ARCHITECT

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Special Detail Section

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THE FUTURE

CONTINUING EDUCATION 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.

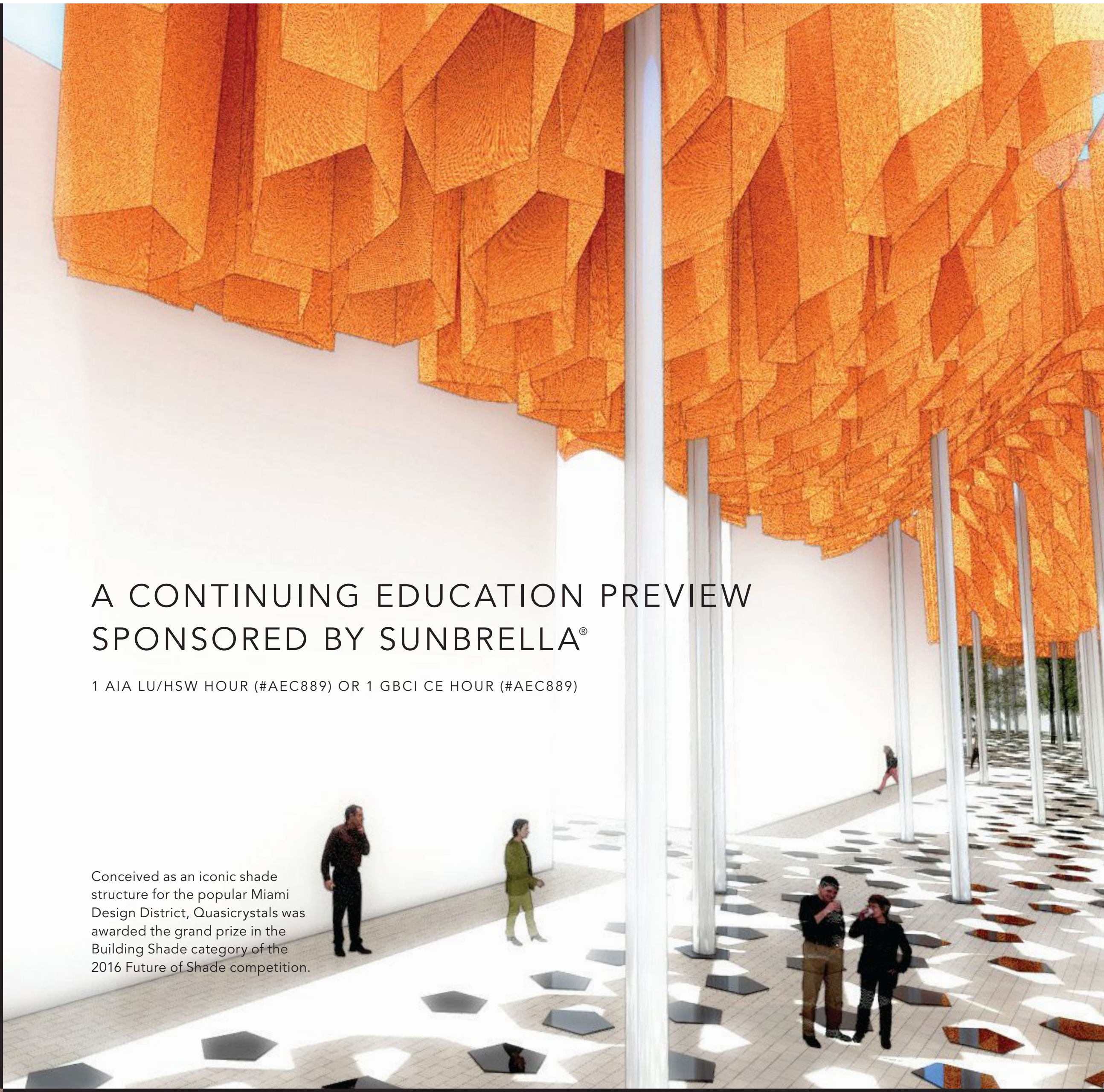
3. Define the benefits of shade structures for personal health and UV protection.

