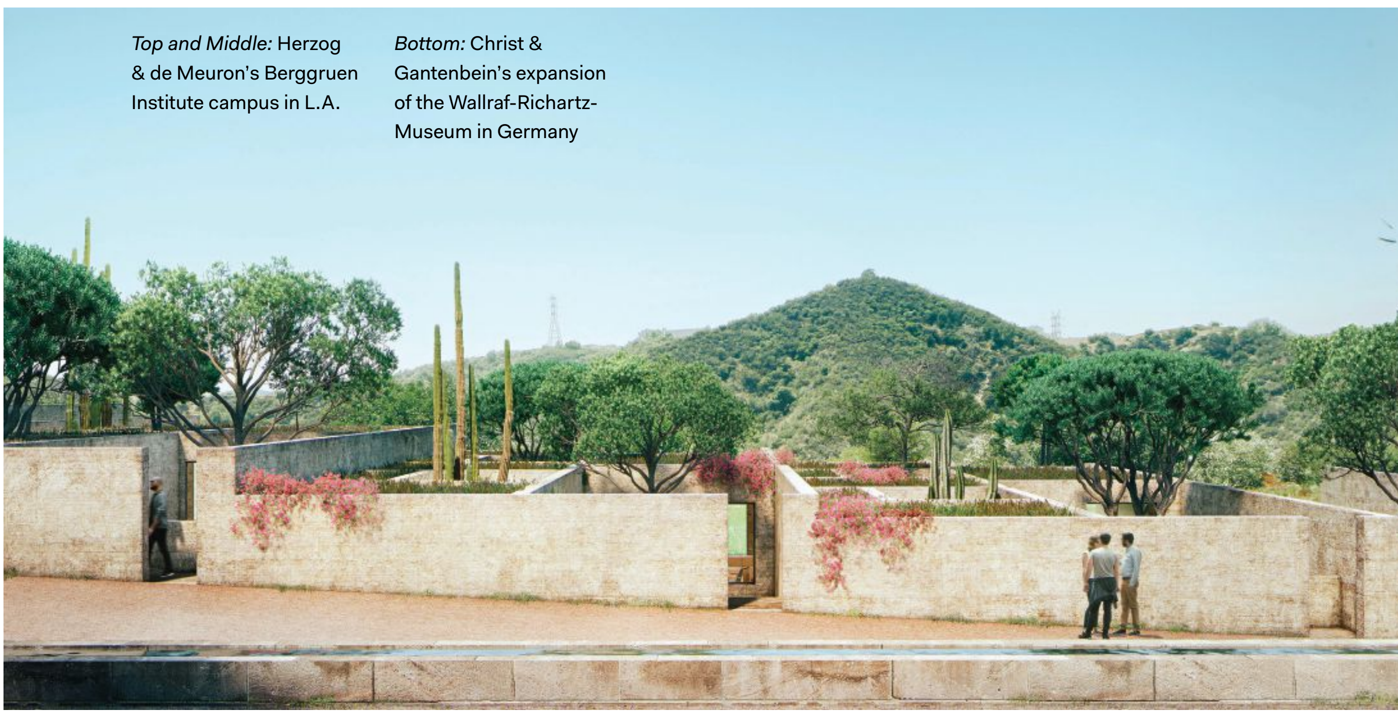

Top and Middle: Herzog & de Meuron's Berggruen Institute campus in L.A.

Bottom: Christ & Gantenbein's expansion of the Wallraf-Richartz-Museum in Germany

never quite match the inventive cool of an architect that Bergdoll has studied closely, Ludwig Mies van der Rohe. He included in his section a pair of Mies drawings, a 1954 collage of the Chicago Convention Hall, and a rendering of the 1921 Friedrichstrasse skyscraper in Berlin. They served to yank visitors out of Wright's world and into that of Mies, an architect whose modernist bona fides, unlike Wright's, remain unimpeachable.

Some of the show's inconsistency, of course, can be traced directly back to the complicated, deeply ambivalent relationship that Wright maintained with MoMA—and vice versa. There was a mutual curiosity between the museum and America's most famous (and one of its most prolific) architects and from time to time a mutual disdain. Wright was never a figure to be ignored; yet neither did he ever fit neatly into the museum's definition of avant-gardism. There was always a sense that—to paraphrase a famous put-down

TOP: COURTESY HERZOG & DEMEURON; BOTTOM: COURTESY CHRIST & GANTENBEIN

by Philip Johnson, the founder of MoMA's architecture and design department—Wright and his work belonged more to the 19th century than the 20th.

While this may have been at least partly true in terms of Wright's personal style and his favored brand of architectural representation, that combination of caped dandyism and sepia-washed drawings we're all familiar with, it was never true of his approach to the art of building. From the beginning of Wright's long career to the end, there were all kinds of detours, personal and professional, setbacks, crises, periods out of the spotlight, and dramatic reinventions. What stayed consistent was Wright's restlessness, his desire—common to so many geniuses, musical and artistic as well as architectural—to press the boundaries of his field. He did so almost unthinkingly; there was something impulsive about the way he displayed his boredom with architectural problems he had already confronted.

Houses for a Mayan God

Take the L.A. houses. For much of the year I've been working to finish "That Far Corner: Frank Lloyd Wright in Los Angeles," a documentary set to air on L.A.'s KCET-TV next March. (The title is borrowed from a phrase Wright used in his autobiography to describe Southern California.) It's true that L.A. was a place for him to hide out and slowly heal after Mamah Borthwick Cheney—the woman he'd run off to Europe with in 1909, abandoning both his career and family—was murdered by a deranged servant at Taliesin in Wisconsin along with her two children and four others in the summer of 1914. (Wright was in Chicago when it happened, working on the Midway Gardens project.) Yet he hardly used that recuperative period in California simply to lick his wounds. Wright turned his attention to pioneering a new method of bringing together structure and ornament that was entirely different from the work he had done up that point—and distinct from both the houses European modernists were designing and those the leading L.A. architects of the day were turning out, which were mostly variations on the Spanish Colonial Revival.

Between 1919 and 1924, Wright designed five houses in Southern California. The first, for the oil heiress Aline Barnsdall, was a transitional design; it marked the end of the Prairie Style, the possibilities of which Wright had largely exhausted by 1909, and incorporated, along with pre-Columbian elements and hints of the Midway Gardens design, influences he'd picked up during his European sojourn, most notably the Viennese Modernism of Otto Wagner and others. Colin Rowe called the result "so very *Wagnerschule*."

The four houses that followed were something new, a clean break and a fresh chapter: experiments in modular construction that featured concrete blocks stacked in rows, threaded through with steel rods and stamped with a variety of ornamental patterns, most of them derived from Mayan ruins and other pre-Columbian sources. (Wright referred to this structural strategy as a kind of weaving, hence the phrase "textile-block houses.") These crypt-like houses are hardly welcoming or especially domestic—Brendan Gill, one of Wright's most perceptive biographers, called them "better suited to sheltering a Mayan god than an American family"—but are doubtless full of experimental energy.

> If you do your best to understand the buildings on their own terms, as I've been trying to do with the L.A. houses, what emerges is a figure rushing into the future more energetically than we remember.

Because we tend to see any architecture of that period that uses ornament, decoration, or historical quotation as retrograde, we have tended to overlook the radical nature of those houses from a structural point of view. The way Wright looked to rehabilitate the reputation of lowly concrete—which the architect correctly described as a "gutter rat" of the building trades—by bringing it into the domestic realm and the world of high design, is also not readily observed with 21st-century eyes, now that concrete walls in million-dollar loft apartments have become commonplace.

Wright was trying to rebuild his life as well as his career while he was in Los Angeles. Aside from the Imperial Hotel in Tokyo, which he was also designing during this period, he had very little work and few prospects. His son Lloyd lived in Los Angeles, having found work both as an architect and head of the design department for Paramount Pictures; otherwise Wright's contacts were minimal. And yet instead of trading on the wide popularity of his Prairie School houses or producing his version of the widely popular Spanish Colonial Revival—either of which would likely have been a lucrative approach—he instead tried an entirely new and untested system that aimed to be

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(B) Gain favor with the termite king by marrying his termite daughter.

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REDWOOD

REAL. STRONG.

modern and deeply historical at once, both of its time and out of time.

This desire to test himself often led Wright into problems. The L.A. houses, especially the ones on steep lots, began to crumble almost immediately, and water seeped between the cracks that inevitably opened up between one row of blocks and the next. Sometimes Wright courted these problems himself: Instead of siting the Millard House in Pasadena on the flat middle part of the lot, he perversely decided to build it right in the middle of a ravine that runs along one edge of the property. That made the house immeasurably more romantic but also essentially guaranteed, as soon as heavy rains came and filled up the ravine, that the basement would flood. It's a cliché that modern houses, with their flat roofs, are vulnerable to leaking. Wright did his modernist counterparts one better, producing a house that took on water from above *and* below.

These Southern California houses, monumental and largely windowless as they face the street, are also primordial in tone and inspiration. The historian Thomas Hines has called them "aloof and impregnable bastions [with] fortress-like façades." It's here that we can begin to see some links between Wright and contemporary architecture. Whenever architecture becomes concerned with history—as was true in the 1920s, when Wright lived in a revivalism-crazed Los Angeles; in the 1980s, with Postmodernism's ascent; and again today—there is nearly always a related effort to go back to prehistory, or a kind or primitivism. Wright examined the eclecticism rampant in Los Angeles and found it repulsed him; he tried to look deeper into history and produce an indigenous architecture authentic to the southwest, even if his quotations of pre-Columbian forms were sometimes scattershot or naive. Today, architects such as Chile's Pezo von Ellrichshausen and Smiljan Radic and Switzerland's Christ & Gantenbein and Herzog & de Meuron are similarly building an archaism into their work, a solid, Platonic kind of form-making that looks not to direct historical reference as much as architecture's deep memory and archetypal forms.

I see their architecture more clearly weighed against Wright's pre-Columbian designs, and vice versa. And that's largely what I mean when I say that Wright is more interesting at

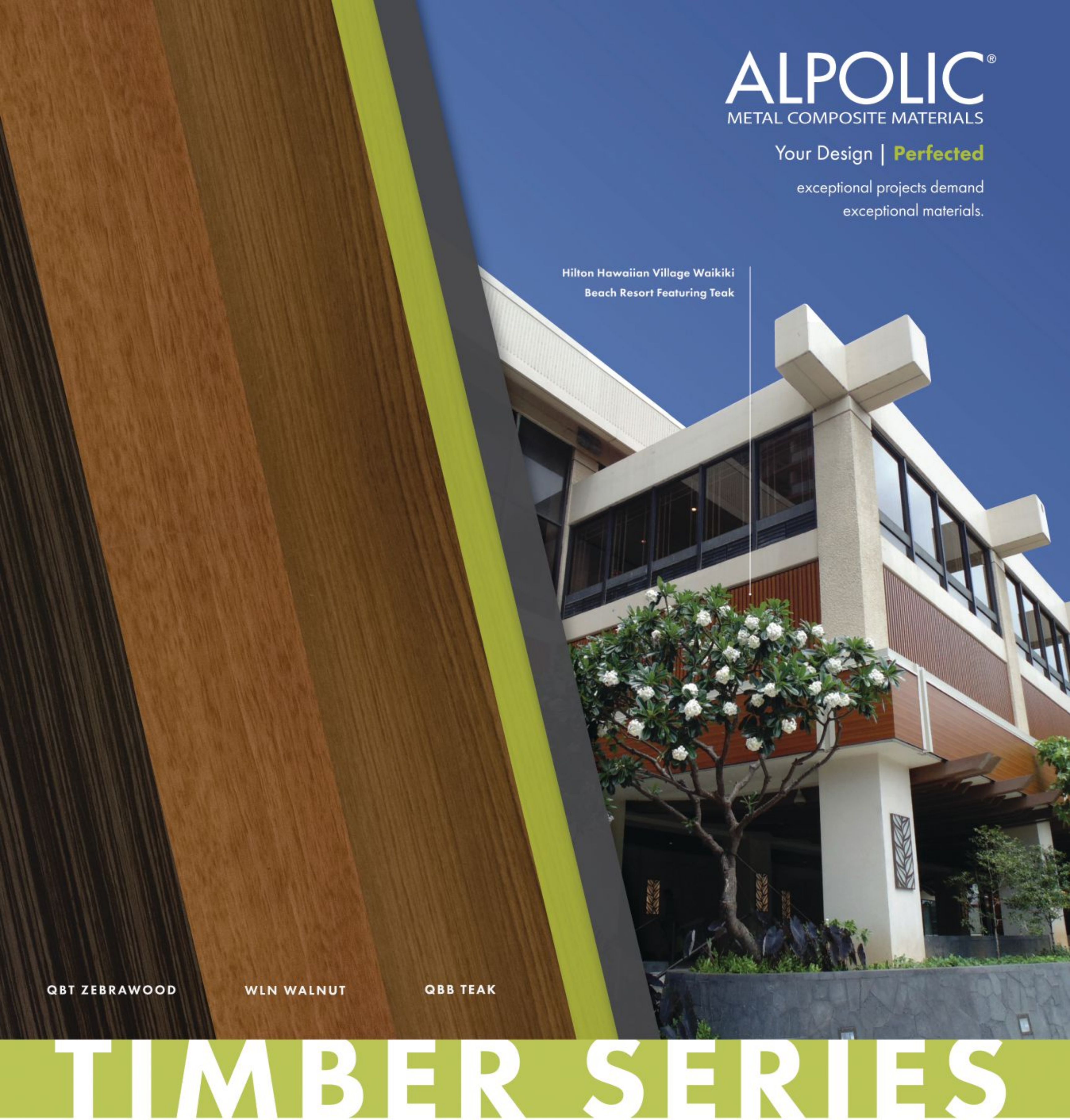
151 than 150. What's been important is not so much the milestone itself as the way celebrations of it have played out against the backdrop of contemporary architecture. And maybe that's why we carry out these ritualistic anniversary rites in the first place: Because in remembering the protean figures of the profession we learn something about our own cultural production and architectural priorities.