4. Discuss how the use of textiles in shade structures can positively impact thermal performance and energy efficiency.

5. List LEED 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

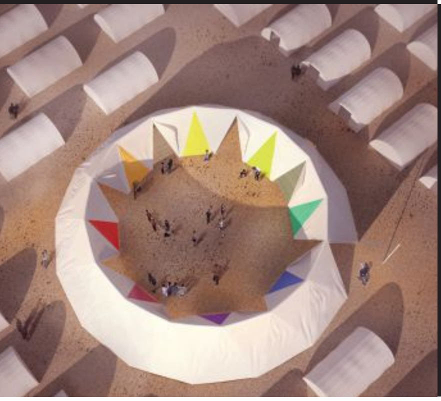
To receive credit for this course, you must read the entire article available on ce.architecturalrecord.com and pass the free test.



A CONTINUING EDUCATION PREVIEW SPONSORED BY SUNBRELLA®

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

Conceived as an iconic shade structure for the popular Miami Design District, Quasicrystals was awarded the grand prize in the Building Shade category of the 2016 Future of Shade competition.



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.

A deployable school designed for refugee camps, REVOLVE, creates a free-flowing space that provides a balance between work and activity.

OF SHADE

FABRIC COMPONENTS IN SUSTAINABLE ARCHITECTURAL DESIGN

Increasingly, shade structures begin the design conversation. This is particularly so in commercial buildings, those in sunny climates, those which will inhabit a warming planet (this one), and by 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 non-profit 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.

Hanging Parasol Garden combines sun shading, illumination, water collection and climbing plants into one innovative shade system.

Cardo Plana is an efficient, easy-to-assemble flat-pack system designed to provide immediate shelter in disaster relief zones.

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Volume 105, number 12. December 2016.
On the cover: MacKay-Lyons Sweetapple Architects' Point House.
Photo by Matthew MacKay-Lyons/William Green.

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The Journal of the American Institute of Architects

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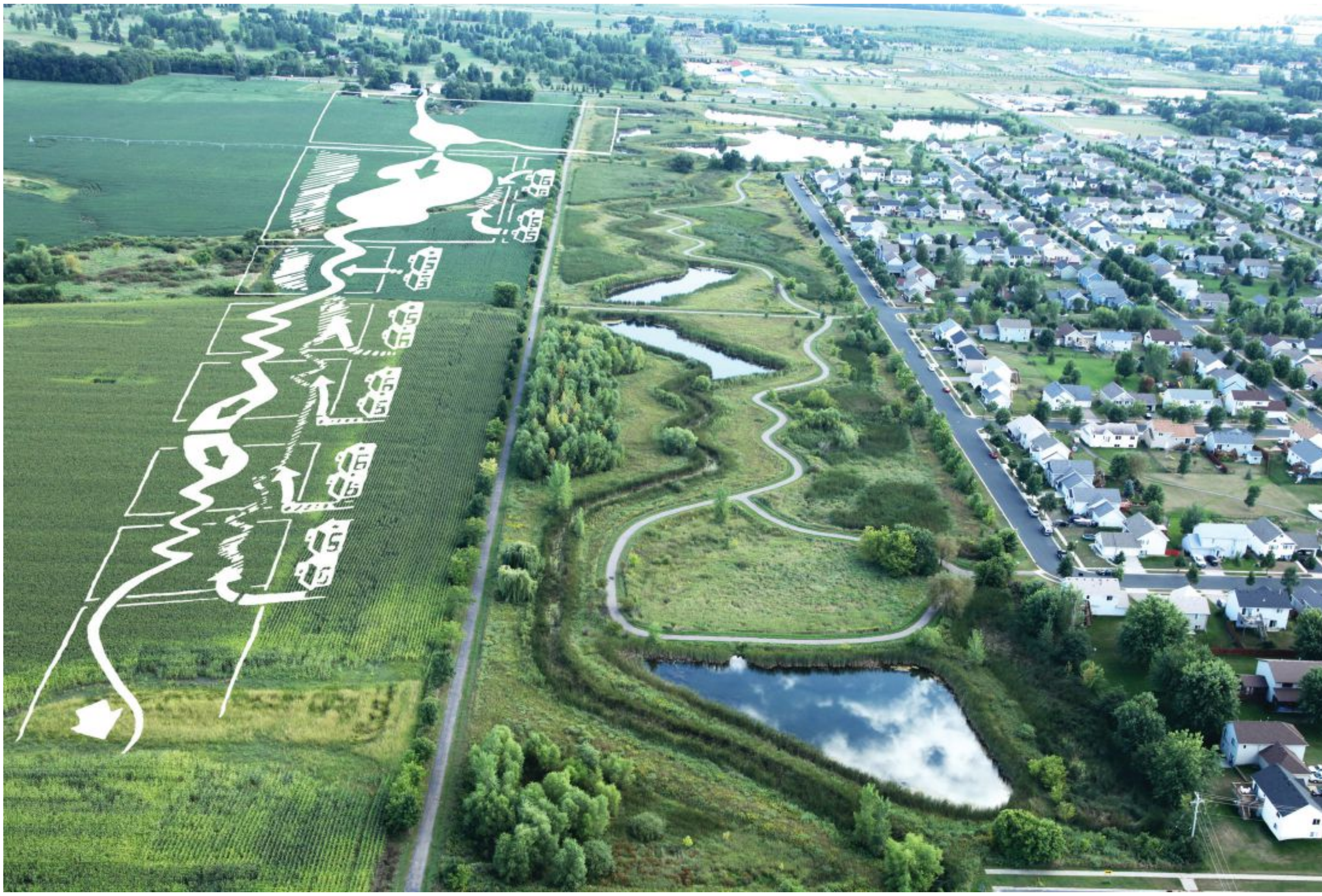

BORDNER AERIALS

Diana Balmori Dies at 84

Landscape architect and urban designer Diana Balmori, the founder of New York City–based Balmori and Associates and a fellow of the American Society of Landscape Architects, died on Nov. 14. Balmori and her firm, established in 1990, completed memorable projects around the world, including the Prairie Waterway Stormwater Park outside of Minneapolis (1996, above); the Garden that Climbs the Stairs in Bilbao, Spain (2009); and the Osaka National Museum of Art in Japan (2004), which was a collaboration with Pelli Clarke Pelli Architects, whose senior principals include her husband, Cesar Pelli, FAIA. —SELIN ASHABOGLU

> *Read more about the accomplishments of Diana Balmori at bit.ly/BalmoriObituary.*

WILL RAGOZZINO

Pierre Chareau, Animated

Known for that *ballet mécanique* of architecture, Maison de Verre, Pierre Chareau also designed one-off Art Deco pieces. A new exhibition, "Pierre Chareau: Modern Architecture and Design," at New York City's Jewish Museum, is as compelling for Diller Scofidio + Renfro's installation as for the French cult figure's work. Full-size silhouettes of people—scribbling at a desk, dressing at a vanity, setting the table—are projected onto a theater of floor-to-ceiling, wall-to-wall screens, and move among silhouettes of Chareau's furniture, staged on the other side of the fabric. The exhibition runs through March 26, 2017. —JOSEPH GIOVANNINI

> *Read more about the exhibition at bit.ly/PierreChareauJewishMuseum.*

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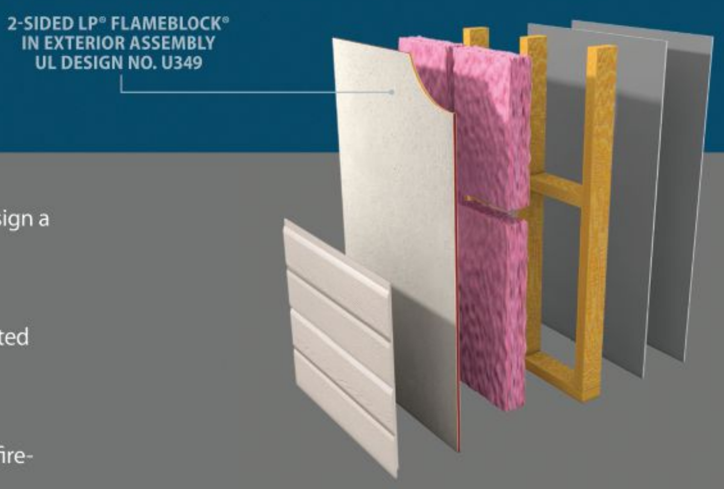