Rushing into the Future

Philip Johnson did finally come around to Wright's work, asking near the end of his life, according to Wright scholar Kathryn Smith, to spend one final afternoon in the Taliesin living room, a space he found deeply touching. And so have I come around, at least to a degree.

The elements of Wright's work that once struck me as simply nostalgic now look much more complex and layered: more like a synthesis of forward- and backward-looking impulses, as interested in the future of modular systems, say, as in the importance of memory or the power of archaic form. His best work was American in a deeply historical sense—throughout his career he rejected imported models—but it was also American in an inventive, optimistic, and pragmatic sense, in its ad hoc and can-do spirit.

The capes and the gauzy rendering style and the towering self-regard—all those trademarks of Wright's public persona—are still grating, especially to a 21st-century sensibility. They serve to drape his buildings with a nostalgic scrim and distort what they were fundamentally about. Because Wright created and carefully tended to that persona, I think it's fair to place at least some of the blame for that misreading of his architecture at his feet. But if you strip all of that away and look at the work itself—and, more to the point, do your best to understand the buildings on their own terms, as I've been trying to do with the L.A. houses, for their structural logic and materiality as much as their formal vocabulary or picturesque qualities—what emerges is a figure rushing into the future more energetically than we remember. Wright wanted to experiment not just with his buildings but the limits of the field itself. He wanted to put an energetic new American architecture on a wide test track, open up the engine, and let the thing run.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The Ninth Annual

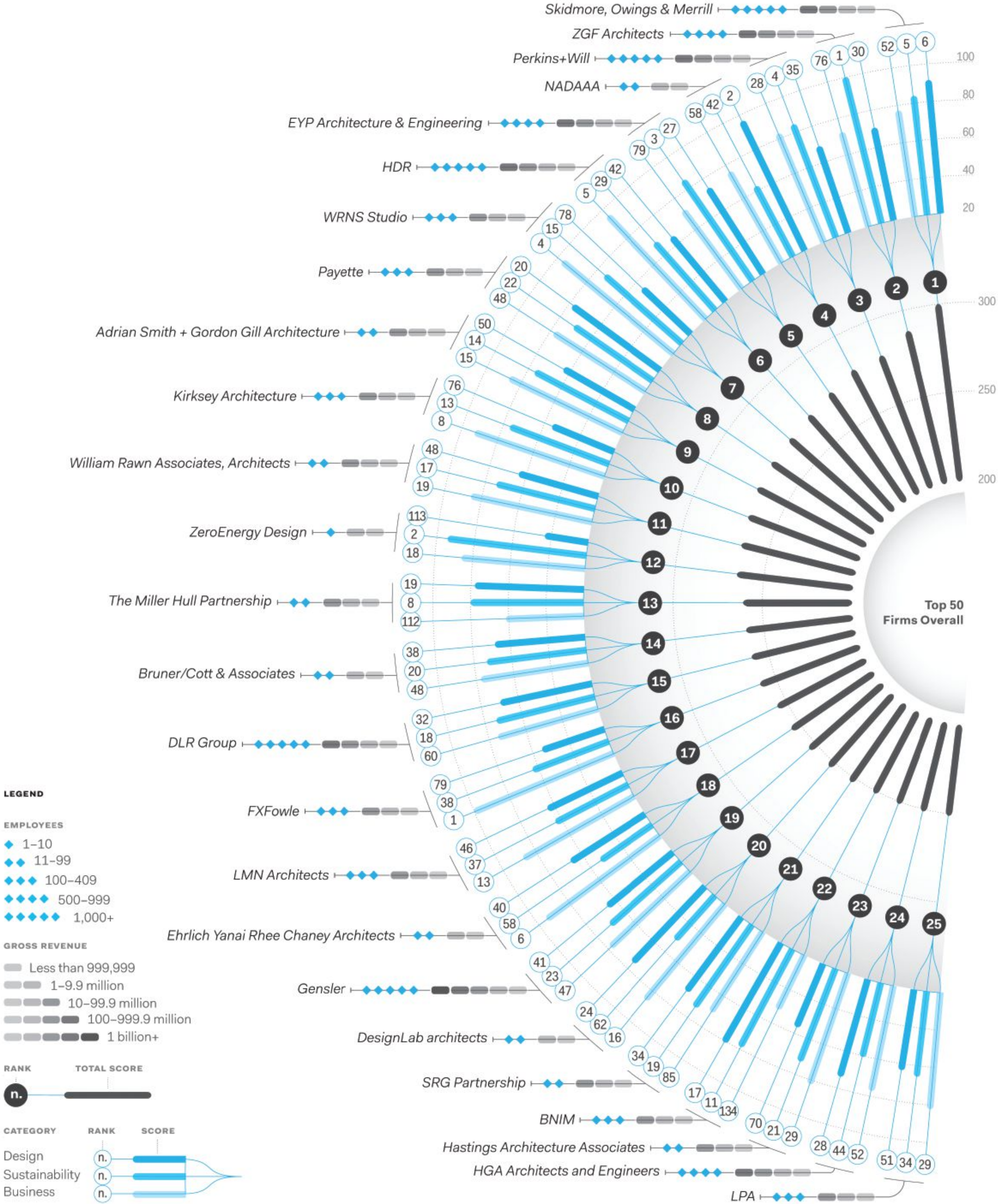
This page: SOM's Public Safety Answering Center II in the Bronx
PHOTO BY ALBERT VECERKA/ESTO

Opposite: SOM's San Francisco office
PHOTO BY CODY PICKENS

ARCHITECT 50

TEXT BY AMANDA KOLSON HURLEY AND DAVID HILL
DATA VISUALIZATION BY SARA PICCOLOMINI

There were plenty of reasons why this edition of the ARCHITECT 50 was the most competitive yet. For starters, a record number of firms—149—submitted entries. And the practices that did rise to the top, at least in the business rankings, demonstrated massive revenue gains and enviable growth. First-time entrants made an immediate impression, the most notable of them taking top honors in the design category. In the end, this year was as much about the established heavyweights as the young upstarts: A celebrated practice became the first to secure the overall number one position twice. Turn the page to see how firms stacked up according to our refined methodology, and visit architect50.com if you're interested in participating next year.


Top 50 Firms Overall
Skidmore, Owings & Merrill
ZGF Architects
Perkins+Will
NADAAA
EYP Architecture & Engineering
HDR
WRNS Studio
Payette
Adrian Smith + Gordon Gill Architecture
Kirksey Architecture
William Rawn Associates, Architects
ZeroEnergy Design
The Miller Hull Partnership
Bruner/Cott & Associates
DLR Group
FXFowle
LMN Architects
Ehrlich Yanai Rhee Chaney Architects
Gensler
DesignLab architects
SRG Partnership
BNIM
Hastings Architecture Associates
HGA Architects and Engineers
LPA
100
80
60
40
20
300
250
200
LEGEND
EMPLOYEES
1–10
11–99
100–409
500–999
1,000+
GROSS REVENUE
Less than 999,999
1–9.9 million
10–99.9 million
100–999.9 million
1 billion+
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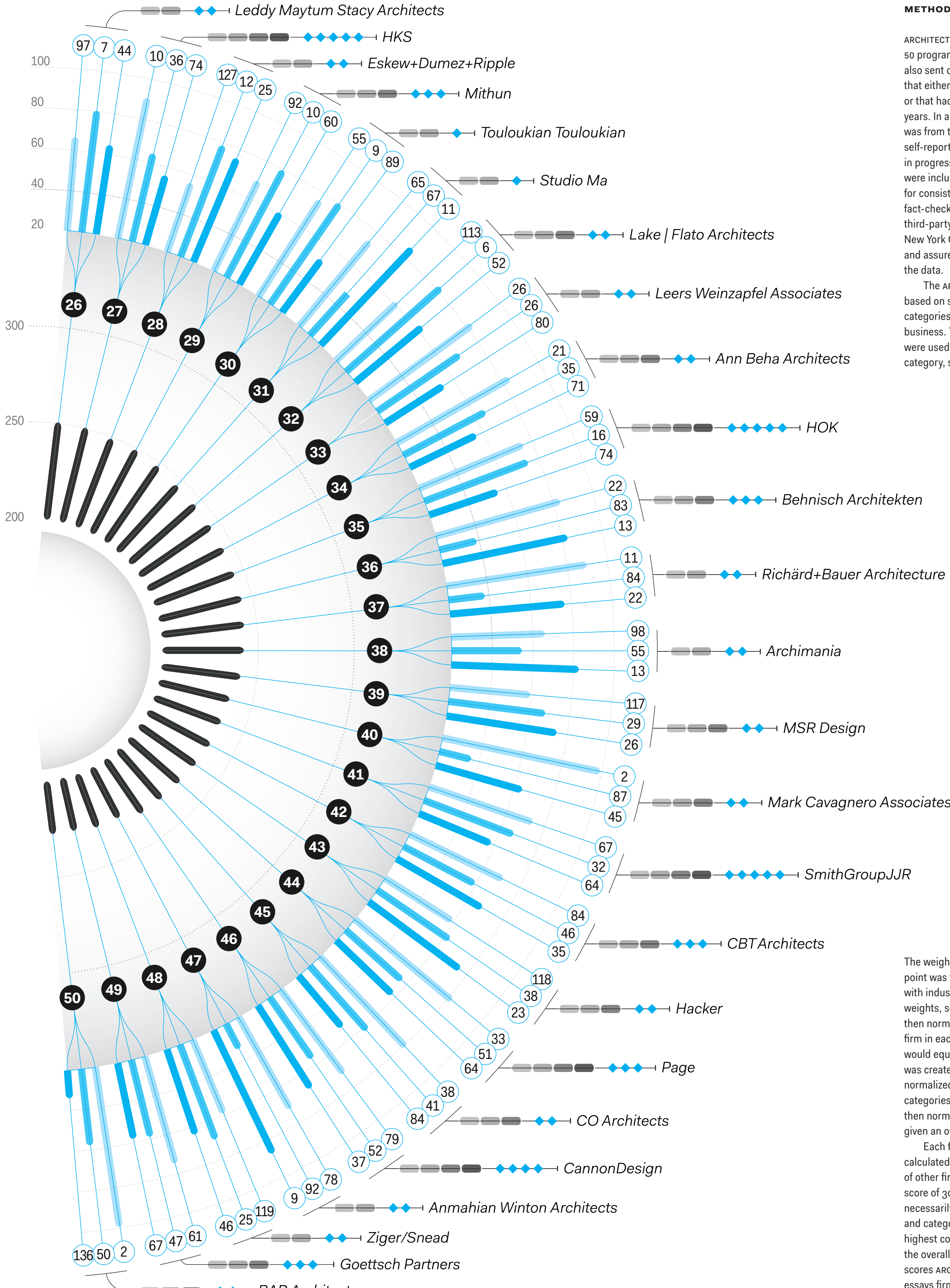
TOTAL SCORE
CATEGORY
RANK
SCORE
Design
Sustainability
Business



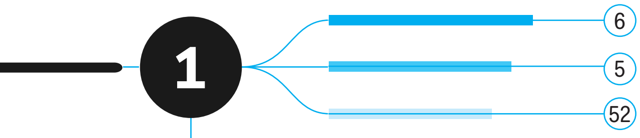
METHODOLOGY

ARCHITECT advertised the ARCHITECT 50 program in print and online, and also sent direct invitations to firms that either requested entry forms or that had participated in previous years. In all, 149 firms qualified. Data was from the 2016 fiscal year and was self-reported. Projects completed or in progress during the calendar year were included. Data was checked for consistency, and outliers were fact-checked. Karlin Research, a third-party research firm based in New York City, compiled the ranking and assured the confidentiality of the data.

The ARCHITECT 50 ranking is based on scores in three separate categories: design, sustainability, and business. To see which data points were used to generate scores in each category, see the following pages.

The weight assigned to each data point was formulated after consulting with industry experts. Using the weights, scores were calculated and then normalized so the top scoring firm in each of the three categories would equal 100. The overall ranking was created by adding together the normalized scores from the three categories. Those scores were also then normalized, with the top firm given an overall total of 300.

Each firm's performance was calculated relative to the performance of other firms. The firm with an overall score of 300, for example, did not necessarily top out on every indicator and category; it accumulated the highest composite score. Any ties in the overall list were broken using the scores ARCHITECT editors gave to the essays firms submitted about why they deserved to make the Top 50.



TOP OVERALL

SOM

Founded in Chicago in 1936, Skidmore, Owings & Merrill (SOM) is responsible for some of the world's most celebrated buildings. Sears (now Willis) Tower. John Hancock Center. Lever House. One World Trade Center. Over the course of 80-plus years, the venerable firm has completed more than 10,000 projects in over 50 countries. "In some ways, SOM is an old fart," says managing partner Ted J. Gottesdiener, FAIA, from his New York office. At the same time, he says, "We've always reinvented ourselves."

That's evident in the way SOM ascended to the top of the ARCHITECT 50 this year, becoming the first firm to be ranked Number One twice. When it took top honors in 2010, SOM had recently completed Dubai's Burj Khalifa, which remains (for now) the world's tallest building. In 2016, the firm's portfolio didn't include a single supertall, but rather featured a diversity of completed projects "that reflects the breadth of the work we do," says Gottesdiener. The design judges highlighted SOM's "beautifully detailed public work" with "sculptural surfaces and façades and structural forms."

In downtown Los Angeles, the U.S. District Courthouse, a glass cube that "floats" on a stone pedestal, reflects how SOM's commitment to sustainability hasn't undermined its pursuit of design excellence. Certified LEED Platinum and designed by San Francisco–based senior consulting design partner Craig Hartman, FAIA, the project boasts a number of sustainable features, including a rooftop solar array and a pleated-glass façade with opaque east- and west-facing panels to minimize solar gain.

Design partner Gary Haney, FAIA, took a similar cubist approach for the Public Safety Answering Center II, located in the Bronx. Designed to operate as one of New York's call centers during a natural disaster or large-scale emergency, the 450,000-square-foot blast-resistant cube was covered with an aluminum skin. "The idea of 'wellness' was a driving force in the design because of the intensity of the labor that goes on inside the building," Haney says.

The firm also once again left its mark on the U.S. Air Force Academy, the National Historic Landmark District campus designed by legendary SOM partner Walter Netsch in the 1950s. The first new project on the campus in decades, the Center for Character & Leadership Development, a 105-foot-tall tilted tower, was the work of design partner Roger Duffy, FAIA, of the firm's New York office, and required a nuanced consideration of its historic context.

Current projects, which helped contribute to SOM's stong financials, include phase one of Moynihan Train Hall, part of an expansion of New York's Penn Station, and the nearby Manhattan West development, which will include two office towers and a residential building.

Gottesdiener says a new generation of leaders is poised to take the reins at SOM in the coming years, as some longtime partners begin to retire. But, he says, the ethos will remain the same. "We're not about individuals; we're about the work," he says. "We're not about egos; we're about results." —D.H.

A Selection of SOM Partners

A. Anthony Vacchione, AIA (NY) **B.** Keith Boswell, FAIA (SF) **C.** Stephen Apking, FAIA (NY)
D. Scott Duncan, AIA (CH) **E.** Mustafa K. Abadan, FAIA (NY) **F.** T.J. Gottesdiener, FAIA (NY)
G. Laura Ettelman, AIA (NY) **H.** Roger Duffy, FAIA (NY) **I.** Brian Lee, FAIA (CH)
J. Philip Enquist, FAIA (CH) **K.** Mark Sarkisian (SF) **L.** Leo Chow, AIA (SF) **M.** Jonathan Stein, AIA (CH)
N. Gene Schnair, FAIA (SF) **O.** Kenneth A. Lewis, AIA (NY) **P.** Carrie Byles, FAIA (SF)
Q. Brant E. Coletta, AIA (NY) **R.** Xuan Fu, AIA (CH) **S.** Gary Haney, FAIA (NY) **T.** William F. Baker (CH)

CODY PICKENS

SOM Projects Completed in 2016 or 2017

U.S. Offices
- ○ CHICAGO ◆ 331
- ○ LOS ANGELES ◆ 68
- ○ NEW YORK ◆ 391
- ○ SAN FRANCISCO ◆ 241
- ○ WASHINGTON, D.C. ◆ 41

LEGEND
- ◆ Number of Employees
- ● Project, Completed 2016
- ○ Project, Completion 2017
- X Partner on Project

AURORA, COLO.
○ Department of Veterans Affairs Medical Center I

CLARKSBURG, W.VA.
● FBI Biometric Technology Center C, S

COLORADO SPRINGS, COLO.
● U.S. Air Force Academy — Center for Character & Leadership Development A, H

DETROIT
○ Detroit East Riverfront Framework Plan J, M

FLORIDA (VARIOUS LOCATIONS)
○ All Aboard Florida's Brightline F, H

INDIANAPOLIS
● Roche Diagnostic I, T

GOLETA, CALIF.
○ University of California, Santa Barbara, San Joaquin Apartments and Precinct Improvements P

LOS ANGELES
● Geffen Hall, David Geffen School of Medicine at UCLA P

MONTEREY, CALIF.
○ Monterey Conference Center N

NEW YORK
● Penske Media Corporation Q, C
○ Cornell Tech Campus Framework Plan H
● Public Safety Answering Center II S

PHILADELPHIA
● Philadelphia 30th Street Station District Plan A, H, T

SALT LAKE CITY
● 111 Main N

SANTA MONICA, CALIF.
○ Pen Factory

STORRS, CONN.
○ Univeristy of Connecticut Innovation Partnership Building E

International Offices
- ○ DUBAI ◆ 3
- ○ HONG KONG ◆ 13
- ○ LONDON ◆ 94
- ○ SHANGHAI ◆ 47

BEIJING
● Zhong Hong Tower A, D, S

BONIFFACIO GLOBAL CITY, PHILIPPINES
● Arthaland Century Pacific Tower E, F

BRUSSELS
○ NATO Headquarters C

CHENGDU, CHINA
● Sichuan Airlines Center L, N

CIXI CITY, CHINA
● Ssiger International Plaza Phase II I

ISTANBUL, TURKEY
○ Istanbul Tower

KUALA LUMPUR, MALAYSIA
● WKL Hotel and Tropicana the Residences A, E

KUNMING, CHINA
● Kunming Wujiaba New City Center N
○ Kunming Junfa Dongfeng Square J, R, T

LONDON
○ Manhattan Loft Gardens T

MAHBOULA, KUWAIT
○ Al Ahmadi Cultural Center A, H

METRO MANILA, PHILIPPINES
○ The Curve Tower E, F, M

MUMBAI, INDIA
○ Carmichael Residences G, H

NANCHANG, JIANGXI,CHINA
● Nanchang Greenland Exhibition Center R

NINGBO, ZHEJIANG,CHINA
● Ningbo Bank of China Headquarters I

SHANGHAI
○ White Magnolia Plaza

SINGAPORE
○ Tanjong Pagar Center E, F

Top Firms in Design

1. WORKac **2.** NADAAA **2.** Marlon Blackwell Architects **4.** John Ronan Architects **5.** Lorcan O'Herlihy Architects **6.** Skidmore, Owings & Merrill **7.** Atelierjones **8.** MASS Design Group **9.** Anmahian Winton Architects **10.** Studio Gang Architects **11.** Studio Ma **12.** nArchitects **13.** Archimania **13.** Behnisch Architekten **15.** Works Partnership Architecture **16.** El Dorado Architects **17.** BNIM **18.** Architecture Research Office **19.** The Miller Hull Partnership **20.** Payette **21.** Koning Eizenberg **22.** Richärd+Bauer Architecture **23.** Hacker **24.** DesignLab Architects **25.** Eskew+Dumez+Ripple **26.** MSR Design **27.** EYP Architecture & Engineering **28.** HGA Architects and Engineers **29.** Machado Silvetti **30.** ZGF Architects **31.** 5G Studio Collaborative **32.** DLR Group **33.** Ross Barney Architects **34.** SRG Partnership **35.** Perkins+Will **35.** CBT Architects **37.** CannonDesign **38.** Bruner/Cott & Associates **39.** Helix Architecture + Design **40.** Ehrlich Yanai Rhee Chaney Architects **41.** Gensler **42.** HDR **42.** Ayers Saint Gross **44.** Leddy Maytum Stacy Architects **45.** Mark Cavagnero Associates **46.** Ziger/Snead Architects **46.** LMN Architects **48.** William Rawn Associates, Architects **48.** Dake Wells Architecture **50.** Adrian Smith + Gordon Gill Architecture

METHODOLOGY

72% A design portfolio, scored individually by Sheila Kennedy, AIA, founding principal of Kennedy & Violich Architecture; Mark Lee, founding partner of Johnston Marklee; and Jennifer Yoos, FAIA, president of VJAA. Their scores were combined to create an overall score.

14% Licensure, as measured by the percentage of designers licensed in their respective fields, the average percentage increase in salary upon licensure, and how the firm mentors young designers

7% Pro bono work, as measured by participation in Public Architecture's 1+ program, the percentage of billable hours dedicated to pro bono, and the scope of the pro bono work

4% Design awards, including awards issued by ARCHITECT and prominent institutions such as the AIA and the ASLA

3% Research, as measured by the percentage of profits invested in it and its scope and significance

Patience is its own reward, as the proverb has it, but it's nice when it also pays off in more tangible ways. For New York–based WORKac, this year brought a major reward: the opening of the Kew Gardens Hills Library in Queens, which the architects have expanded and transformed with a new exterior, made of glass-fiber-reinforced concrete, that looks like an open book. The project had been delayed for years. "We are always imagining the future," says Dan Wood, FAIA, of the practice he leads with Amale Andraos. "Especially," he adds with a laugh, "because projects sometimes take a long time."

WORKac earned another major reward this year: the Number One spot in the design ranking of the ARCHITECT 50. The firm's portfolio included the Edible Schoolyard at P.S.7 in East Harlem, a bright hands-on children's garden with a greenhouse and kitchen classroom; "Stealth Building," a renovation, featuring a sharply pleated rooftop addition, of a cast-iron Tribeca building; and an off-the-grid "earthship" house in Arizona.

"Playful, colorful, and well-detailed projects that emphasize space over form and surface," is how one judge described WORKac's submission. "The work uses a fresh formal vocabulary to engage social and environmental ideas."

Andraos is dean of the Graduate School of Architecture, Planning and Preservation at Columbia University, so it's not surprising that research is interwoven with the practice. "It's a way for us to keep ahead of our own work," he says. "We use research in the same way we teach, to think more broadly about architecture's ability to engage with issues. When we have a project, these ideas come back into play." Investigations into ecology and urbanism have shaped the firm's work in the past, but its current research focus is preservation, as evidenced by its Chicago Architecture Biennial installation (with James Ewing) about a 1930s Art Deco villa in Beirut.

A mission statement on the firm's website reads: "We hold unshakable lightness and polemical optimism as a means to move beyond the projected and towards the possible." There's something heartening about a commitment to "polemical optimism" in fraught political times. "As architects, we're always manifesting change. We're creating things where something didn't exist before," Wood explains. "You always have to be optimistic that you're going to contribute to the city or the site or the discipline. I think we are kind of like science-fiction writers." —A.K.H.

TOP DESIGN

WORKac

Edible Schoolyard at PS7 in Harlem

TOP SUSTAINABILITY

ZGF

For the second year in a row, Portland, Ore.-based ZGF Architects has landed the top spot in sustainability on the ARCHITECT 50. The firm embraced sustainability as a key element of its practice long before LEED became the industry standard. "It's part of our design process," says managing partner Ted Hyman, FAIA, "not something that gets added after the fact."

Ninety percent of ZGF's projects that were in design during 2016 used energy simulation modeling. The result is a portfolio that combines high performance with design excellence. The LEED Platinum (and net-zero) J. Craig Venter Institute in La Jolla, Calif., generates electricity via two rooftop photovoltaic arrays and uses chilled-beam technology for heating and cooling. For a new U.S. embassy in Paramaribo, Suriname, ZGF responded to the local climate conditions by including green roofs and rain gardens to capture and treat rainwater onsite.

In Japan, ZGF is collaborating on the design of Kashiwa-no-ha Smart City, which is now the largest LEED Neighborhood Development Plan Platinum–certified smart city in the world. The project, less than an hour from Tokyo by train, is an outgrowth of the firm's urban planning efforts, particularly its design of sustainable "EcoDistricts."

For the Rocky Mountain Institute's Innovation Center in Basalt, Colo., ZGF designed a two-story office building without conventional heating or cooling. The structure is petal certified under the International Living Future Institute's Living Building Challenge, and ZGF has closely monitored the project's energy performance since it was completed in late 2015. "We're always looking at how we can innovate," Hyman says, "in order to make greater and greater energy reductions in the projects we're working on, and not just saying, 'OK, we've got it now.' Net-zero is getting us moving in the right direction, but we've got a long way to go beyond that." —D.H.