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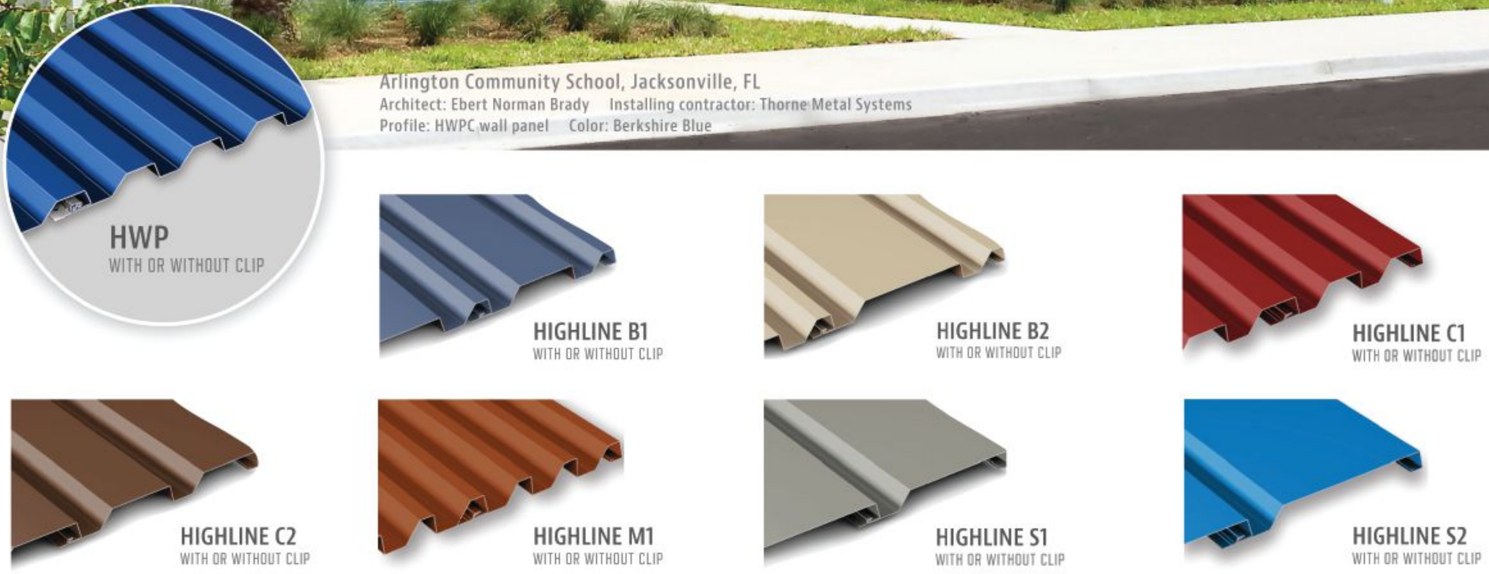
The Best Tall Building

The Council on Tall Buildings and Urban Habitat announced the Shanghai Tower as the Best Tall Building Worldwide, joining the ranks of Bosco Verticale in Milan (the 2015 winner) and One Central Park in Sydney (the 2014 winner). Designed by Gensler and completed last year, Shanghai Tower was selected out of 132 entries. The 2,073-foot-tall, 133-floor building contains commercial, office, retail, and hospitality spaces and features multistory atriums between the tower's double-skin façade to help with ventilation. Additionally, the twisting form reduces the tower's need to resist wind loads by 24 percent. —SELIN ASHABOGLU

> *Follow ARCHITECT's coverage of technology news at architectmagazine.com/technology.*