ZGF ARCHITECTS + NIKKEN SEKKEI

Kashiwa-no-ha
Smart City

Top Firms in Sustainability

1. ZGF **2.** ZeroEnergy Design **3.** EYP Architecture & Engineering **4.** Perkins+Will **5.** Skidmore, Owings & Merrill **6.** Lake|Flato Architects **7.** Leddy Maytum Stacy Architects **8.** The Miller Hull Partnership **9.** Touloukian Touloukian **10.** Mithun **11.** BNIM **12.** Eskew+Dumez+Ripple **13.** Kirksey Architecture **14.** Adrian Smith + Gordon Gill Architecture **15.** WRNS Studio **16.** HOK **17.** William Rawn Associates, Architects **18.** DLR Group **19.** SRG Partnership **20.** Bruner/Cott & Associates **21.** Hastings Architecture Associates **22.** Payette **23.** Gensler **24.** Lord Aeck Sargent **25.** Ziger/Snead Architects **26.** Leers Weinzapfel Associates **27.** Sasaki Associates **28.** Studios Architecture **29.** HDR **29.** Orcutt | Winslow **29.** MSR Design **32.** SmithGroupJJR **33.** Weber Thompson **34.** LPA **35.** Ann Beha Architects **36.** HKS **37.** LMN Architects **38.** FXFowle Architects **38.** Hacker **40.** DiMella Shaffer Architecture **41.** Co Architects **42.** NADAAA **43.** Lehrer Architects **44.** HGA Architects and Engineers **45.** Dewberry **46.** CBT Architects **47.** Goettsch Partners **48.** The S/L/A/M Collaborative **49.** Dattner Architects **50.** BAR Architects

METHODOLOGY

33% 2030 Commitment: Participation in the AIA's 2030 Commitment program, submittal of a report of predicted energy use of all active projects to the AIA in 2016, percentage of predicted energy use intensity reduction from the national average reported, and percentage of gross square footage of projects in design during calendar year 2016 that were demonstrated through energy modeling to meet or exceed 2030 energy targets

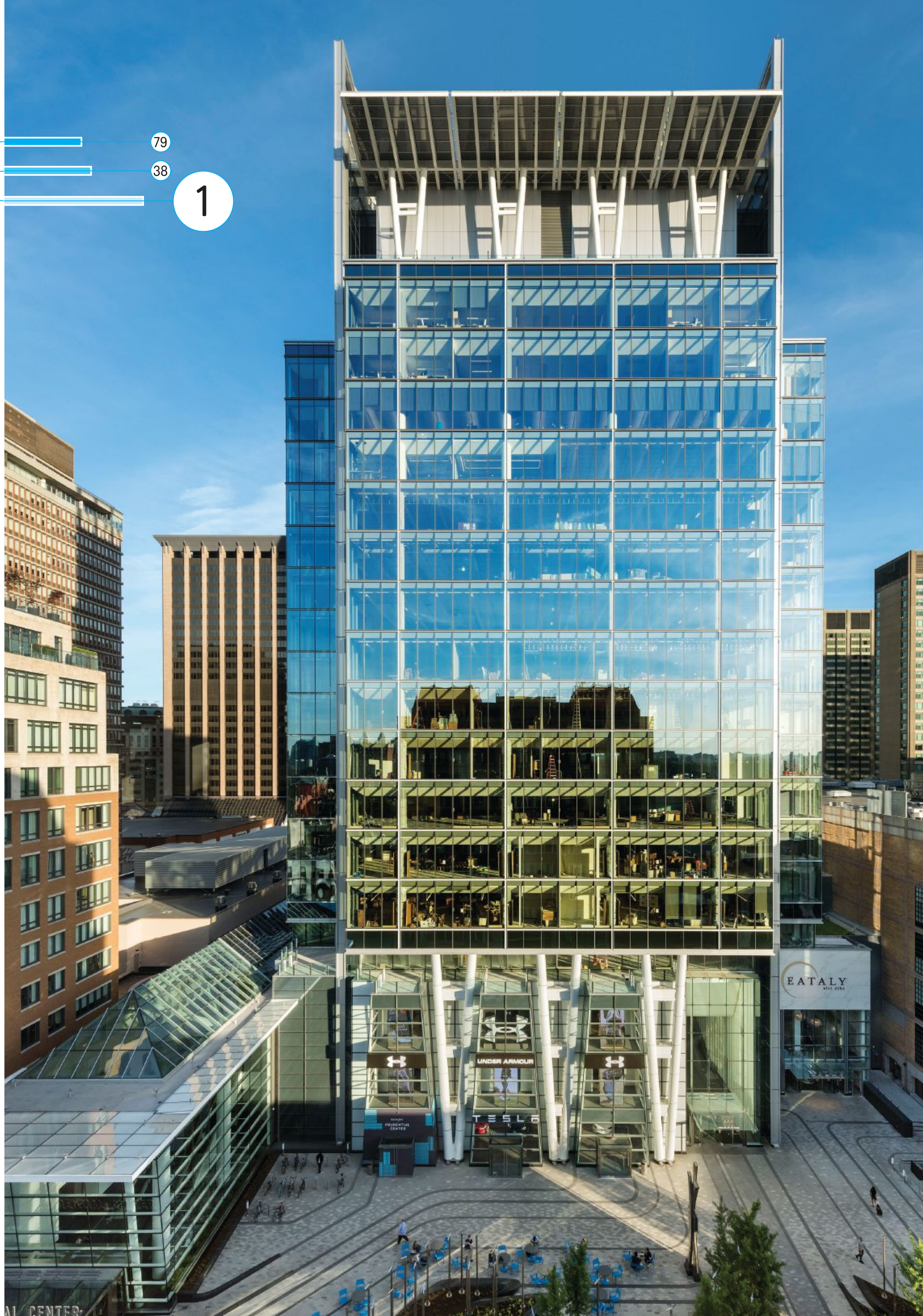
18% Energy and water metrics: the percentage of gross square footage of a firm's projects in design during 2016 that achieved a 20% reduction or greater in regulated potable water use than the standards of the U.S. Energy Policy Act of 1992; that incorporated simulated energy modeling or daylighting studies; for which firms used a life-cycle assessment, calculated the embodied energy, and sourced material ingredient disclosure documents and environmental product declarations; for projects completed in 2015, the percentage for which firms collected at least one year of actual energy performance data; and finally, a firm's approach towards resilient design

12% Employee certifications: The percentage of a firm's design employees with Living Future, Certified Passive House, WELL, Green Globes, Green Roof Professional, or LEED AP or Green Associate credentials (and the specialty LEED credentials represented at the firm), as well as the percentage increase in salary given to employees who achieve LEED AP accreditation

24% Building certifications: points awarded on a sliding scale for projects that were in design during 2016 and registered to achieve LEED, Living Building Challenge, Green Globes, Net Zero, Green Guide for Health Care, Energy Star, Passive House, and other leading certifications

13% A score for the green project that best demonstrated a firm's commitment to sustainability (scoring by ARCHITECT editors)

16
79
38
1



ANTON GRASSI/ESTO

TOP BUSINESS

FXFowle

We've been hearing it for years: mid-sized architecture firms are in trouble, squeezed by ambitious small practices on one side and jack-of-all-trades global megafirms on the other. That's not the case for New York–based FXFowle Architects, however. "We're one of those firms that have really claimed the middle, and own it," says senior partner Dan Kaplan, FAIA. "We feel that in the era of very large design organizations, there's a lack of nimbleness maybe, and a lack of personal touch. Yet for our size, in the age of leveraging technology, there's nothing we can't do."

This year's ARCHITECT 50 bears that out, as FXFowle claimed the top spot in business. The firm posted an enviable net revenue-per-employee figure, and most notably, a 43-percent increase in net revenue from 2015 to 2016. Kaplan attributes the jump to a number of projects "really getting into high gear" over the past year, including what will be the first new ground-up office building in downtown Brooklyn for decades. Plus, he says, the firm's interior practice is growing, thanks to the addition of principals Len Cerame, AIA, and Angie Lee, AIA.

As demonstrated by its portfolio, FXFowle can both ramp up for big projects and hone in on much smaller, specialized ones. A 425,000-square-foot LEED Platinum office building, 888 Boylston Street grandly rounds out Boston's Prudential Center complex, while the Chapel at Congregation Kehilath Jeshurun Synagogue repurposes a 2,050-square-foot former gymnasium as a minimalist room for meditation and prayer beneath a midnight-blue ceiling. The firm is also working on a new 26,000-square-foot Statue of Liberty Museum on Liberty Island, expected to open in 2019.

FXFowle also stood out for the diversity of its design staff: 35 percent are women and 30 percent are racial or ethnic minorities. "It's one of those issues that we self-diagnosed five years ago, and decided to do something about it and be proactive. It didn't just happen," he says.

There's a group at the office called Women of FXFowle, and role models in senior leadership include senior partner Sylvia Smith, FAIA, and partner Heidi Blau, FAIA. "I do think there is a structural problem in the profession" for women, says Kaplan, who also teaches at Cornell University College of Architecture, Art, and Planning. "We're graduating a majority of women. I do see as time goes on, this sort of winnowing, for a variety of reasons. We're trying to find those pressure points along the way and relieve them, but I don't think there's a magic bullet." —A.K.H

Top Firms in Business

1. FXFowle **2.** Mark Cavagnero Associates **2.** BAR Architects **4.** WRNS Studio **5.** HDR **6.** Ehrlich Yanai Rhee Chaney Architects **7.** SfL+a Architects **8.** Kirksey Architecture **9.** PBK **10.** HKS **11.** Richärd+Bauer Architecture **12.** Marmol Radziner **13.** LMN Architects **14.** Carrier Johnson + Culture **15.** Adrian Smith + Gordon Gill Architecture **16.** DesignLab Architects **17.** Spector Group **18.** ZeroEnergy Design **19.** William Rawn Associates, Architects **20.** Shepley Bulfinch **21.** Ann Beha Architects **22.** Behnisch Architekten **23.** Substance Architecture **24.** CSArch Architecture | Engineering | Construction Management **25.** TreanorHL **26.** Leers Weinzapfel Associates **27.** Cambridge Seven Associates **28.** Perkins+Will **29.** Hastings Architecture Associates **29.** LPA **29.** 5G Studio Collaborative **29.** Array Architects **33.** Page **33.** Duda Paine Architects **35.** ELS Architecture and Urban Design **35.** Studios Architecture **37.** BRPH **38.** CO Architects **39.** NAC Architecture **40.** SAA **41.** MBH Architects **42.** Marlene Imirzian & Associates Architects **43.** Populous **44.** Architecture+ **45.** Snow Kreilich Architects **46.** Pei Cobb Freed & Partners Architects **47.** Gensler **48.** Payette **48.** Bruner/Cott & Associates **50.** Perkins Eastman Architects

METHODOLOGY

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14% Profitability (positive change in net revenue from 2015)

13% Business practices, including the percentage of women and minority designers, percentage of new full-time positions, and voluntary staff turnover rate

15% Employee benefits, including ARE benefits, stock options, and the value and scope of other fringe benefits

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Rockefeller Arts Center at SUNY Fredonia
Fredonia, N.Y.
Deborah Berke Partners

A classic I.M. Pei arts building gets an addition and renovation by the masters of thoughtful pragmatism.

INTERVIEW BY KATIE GERFEN
PHOTOS BY CHRIS COOPER

How did the existing I.M. Pei–designed arts center influence your design for your addition to it?
Maitland Jones, AIA*:* What's interesting about the SUNY [State University of New York] Fredonia campus is it is an artifact of design. It was designed by I.M. Pei & Partners in the 1960s, and it has a positive figural presence: It looks like a campus, it has a shape. But the campus had outlasted that initial vision. Everyone entered the arts center from the service side—the campus had grown up in that direction. We acknowledged that and gave the building a new face.

The Pei buildings are all poured-in-place concrete with large expanses of glass and metal appointments. We designed an addition for the arts center that was mostly metal and glass with concrete appointments—in a way, turning the Pei language inside out. I think we offered a counterpoint to the heroic bluntness of his work by producing something slightly more delicate.

Deborah Berke, FAIA*:* This is really a new building laid right up against an old one, with both serving the same purpose: the education of young artists in the applied arts, the fine arts, and the performing arts. So we were collaborating with Pei, in effect, by positioning ourselves right next to him. What any architect does is respond to context, and Pei was our context here.

We also understood that the Pei building is truly a large structure, with large moves. It has big theaters, a big courtyard, and it contains activities that take a lot of space. And we celebrated that. Ours is not a building with seminar rooms in it. This is a building where people dance and practice instruments, where they weld steel and throw pots. All the stuff has a scale of making that's large and tough.

How did you balance design and durability in the materials palette for the addition?
MJ: We've designed a lot of buildings that serve multiple duties and constituents. It's a little easier with art schools, because you've got a concrete floor and blank, white walls, generally. We identified areas of high-wear and we found areas for refinement that could be protected, like the zinc façade. One thing we've learned from doing hard-working buildings is that with forethought, you can have an elegant palette that looks deliberate and designed at any price point.

DB: The building is going to take a lot of wear and tear because it gets intense use. I mean, there's actually a room where they teach young actors how to fight: They bounce off walls, they use rubber swords, they do this crazy cool stuff, but it takes its toll on the building. In addition to having materials that can take abuse, some of it is common sense, like not detailing in a way that your corner gets knocked off the first day somebody comes around it with a 2x4.

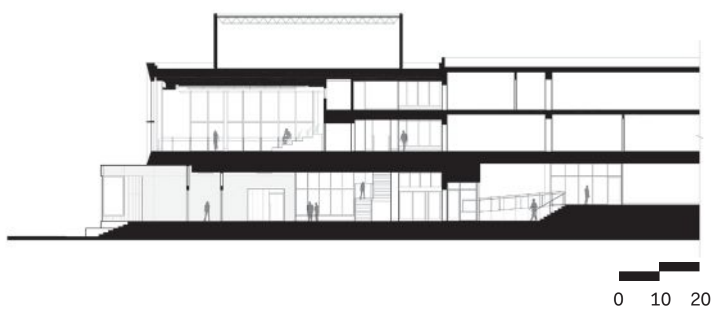
It's also paying attention to how you bring in the mechanical systems and expose your ducts, where the natural light is—appreciating pure elements about the spaces that can't, no matter what you do to them, be destroyed. The light is always going to be beautiful, and the duct is always going to be perfectly centered over the workspace. If you pay attention to things like that, you're creating a rich interior without it being about trim, expensive materials, or a froufrou form of detailing.

How important is daylight to the project?
MJ: We did something we think of as covertly radical: We introduced natural light and views into rooms that are ordinarily dark, like a dance studio. Dance studios depend on the barre and mirrors, and a prevailing sense of privacy to be able to try things out. But everyone agreed natural light is great, and that the activity might be a signpost for the building. I think today's students understand that one can be visible but not on display. They have a different sense of boundaries between social space and study space or living space and public space, and that sense of fluidity allows a room to change purpose throughout the day. So we built a building where those boundaries could be a bit fluid. And that means it's perfectly okay to have windows in spaces that might also be used for performance, to get wonderful, gorgeous natural light into spaces that might otherwise be dark.

You have a vast portfolio of adaptive reuse projects with structures by famed architects. How do you approach these projects, and how does this one fit in?
MJ: We want our intervention to be visible and legible and discernibly different. Who would continue the language of H.H. Richardson with more Richardson and beg the question, was this the real thing or not? What they have in common with our new-built work is an interest in order and simplicity and maybe a little bit of surprise and delight.