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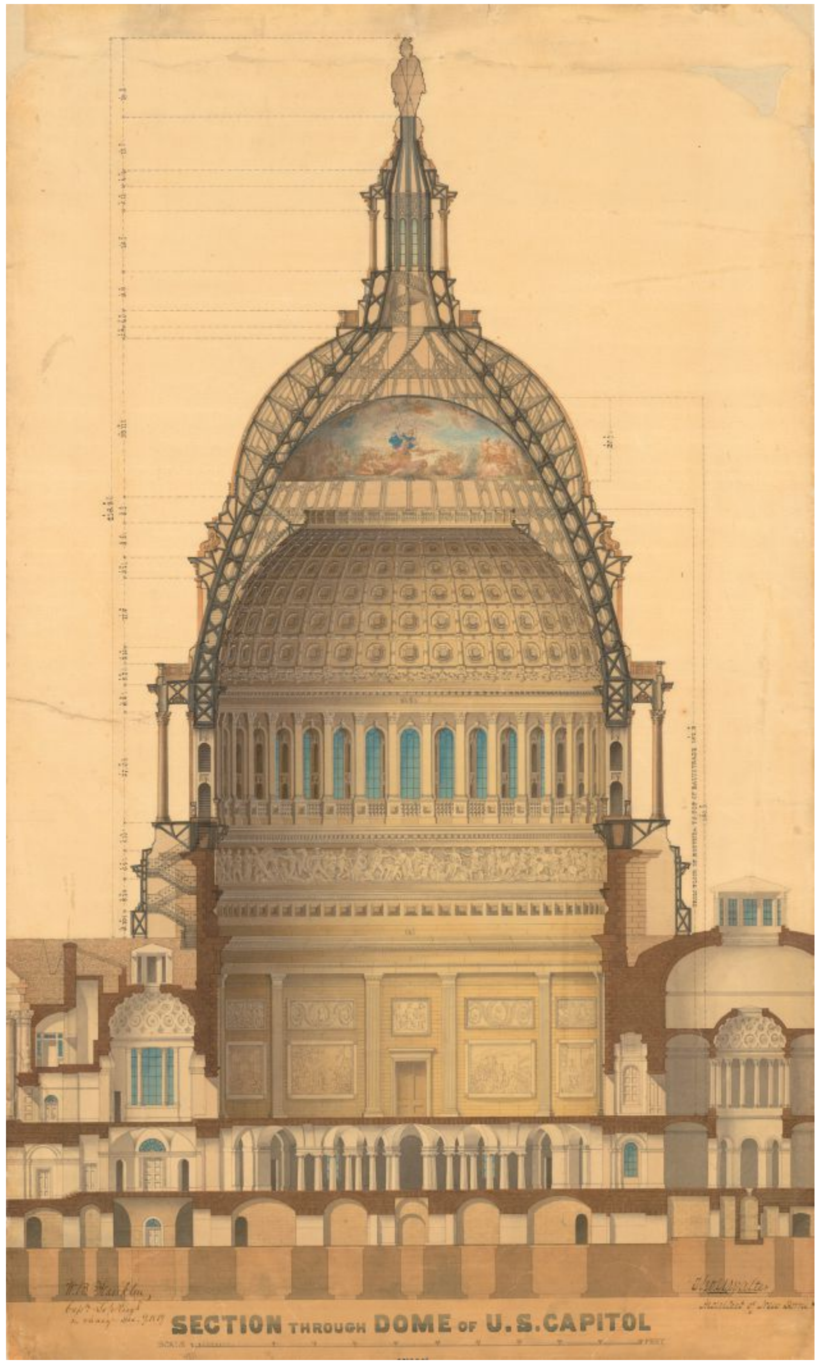