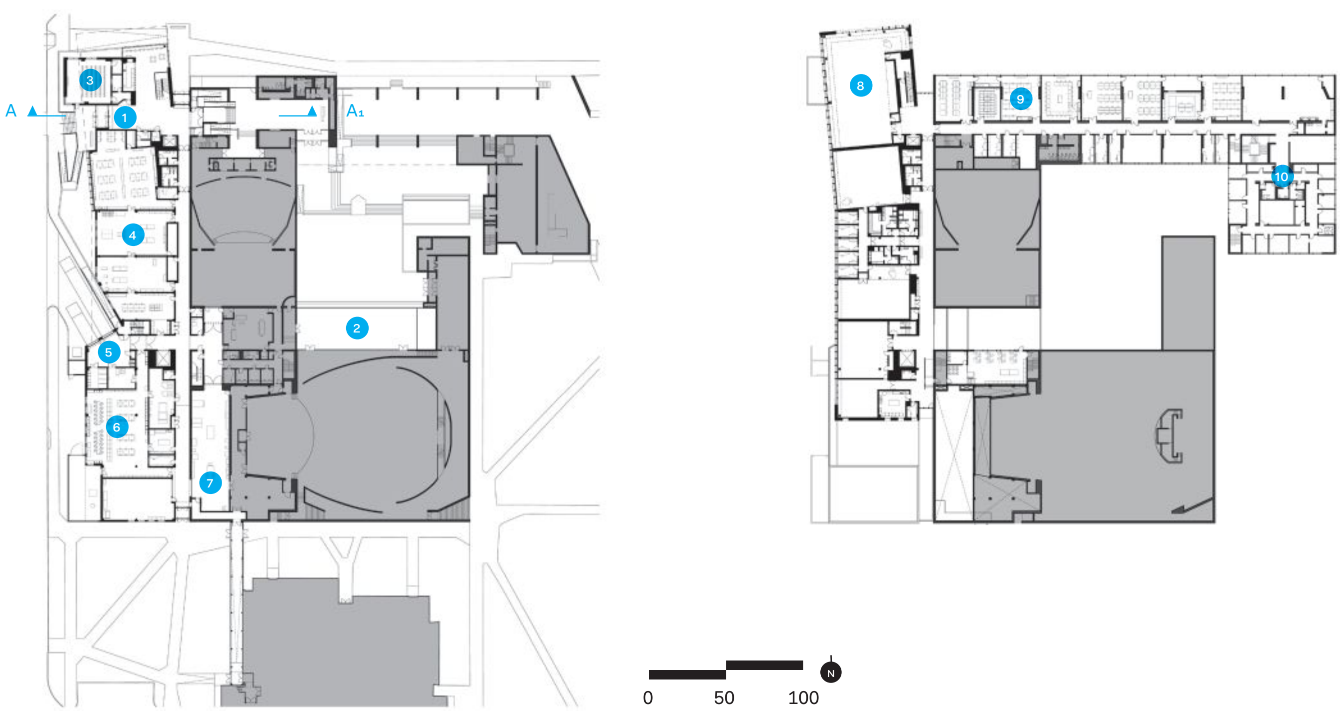
DB: Every one of our transformation projects is specific to that building, that location. We have had the great good fortune to do a lot of adaptive reuse projects in good buildings by famous accomplished architects, but they're often truly adaptive reuse—you know, a McKim, Mead & White bank becomes a hotel. That's change. But I think of this project more as a really good brand-new neighbor to a really good 50-year old I.M. Pei building.

Section A–A₁



Ground-Floor Plan

Second-Floor Plan

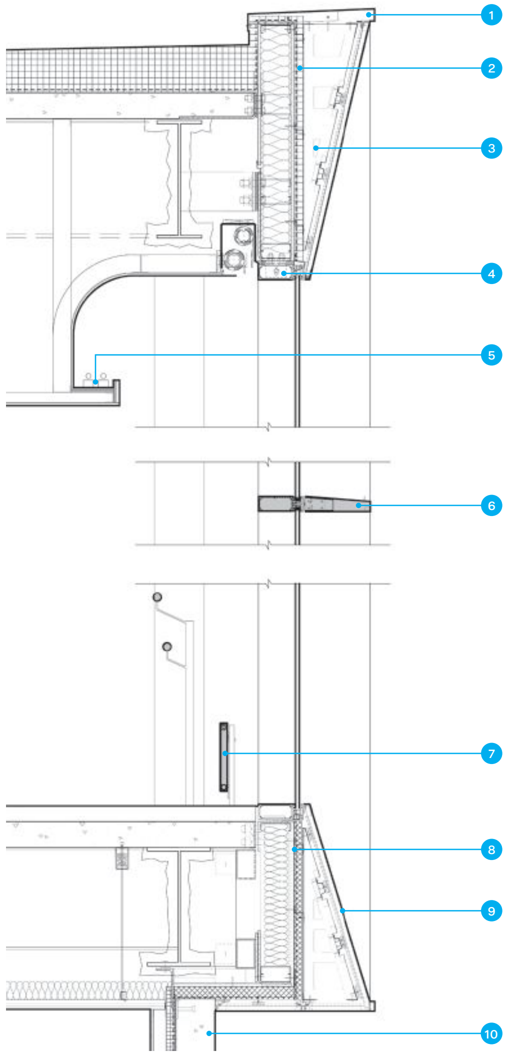


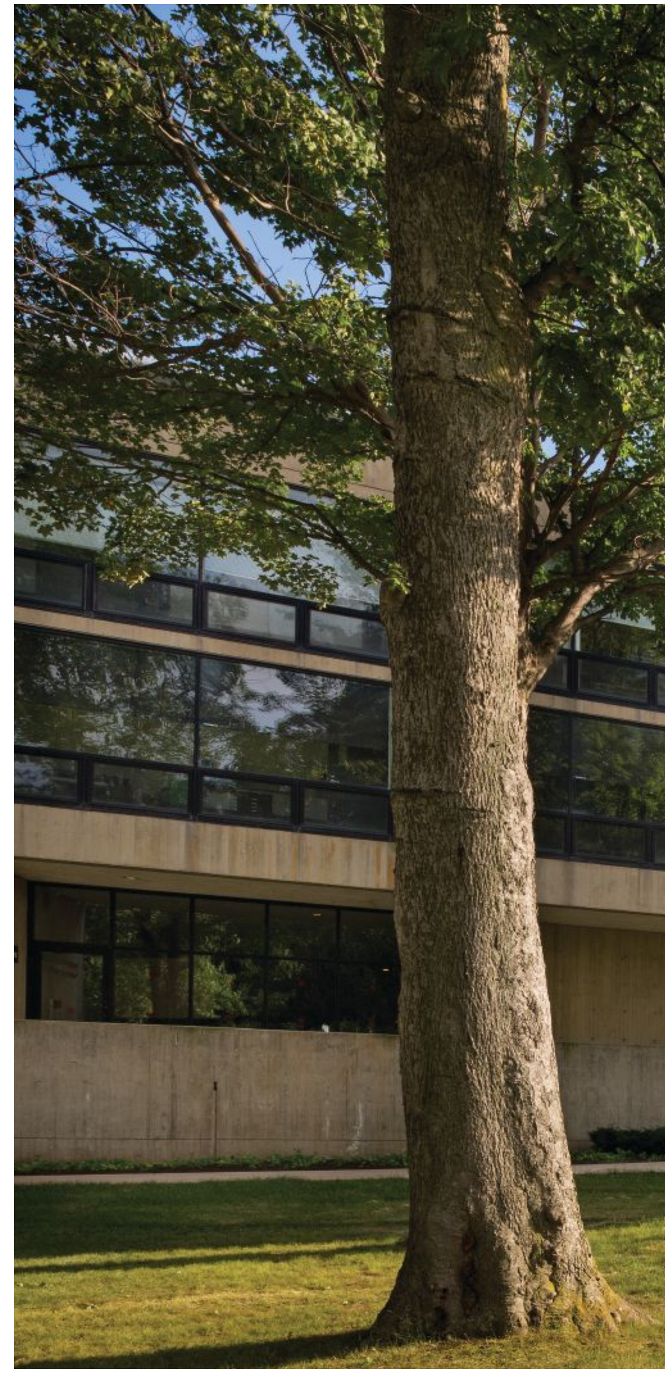
1. Lobby
2. Existing Pei building
3. Multipurpose room
4. Sculpture studios and workshops
5. Loading dock
6. Ceramic studios and workshops
7. Scene shop
8. Dance studio
9. Studio
10. Offices

Previous Spread: View of the new zinc-and-cast-in-place-concrete addition from the southwest, with the original I.M. Pei structure at right.

Above: The east, entrance façade of the Pei building, showing the poured-in-place concrete material palette typical of the campus.

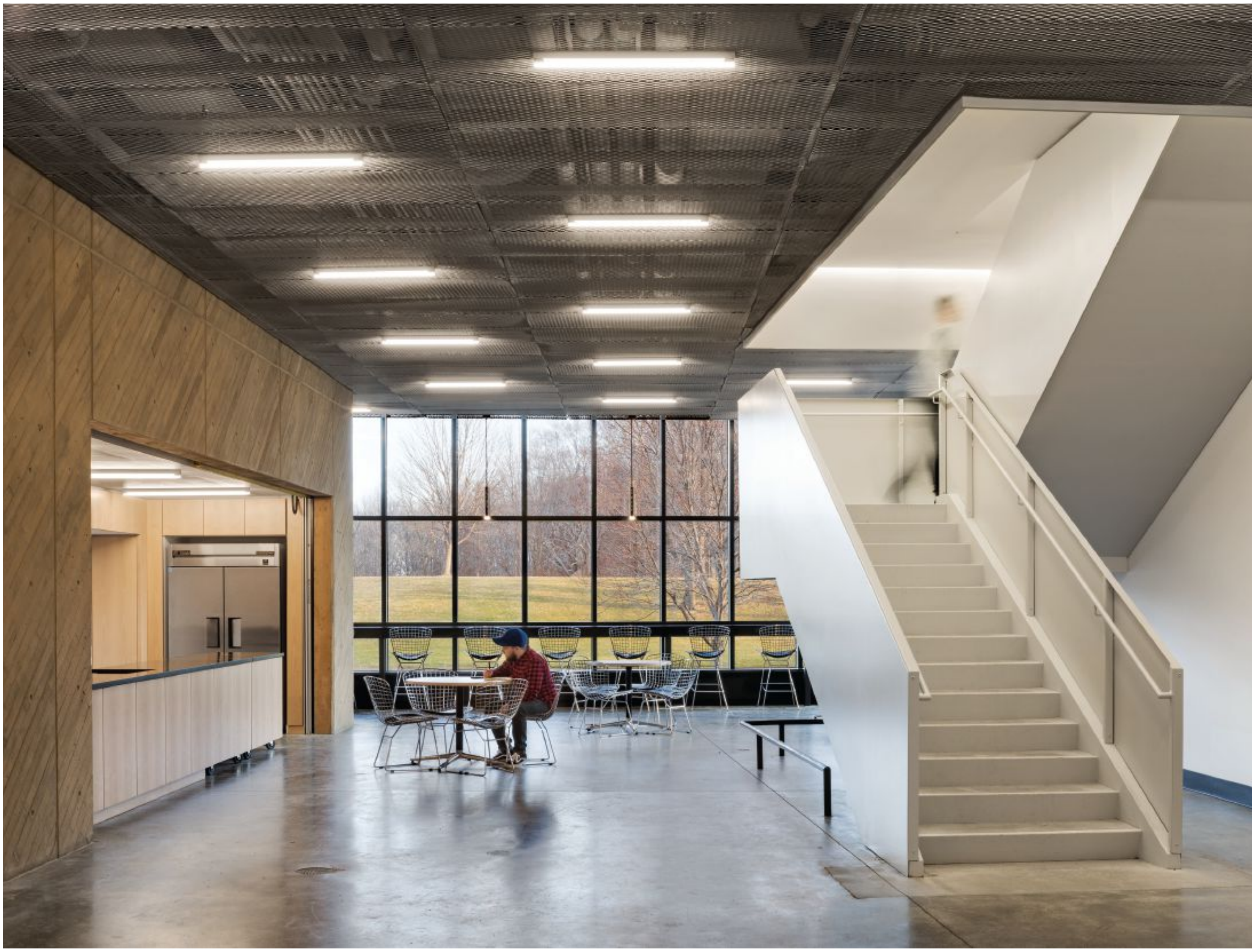
Façade Detail Section





1. Zinc coping
2. Continuous insulation
3. Rainscreen substructure
4. Curtainwall framing
5. Light cove
6. Horizontal fin and substructure
7. Floor-mounted fin-tube radiator
8. Sheathing and air vapor barrier
9. Zinc composite-metal rainscreen
10. Cast-in-place architectural concrete

To have the addition (at right) relate to, but stand apart from the existing Pei building (at left), the team inverted the material language from concrete with glass and metal accents to glass and metal with concrete accents. And the dialogue between the two structures extended down to the details: “We took some of the bias window framing Pei had done in concrete, and rendered those in metal,” says project lead Noah Biklen, AIA. “There’s a smoothness to the existing building, and in many ways we were pushing that theme with a bit more depth and scale, so there’s monumentality to it but with bit more texture.”



Opposite: The concrete details show themselves in the form of cast-in-place panels around the new entry (shown) and in public spaces in the interior. "The 1968 campus showcased a real expertise in concrete in the area, and we were able to take advantage of that," Biklen says. "We wanted to signal that these new architectural concrete walls were both of the Pei building, but new, so we developed formwork with a diagonal pattern."