COURTESY ARCHITECT OF THE CAPITOL

Restoring a Symbol

The two-and-a-half-year-long Capitol Dome Restoration Project was completed last month. Due to deferred maintenance, water infiltration, and good old-fashioned aging, the 288-foot-tall, 8.9-million-pound cast-iron U.S. Capitol dome and rotunda—completed in 1866—was plagued by nearly 1,300 deficiencies and cracks, totaling 12,800 inches long. Its last significant renovation occurred more than half a century ago. Following meticulous repairs led by Architect of the Capitol Stephen T. Ayers, FAIA, along with architect-of-record Hoffman Architects, the landmark is now back to its former glory. —CHELSEA BLAHUT AND WANDA LAU

> *For more information about the renovation project, visit bit.ly/USCapitolDomeRestoration.*

Best Practices: Picking and Prepping Your Successors

TEXT BY NATE BERG

The looming mass retirement of the Baby Boomer generation is "one of our industry's most pressing challenges right now," says Michael Strogoff, FAIA, principal of Mill Valley, Calif.–based Strogoff Consulting, which advises design firms. "And the problem is that the next generation in line—they're just not prepared," adds Stephen Epstein, a management consultant at Strogoff. "They are more risk averse, they've been employees most of their lives, and they're good at doing the work. But they haven't been exposed to running a business."

"Owners who are in their 50s should really be thinking about [who will lead them into the future] now," says Rena Klein, FAIA, principal of RM Klein Consulting, in Seattle. "Owners who are in their 60s should definitely be thinking about it and taking some action."

Identify Potential Leaders

If a firm is going to live on, its current leaders will have to find their next of kin, of sorts, to start grooming them for the job. "They need to be looking for people who they trust, who share the firm's values, who will perpetuate the culture that's been established … and who other people, inside and outside the office, look to as leaders," Strogoff says.

He advises firms to open their search beyond the senior employees and to initiate a two-way conversation between current leaders and candidates.

Bill Endelman, AIA, principal of the architectural accessibility consultancy Endelman & Associates, in Seattle, suggests looking for future leaders before you even need them. "You have to think about it as you hire people," he says. "You have to ask yourself, 'Will this person grow into something beyond current job placement?'"

> "You have to ask yourself [as you hire], 'Will this person grow … beyond current job placement?'"
>
> —Bill Endelman, AIA, principal, Endelman & Associates

Make a Plan

Many consultants and firm leaders recommend creating a transition plan that would ideally span a decade. "It takes time to transfer knowledge, relationships, and leadership—to shift the culture," Klein says.

Incoming leaders will also have to make a sizable financial commitment, because running a firm means owning it. To ensure the current leaders are compensated adequately, Klein recommends hiring an outside valuation expert to estimate the company's worth.

In the case of the 15-person San Francisco firm Axis Architecture + Design, an ambitious, longtime employee expressed interest in taking a bigger role in the firm. Though neither of the two founding partners was considering retiring or thinking about pulling in another partner, the more the two thought about the proposal, the more it made sense.

"It had everything to do with how do we strategically position our business to continue to thrive," says partner Cory Creath, AIA. He and his partner each sold a 5 percent stake to the new partner. "If we incentivize them, and they go out and do what they do every day with an extra degree of motivation, that's going to bring back results to the company."

Train and Mentor

While job coaches and executive MBA programs are available, the best way for a new leader to learn the business is from their predecessors, who will "need to relinquish more [control]," Strogoff says. The current management will also need to share information they hadn't divulged before. "It's figuratively and literally speaking opening up your books," Endelman says.

For Lou Bieker, AIA, principal at 4240 Architecture, in Denver, training new leaders requires those in charge to hand over responsibilities regarding project and business operations immediately, while providing guidance along the way. With client permission, he designates them as project managers and as the client's primary points of contact.

This is how Bieker got his own start. "I was put in a position at a very young age to go to meetings and interact with clients," he says. "It was scary and intimidating … but, man, do you learn fast."

> To learn more about ensuring your firm's legacy and identifying potential leaders, visit bit.ly/ARsuccessors.

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Next Progressives: Sports

EDITED BY WANDA LAU

Location:
Syracuse, N.Y.