Above: Some interiors, such as the addition's lobby (shown), are frequented by the performance-going public. Concrete helps the space also withstand hard use by students.

The building needed to accommodate a wide variety of the arts disciplines—dance, ceramics, set-building, and music, among others. Some of it was straightforward, but very specific concerns arose during the programming process: “Ceramics and sculpture really wanted to be near the loading dock,” Biklen says. “They bring in bags of clay powder and didn’t want to drag those through the whole building with dust going everywhere.”

Large windows help showcase the action in a second-floor dance studio to passersby, whether the space is being used for ballet rehearsal or a music performance (it's outfitted with retractable seating, at right). Though the interior feels different from the sculpture studios downstairs, they synchronize thematically: "You go from a gray concrete floor to a gray sprung dance floor," Biklen says. "We use color as well as material to connect things."

The addition and original building meet along a central corridor. Homosote pin-up panels (at left) front the new studios, and existing openings in Pei's exposed concrete façade (at right) were repurposed as passways between the two structures. "It provided a lot of continuity, and allowed for a seamless addition," Biklen says.

Project Credits
Project: Rockefeller Arts Center at SUNY Fredonia, Fredonia, N.Y.
Client: State University Construction Fund; The State University of New York at Fredonia
Design Architect: Deborah Berke Partners, New York · Deborah Berke, FAIA, Maitland Jones, AIA; Noah Biklen, AIA (project lead); Scott Price (project manager)
M/E/P Engineer: Lakhani & Jordan Engineers
Structural Engineer: Robert Silman Associates Structural Engineers
Civil Engineer: Larsen Engineers
Geotechnical Engineer: Fisher Associates
Construction Manager: Campus Construction Management Group
General Contractor: Northland Associates
Landscape Architect: Mathews Nielsen Landscape Architects
Lighting Designer: PHT Lighting Design
Façade Consultant: Front
AV/IT/Security/Theater/Acoustical Consultant: Harvey Marshall Berling Associates
Signage: Two Twelve
Size: 60,000 square feet (addition); 40,000 square feet (renovation)
Cost: Withheld


EXIT
EXIT

Southern Utah Museum of Art
Cedar City, Utah
Brooks + Scarpa and Blalock & Partners Architectural Design Studio

Constraints give rise to formal and material creativity in this new art museum for Southern Utah University.

TEXT BY NATE BERG
PHOTOS BY TIMOTHY HURSLEY

There's a certain architectural quality to the bright red sandstone mountains, sharp canyons, and curving rock formations of Southwest Utah's high desert. For Los Angeles–based Brooks + Scarpa's design of the Southern Utah Museum of Art, a new 28,000-square-foot museum and gallery associated with Southern Utah University in Cedar City, the monumental topography of the region was an almost unavoidable influence. "It's literally a wall that's the backdrop of the city," says Lawrence Scarpa, FAIA.

The area's natural forms inspired what Scarpa calls the museum's two major design moves: a sloping roof that cantilevers 120 feet over a cavelike 6,000-square-foot open-air event space, and the flowing geometries of the gray-white plaster walls inside. "We put 80 percent of the budget in 20 percent of the space so the rest can be neutral and unoffensive," Scarpa says.

The museum itself is relatively simple, with one main gallery, a large classroom, offices, and some back-of-house storage. Windows line most of the building's north and west ends, creating clear views from the surrounding neighborhood into the museum, which is part of the $39 million Beverley Taylor Sorenson Center for the Arts campus, also master planned by Brooks + Scarpa.

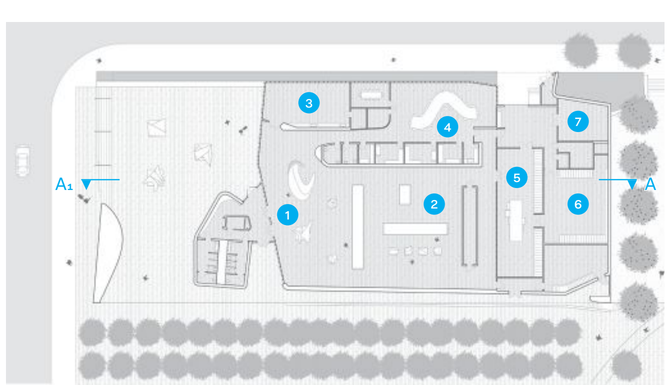
"You can see the artwork in the museum from the street," Scarpa says. "I wanted the gallery to have a presence to the community and onto the street. So to make it all glass, 20 feet high, it really needed a deep overhang."

The cantilever at the west end provides the necessary shading to protect the artwork within while also defining a programmable outdoor space. The smooth plaster blends from walls into ceilings and moves through the glass into the gallery itself. This geologic fluidity continues on the roof, with a subtle bow tie form directing drainage into two canyons at each end of the building that form tiny waterfalls of runoff on the façade in the wet months. It's an elegant solution for a snowy region, but not so intuitive for a contractor to build. To translate, the architects relied on Grasshopper and other 3D modeling programs. "We developed a series of scripts where we can pretty easily describe and rationalize the geometry for complex shapes and make them easy to understand and therefore easy to price," Scarpa says.

The built result is remarkably similar to the 3D design. Though a significant amount of the budget went into the museum's silky features, the contractors were able to achieve some savings through the use of precast concrete panels to clad the flat façades. The lack of drainage equipment and the maintenance they'd require also helped bring down the costs to about $250 per square foot. "We did a lot of little things that add up to significant dollars," Scarpa says. "I think you do better work when you have some constraints."

Section A–A_1

Floor Plan



1. Lobby
2. Gallery
3. Education room
4. Office
5. Conservation
6. Art storage
7. Workshop

0 20 40

ALAN BLAKELY

Previous Spread: View of museum from north, showing cantilevered roof over outdoor event space at west end

Above: Aerial view from northeast, showing arts campus beyond

View from west showing entrance

Opposite, Top: Main gallery, looking east

Above: Lobby area

Opposite, Bottom: Education room


KEVIN KEHOE
WESTERN THERAPY

View from southeast, showing texture of precast concrete façade panels

Project Credits
Project: Southern Utah Museum of Art, Cedar City, Utah
Client: Southern Utah University
Design Architect: Brooks + Scarpa, Los Angeles · Lawrence Scarpa, FAIA (lead designer); Angela Brooks, FAIA (project architect); Emily Hodgdon, Mark Buckland, Chinh Nguyen, Diane Thepkhounphithack, ASSOC. AIA, Cesar Delgado, Mario Cipresso, AIA, Brooklyn Short, Royce Scortino, Sheida Roghani, ASSOC. AIA, Ryan Bostic, ASSOC. AIA (project design team)
Local Architect: Blalock & Partners Architectural Design Studio, Salt Lake City, Utah
Structural Engineer: Reaveley Engineers + Associates
Mechanical Engineer: Van Boerum & Frank Associates
Electrical Engineer/Lighting: BNA Consulting Group
Lighting: Luminescence Design
Civil Engineer: Insite Engineering, Surveying & Landscape Architecture
Landscape: Brooks + Scarpa; Coen + Partners; G. Brown Design
Acoustics: Fisher Dachs Associates
Specifications: Blalock & Partners Architectural Design Studio
Contractor: Big D Construction
Size: 28,000 square feet
Cost: $8 million


SOUTHERN UTAH MUSEUM of ART
SOUTHERN UTAH UNIVERSITY

Trumpf Smart Factory Chicago
Chicago
Barkow Leibinger

A new facility for the German machine and laser manufacturer showcases the precision of digital fabrication.

TEXT BY AARON BETSKY
PHOTOS BY SIMON MENGES

Previous Spread: View from south, with machine showroom at left

This Image: View from west, with entry at plaza

Drive the I-90 expressway northwest of Chicago's O'Hare International Airport and you will start to notice, sprinkled in-between the blank warehouses and opaque office parks, a few buildings that face the highway with expanses of glass. Architect Frank Barkow, of Berlin's Barkow Leibinger, calls them *schaufenster*, or display windows, and they advertise the wares of companies that produce the latest manufacturing tools. The companies fly in clients from around the country to see CNC milling machines and other robots at work. These buildings are neither factories nor showrooms, but hybrids, the industrial equivalent of the bedroom or living-room scenes Ikea installs in its retail locations: "Your manufacturing could look like this." The Trumpf Smart Factory Chicago, which Barkow Leibinger designed for the German company Trumpf takes this type of building further: It displays architecture as well as machines.

Barkow and his partner, Regine Leibinger, have designed many projects for Trumpf, which leads the charge in what the company calls "fourth generation" technology. (Leibinger's family owns the company.) All of the duo's projects for the machined-tools and laser manufacturer foreground structure to frame the machines that shape, cut, fold, and otherwise manipulate sheet metal. The designs themselves both honor the machines' industrial heritage and carry the buildings into an altogether thinner, more precise, and more ethereal realm. Instead of heavy halls or anonymous boxes, Barkow Leibinger's projects are temples of craft and precision.

So it is with the $15 million, 57,000-square-foot Chicago project, which opened this summer. The main space is a loft in which rows of Vierendeel trusses march across the sloping ceiling. The trusses were cut and folded by Trumpf's own machines and are much lacier than you might expect. The taller side of the space, which faces the highway along its length, is a glass window from which you can see the cars and trucks racing by—and they, in turn, can see inside the factory. The building's façades are clad in a combination of Cor-Ten steel and charred Douglas fir: The rust might recall the factory's industrial past, but it also elevates the factory's appearance from the beige-and-bland stucco or corrugated metal faces that cloak most examples of the type.

The Trumpf Smart Factory is more than a modern day machine hall. The whole building is an angular figure eight in plan: You enter where the two square forms meet, into an open-plan space that serves as a reception hall, and then turn either toward that loft-like room where the machines work silently and with almost no human intervention, or toward a courtyard surrounded by metal beams on end. An office space at the far end of the courtyard accommodates an approximately 50-person sales and administration staff.

The site is a fragment of an expansive campus that AT&T built around preserved wetlands, and Barkow Leibinger made good use of the serene views. The portion of the building that surrounds the courtyard, its walls clad with the same Douglas fir as the entry, recalls a monastery cloister, with walkways around a rock garden dotted with a few trees. Its raw materials and colors, including a polished concrete floor, are modest, primitive in feel, and closely aligned in texture and color.

Barkow says he was inspired in the design by Ludwig Mies van der Rohe's collages of spaces, like the Chicago Convention Hall and the New National Gallery in Berlin, in which paintings hang in cavernous halls. He wanted to "recapture the clarity and the optimism of that kind of Modernism. … We shouldn't be so afraid how things are made, how big they are, or even how they look." Barkow also loves projects such as Eero Saarinen's John Deere World Headquarters (finished by Kevin Roche John Dinkeloo and Associates) for its frank expression of steel and glass structure.

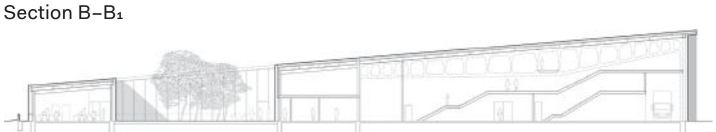
For the Chicago facility, Barkow and his team concentrated on the "amazing precision" and the "almost inhuman beauty" that industrial processes these days can produce, boosted by machines such as Trumpf's. "Ultimately, what I wanted to do was to explain technology," he says. He also had a practical reason for the simplicity and openness of the design: A catwalk and small observation deck now string through the trusses in the machine hall, but the angular structural forms can be adapted for more office or display space; the hall can also be extended in a future expansion. Eventually, the whole complex could be double its current size.

An American who has lived and worked in Germany for the last 30 years, Barkow still loves the muscle and messiness of the American landscape. "Look at these highway bridges," he exclaims as we drive toward the site, "and the structure holding up those billboards and traffic signs. That is the real architecture here. It has none of the fakeness of the buildings: It is honest and clear and really big. I love that."

In the Trumpf Smart Factory Chicago, Barkow Leibinger captures the energy of the city that makes things, as it transitions into an age where humans watch over machines that operate by themselves. The design frames those new machines with clarity and economy, and also places them in context. Instead of dark Satanic Mills, Barkow Leibinger shows us factories as modern museums of industrial art.

Section A–A1

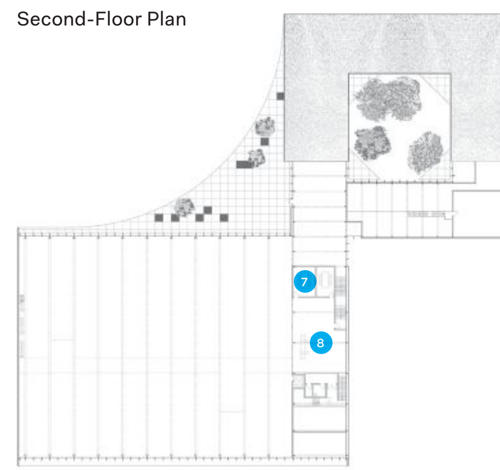
Section B–B1



Section C–C1

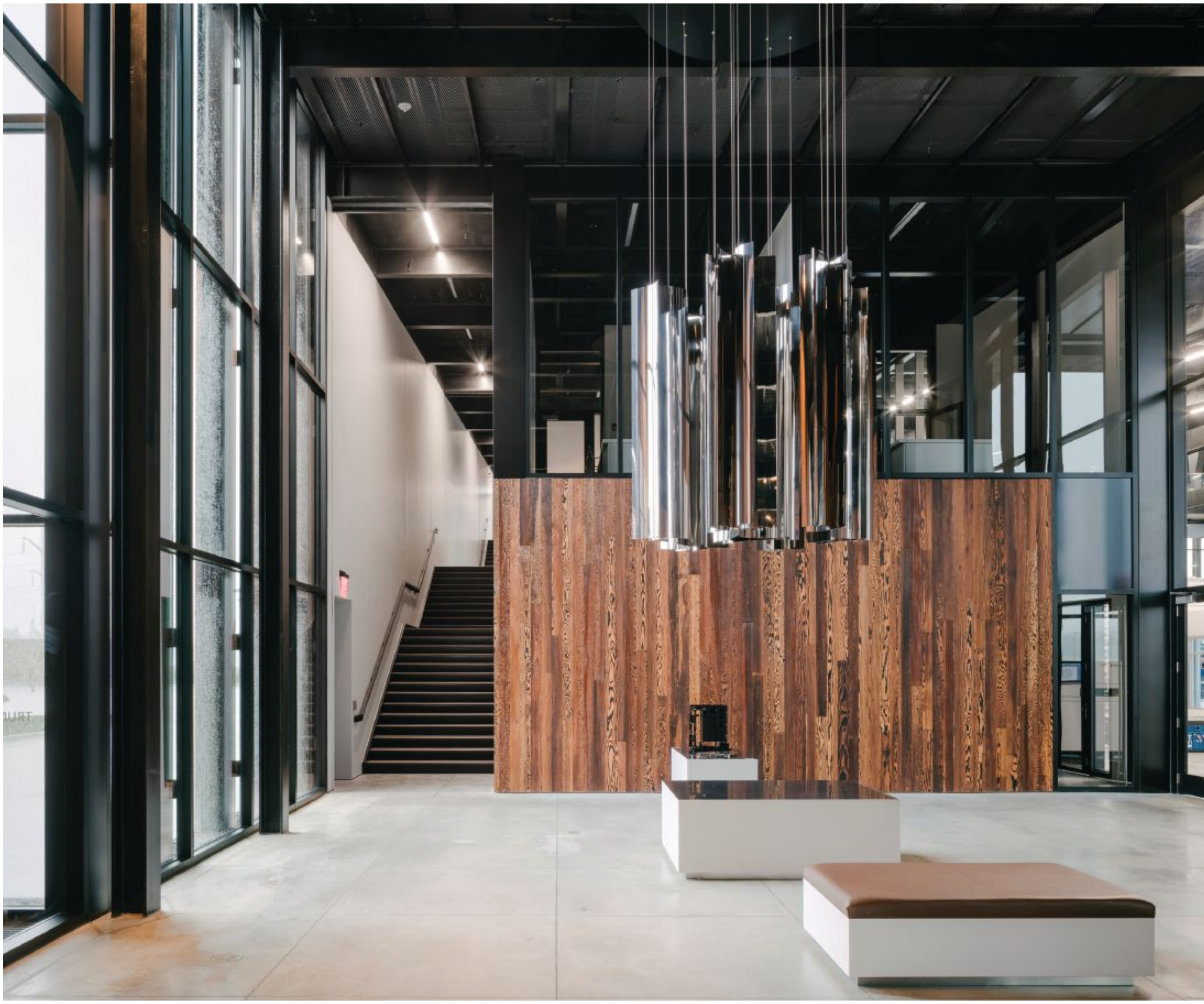
Third-Floor Plan

Second-Floor Plan



First-Floor Plan

1. Lobby
2. Machine showroom
3. Office
4. Courtyard
5. Auditorium
6. M/E/P room
7. Conference room
8. Control center
9. Lounge
10. Skywalk



Lobby, with stair to second-floor control center at left

View into auditorium from courtyard

Above: Machine showroom hall, with second-floor control center at rear

Opposite: Metal stair from machine showroom to third-floor skywalk

Skywalk, with view to machine showroom below

Project Credits

Project: Trumpf Smart Factory Chicago, Chicago
Client: Trumpf Group
Design Architect: Barkow Leibinger, Berlin · Frank Barkow, Regine Leibinger (principals); Heiko Krech (project architect); Johannes Beck, Jordan Berta, Carles Figueras, Cecilia Fossati, Andreas Moling, Antje Steckhan, Daniel Toole, Alexa Tsien-Shiang, Annette Wagner, Jens Wessel (project team)
Architect of Record: Heitman Architects, Itasca, Ill.
General Contractor: McShane Construction
Project Management: Lendlease
Structural Engineer: Knippers Helbig Advanced Engineering (design), IMEG Corp. (of record)
Climate/Energy Design/Mechanical/ Electrical Engineer/HVAC: IMEG Corp.
Façade Consultant: Knippers Helbig Advanced Engineering
Lighting Design: Licht Licht
Landscape Architect: Capatti Staubach (design), Gary R. Weber Associates (of record)
Size: 57,000 square feet
Cost: Withheld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Residential:

Yale Students Design Two-Unit House for Formerly Homeless New Haven Residents

TEXT BY SARA JOHNSON

While head of Yale's architecture program, Charles Moore established an annual first-year design/build project with his colleague Kent Bloomer. Fifty years later, that effort, now called the Jim Vlock First Year Building Project, continues, and this year's iteration is a building designed for formerly homeless residents of New Haven, Conn.

The program has built 29 houses in the city, and this year's is the first of a five-year partnership, Homeless:Housed, with local nonprofit Columbus House. The 1,000-square-foot building contains two units: one ground-floor studio and one two-bedroom, two-bathroom unit with living spaces on the ground floor and a second story that spans a breezeway between the units. The window frames, stairs, cabinets, and dormers were all prefabricated in a facility on Yale's West Campus.

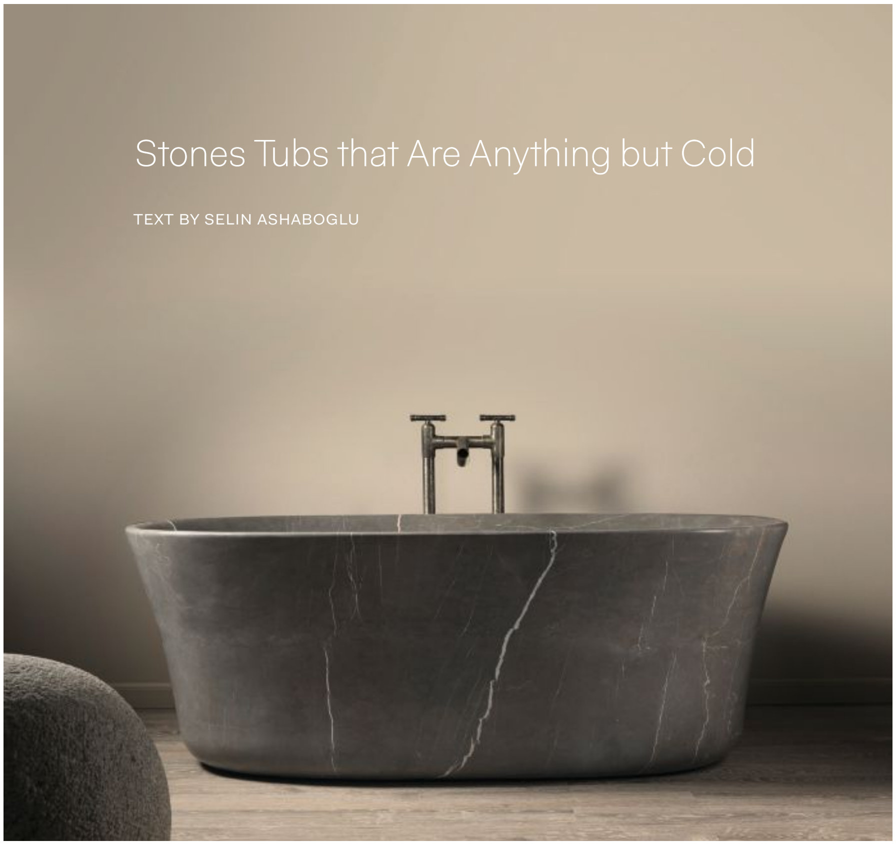
Filmmaker Anne Munger and producer Matt Marr produced a film about this year's house, *A New Haven*, which was submitted to the AIA's 2017 I Look Up Film Challenge. "When we first met them, [Columbus House CEO] Alison Cunningham … said, 'We are Columbus House and our mission is to end homelessness,' which I thought was the most kick-ass statement ever," said student and team member Katrina Yin in the film. The project was completed in October, and residents are expected to move in this month.

ZELIG FOK AND HAYLIE CHAN

> *Read more about the 2017 Jim Vlock First Year Building Project at bit.ly/2017YaleHouse.*

Stones Tubs that Are Anything but Cold

TEXT BY SELIN ASHABOGLU



Calma Bathtub, Stone Forest

This oval bathtub is hand-carved from a single block of limestone or Marquina taupe marble (shown). The freestanding basin measures 56.5" long by 26.5" wide at its base, and flares out to 66" long by 36" wide at its top lip. Calma measures 24" tall, has an approximate dry weight of 1,800 pounds, and holds 85 gallons of water when filled to 3" from its rim. *stoneforest.com*

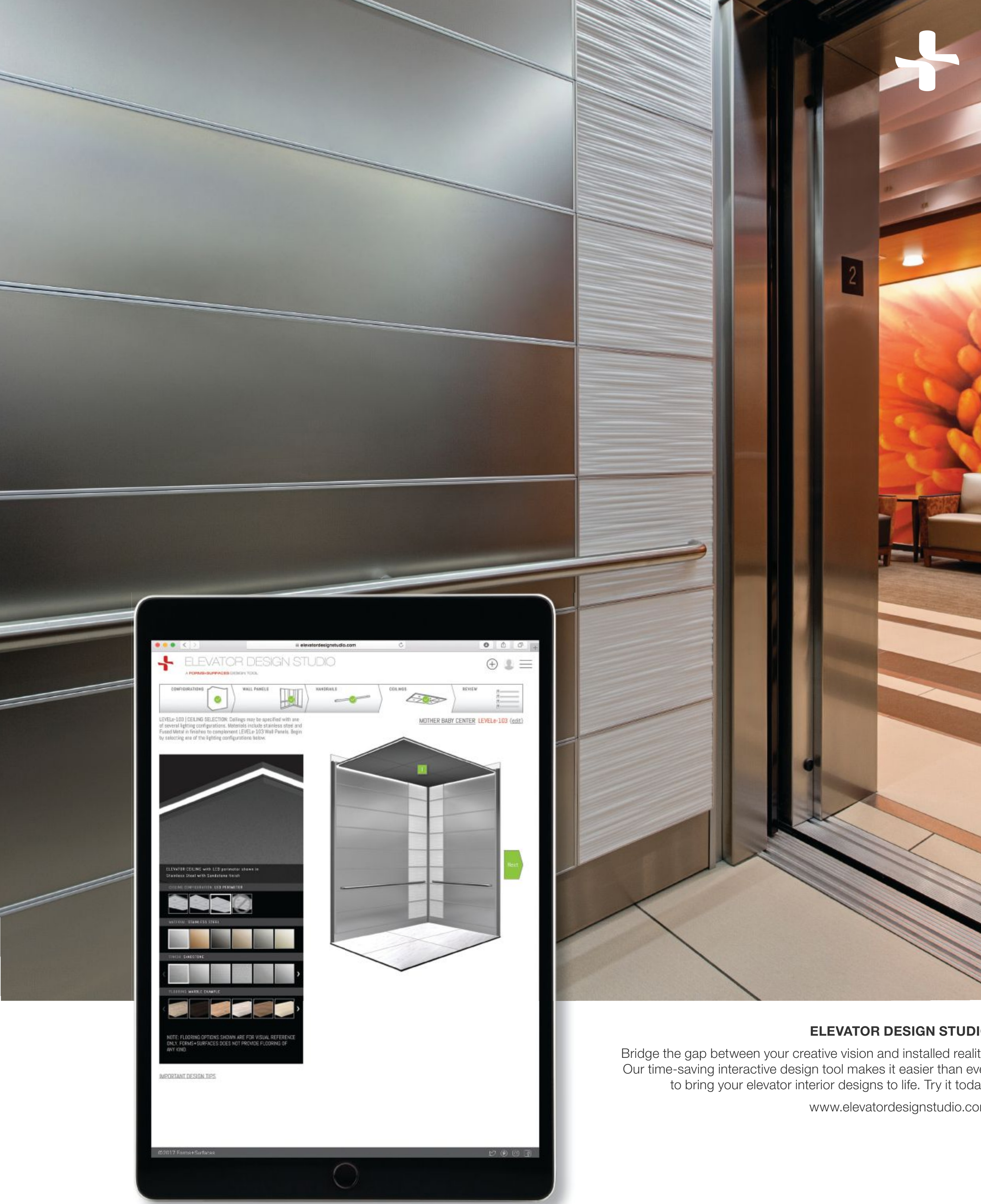
Samara, Porcelanosa

This ovoid bathtub is part of Spanish tile company Porcelanosa's L'Antic Colonial brand. The 75"-long by 37"-wide tub measures 21" tall and comprises three stacked stone rings—top, middle, and base. The tub weighs up to 1,439.6 pounds, depending on the stone type specified. Samara is available in crema Italia (shown), Habana dark, and Persian white stone, and with or without Bioprot, the company's proprietary antibacterial finish. *porcelanosa-usa.com*

Desco Oval, Pibamarmi

Part of the Desco collection of bathroom and bedroom furnishings created by Italian architect Vittorio Longheu for Pibamarmi, this asymmetric tub's design embraces a minimalist aesthetic approach. The 67"-long by 35"-wide tub stands 21" tall and weighs approximately 772 pounds. Desco Oval is offered in 49 types of stone, including nero Marquinia (shown), grigio Portaluppi, rosso Asiago, and verde Barcellona. *pibamarmi.it*

> *To discover more bathtubs, visit bit.ly/StoneBathtubs.*


ELEVATOR DESIGN STUDIO
MOTHER BABY CENTER LEVELe-103 (edit)
Next

National Building Museum Constructs a 1,000-Square-Foot Model of a Flexible House

TEXT BY SARA JOHNSON

Roughly 68 percent of U.S. housing units are single-family, but single-family houses don't necessarily house single families. Today's residential architects have moved beyond adding Murphy beds to apartments and now are designing housing that caters to a client-base that's marrying later, buying less, and living longer. This month, the National Building Museum in Washington, D.C., opens a new exhibition, "Making Room: Housing for a Changing America," showcasing new models for living, from amenity-rich micro-units to residences designed for aging-in-place. Alongside case studies such as nArchitects' Carmel Place in New York and Poster Frost Mirto's Las Abuelitas Family Housing in Tucson, Ariz., the exhibition features the Open House, a full-scale, 1,000-square-foot demonstration unit designed by architect Pierluigi Colombo, designer/art director of Italian furniture company Clei (shown). Over the exhibition's 10-month run, the unit will showcase three different configurations designed to meet the needs of three very different types of inhabitants: roommates, a retired couple, and an extended family. The exhibition runs from Nov. 18 through Sept. 16 of next year.

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> Read more about the exhibition at bit.ly/MakingRoomNBM.


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Cottage in the Vineyard
Fontanars dels Alforins, Spain
Ramón Esteve Estudio de Arquitectura

TEXT BY EDWARD KEEGAN, AIA
PHOTOS BY MARIELA APOLLONIO

For a retreat outside Fontanars dels Alforins, Spain, architect Ramón Esteve wanted to reinterpret the traditional forms of the rural area. “In vernacular architecture, the dominant typology of houses is the gable,” Esteve says. So the architect extruded a gable form of poured-in-place concrete almost 170 feet across the landscape, punctuating it with a series of minimal, balloon-framed, pine-clad boxes that extend outward from the north and south sides of the main volume.

The 4,464-square-foot residence lies on the edge of a vineyard, about a mile west of the town of a thousand residents and about 50 miles southwest of Valencia, the Mediterranean port city where the architect’s office is located. The house was designed for sporadic use—on weekends, for vacations, and for entertaining. Visitors enter through the largest wood volume, which serves as a porch and outdoor living space. Inside, an open plan under the central gable connects each of the wood-lined volumes, which individually contain the living room, kitchen and dining space, and three bedrooms.

There is a subtle hierarchy of heights within the interior spaces: the gable is nearly 20 feet tall; the living room and kitchen ceilings are about 9.5 feet high, the master bedroom ceiling is nearly 9 feet high, and those in the guest rooms are just over 8 feet high. Vertical timber planks, each 20 centimeters (7.87 inches) wide, clad the living spaces, inside and out. Even the concrete formwork followed this module, so that the exposed surfaces bear imprints of the same dimension.

The gabled form is as wide as it is tall and formed by 50-centimeter-thick (nearly 20-inch-thick) walls and roof. Esteve chose concrete because “it takes the texture of the wood mold,” he says. “The house collects patterns of traditional typologies and integrates that into the landscape.” The house was designed according to passive principles, with highly insulated volumes and an orientation that facilitates cross ventilation. Solar panels are obscured from view on top of the wooden boxes, and the sloped concrete roof diverts rainwater to a 26,417-gallon cistern in the basement.

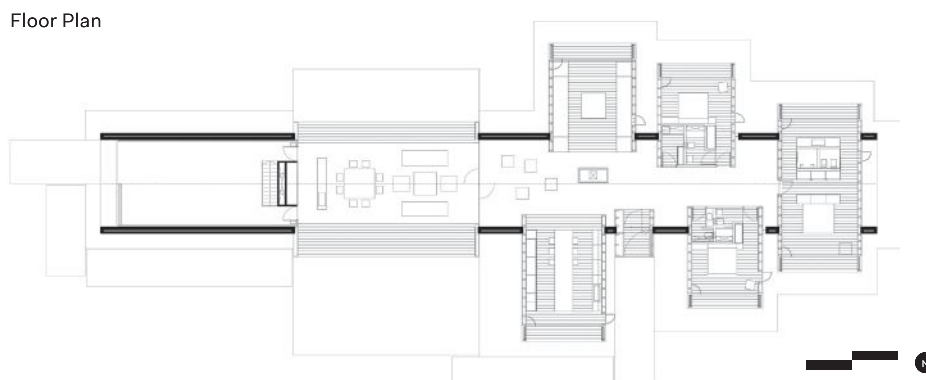
Each wooden volume can open completely to the outdoors: Frameless wood doors integrate seamlessly into the wall when they’re opened, with the intention of blurring the boundaries between inside and out. “The house envelopes you with the idea of being a refuge from nature, but each opening offers a view of the landscape,” Esteve says. “Every space has an intentional view, like a painted picture.” The doors can be closed securely when the owners aren’t in residence, providing a secure perimeter.

With this simple approach to space making, combined with a celebration of elemental building materials, Esteve has crafted a contemporary take on dwelling that still seems at home in the traditional landscape of the region.

Previous Page: From the front, the Cottage in the Vineyard looks like a simple gabled structure, with a concrete frame that is as tall as it is wide.

Above: The nearly 20-inch-thick concrete walls are interrupted by projecting pine-clad volumes, which house living spaces that can be opened to the landscape or closed for security.

Floor Plan



A wood-lined porch separates the garage at the front of the house from the living areas beyond.

Opposite: Each of the wood-lined living spaces opens onto a central common area with a bidirectional fireplace that warms the interior during winter months. Mineral-wool insulation helps the structure retain heat in winter and stay cool in summer.

Above: The kitchen features wood-faced cabinets and counters that blend in with the paneled walls, as well as a cantilevered counter that doubles as a dining area.

A lighting control system helps save energy by automating the balance between natural and artificial light in spaces such as the bedrooms.

Project Credits
Project: Cottage in the Vineyard, Fontanars dels Alforins, Spain
Client: Withheld
Design Architect: Ramón Esteve Estudio de Arquitectura, Valencia, Spain · Ramón Esteve (architect); Anna Boscà, Víctor Ruiz (collaborating architects); Tudi Soriano, Patricia Campos (collaborators); Emilio Pérez (technical architect)
Contractor: Covisal Futur
Size: 414.74 square meters (4,464 square feet)
Cost: Withheld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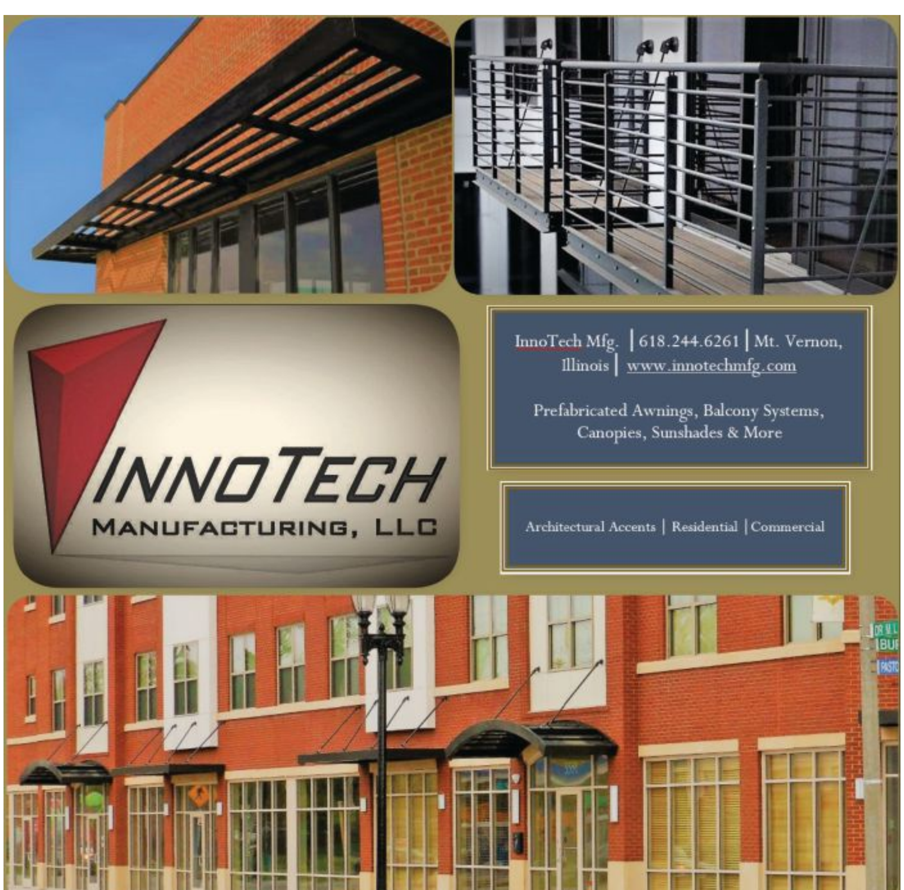
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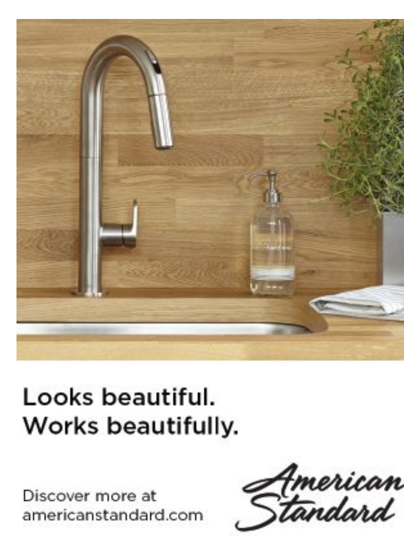
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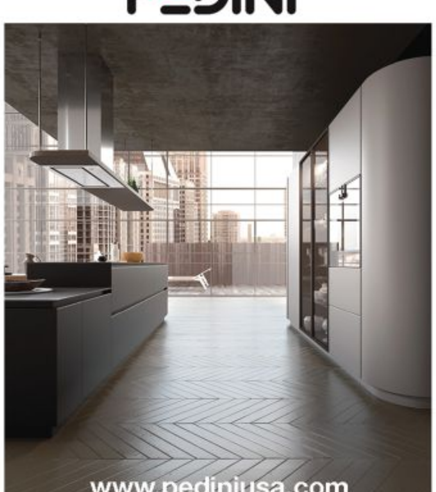

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Editorial: The Replicant City of *Blade Runner 2049*

The future arrives in two years. At least it is according to *Blade Runner,* the 1982 thriller directed by Ridley Scott. The movie takes place in Los Angeles, November 2019, in what is unquestionably the greatest of all cinematic cities of the future. A sequel, *Blade Runner 2049*, opened on Oct. 6, and to maintain continuity, director Denis Villeneuve brought back actor Harrison Ford, screenwriter Hampton Fancher, and concept artist Syd Mead. What he left behind was the original's richness of detail, verisimilitude, and conceptual rigor.

Scott's movie was a glorious swan song for analog special effects: He reworked sci-fi conventions that first appeared in 1927, in Austrian director Fritz Lang's *Metropolis*, a silent parable of progress and personhood set in 2026. In all three films, there are flying cars, impossibly tall buildings, villainous technocrats, a downtrodden populace, and robots masquerading as real people. In the *Blade Runner* universe, robots are called replicants. Not mechanical but bioengineered, and indistinguishable from humans, they're made to work "Off-world" (i.e., in outer space) and forbidden on pain of death to set foot on Earth. Not that Earth is so appealing: Environmental mismanagement has left L.A. denuded of sunshine and palm trees. Ford's character, a policeman bounty hunter, chases down the strays through crowded, dark, and stormy streets.

The city appears as kind of a parasitic life-form, a character in itself, with a richly layered backstory. Its urban evolution becomes evident in a palimpsest of western and eastern iconography, decrepit masonry apartment buildings and pyramidal corporate headquarters, humble neon street signs and enormous animated billboards, and a haywire network of building systems and mechanicals. Filming took place in Burbank, on a Warner Bros. backlot, and at select locations around town, such as Union Station, the Bradbury Building, and Frank Lloyd Wright's Ennis House, linking the L.A. of *Blade Runner* with the true place and its past.

Villeneuve, to his credit, doesn't mimic Scott's aesthetic (though there are nods throughout) and uses digital effects sparingly. He cites Brutalist architecture as an influence, and exhibits a penchant for reductivism, copying a powerfully spare rendering by Spanish modernists Barozzi / Veiga for one interior set. Fancher's story moves the plot and themes in smart directions. Regrettably, the production design, by Dennis Gassner, doesn't follow. In L.A., 2049, the environment has degenerated to the point of sterility, helped along by a nuclear war. Perpetual winter has supposedly set in, but the condition isn't self-evident: Coats go unbuttoned, snow resembles ash, and yellow is the symbolically dominant color. The planet may be dying, but it doesn't seem cold.

In some scenes, L.A. looks deserted, the residents dead or gone Off-world; in others, streets and buildings are crowded, the dim skyline punctuated with innumerable lit windows. Villeneuve shot in Budapest, Hungary, which no one could mistake for L.A.—or even for Las Vegas, where the action moves for a spell. An atmospheric blur of fog, smog, snow, ash, dust, sand, or rain reduces many shots to hazy monochrome, like a succession of horizontal-format Rothko paintings. *Blade Runner 2049* delivers abstraction at the expense of meaning. There are moments of great beauty, but the film feels soulless, like a replicant, desperately searching for an identity of its own in the long shadow of its progenitor.

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