Year founded:
2010

Greg Corso and Molly Hunker

Leadership:
Greg Corso and Molly Hunker (co-captains)

Education:
Corso: B.A. and M.Arch., University of California, Los Angeles (UCLA)
Hunker: B.A., Dartmouth University; M.Arch., UCLA

Experience:
Corso: Studio Gang, Standard Architecture, Cliff Garten Studio
Hunker: Doug Aitken Workshop, Talbot McLanahan Architecture

How founders met:
Graduate school

Staff size:
2 employees

Mission:
Sports strives to make compelling spaces and objects that embrace the ideas latent in everyday phenomena. We are a small studio whose approach to architecture is simple: Balance rigor and research with amusement and curiosity.

Design tool of choice:
Sketches and fun materials.

First commission:
"Life Will Kill You," an installation for the Revolve Clothing showroom (now closed) in West Hollywood, Calif.

Favorite project:
"Rounds," our winning entry for this year's Ragdale Ring competition, is our favorite because we built it with a great team of folks in a beautiful location (on the former estate of Howard Van Doren Shaw in Lake Forest, Ill.) for a terrific organization. We are also not exactly sure why we like it so much, which is why we like it so much.

Second favorite project:
"Stay Down, Champion, Stay Down" was the first competition we won. It was a great opportunity to synthesize a handful of ideas that were floating around our heads at the time into a built product. The project was located in the heart of Hollywood, providing endless interactions with interesting characters.

Modern-day design hero:
We have many; most are not architects. In architecture, we look up to offices like SANAA and Herzog & de Meuron for the way they do a lot with a little.

Special item in your studio space:
A pair of adorable cats.

Memorable learning experience:
Before we started working together, we both worked separately in the art world, which helped broaden our points of reference as architects.

Skills to master:
Remembering it's just architecture.

Morning person or night owl?
Half of us are morning people, half are night people. (Hunker is the former, Corso, the latter.)

When we're not working in architecture …
We are "researching"—also known as watching television.

Superstition:
Always assume we will lose the competition.

Vice:
Naps.

Social media platform of choice:
Printing images and showing them to people in person. We are a little behind the times.

NICK ZUKAUSKAS

SPONSORED CONTENT

ARCHITECTURAL WOOD DOORS ADD MODERN ELEGANCE TO URBAN CHIC APARTMENT COMMUNITY

Hubbard Place, a 43-story, 450-unit luxury rental community in the River North neighborhood of Chicago, exemplifies the distinct vision of Daniel Levin, chairman and founder of the property's developer, The Habitat Company.

Delivered in late 2013 and designed to LEED Silver standards, Hubbard Place boldly embodies Levin's ideals. That process starts with close collaboration with the Hubbard Place architect, Chicago-based Solomon Cordwell Buenz. Tom Black, The Habitat Company senior vice president of development and licensed architect, describes the working relationship as "extensive."

You see that design discipline throughout Hubbard Place, from the architectural elements on the tower exterior to the units' doors. For example, Habitat wanted unit entrance doors that matched the wood veneer used in public areas. That proved challenging. "We looked at a number of different sources and proposed finishes," Black explains. "Only VT Industries had the look we wanted. This isn't the first time we've used their doors. We regard VT very highly."

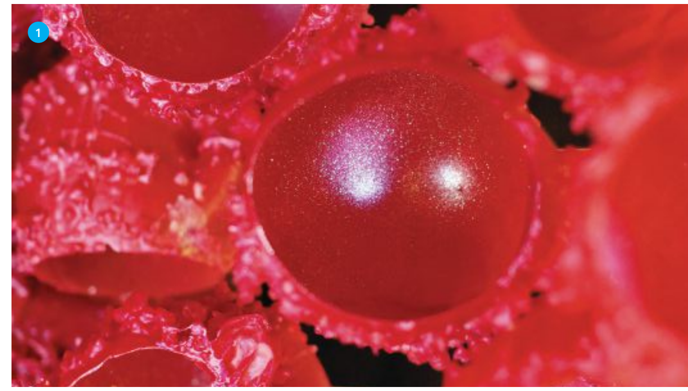
That design rigor serves The Habitat Company well: Hubbard Place achieved nearly 100 percent occupancy six months ahead of schedule.

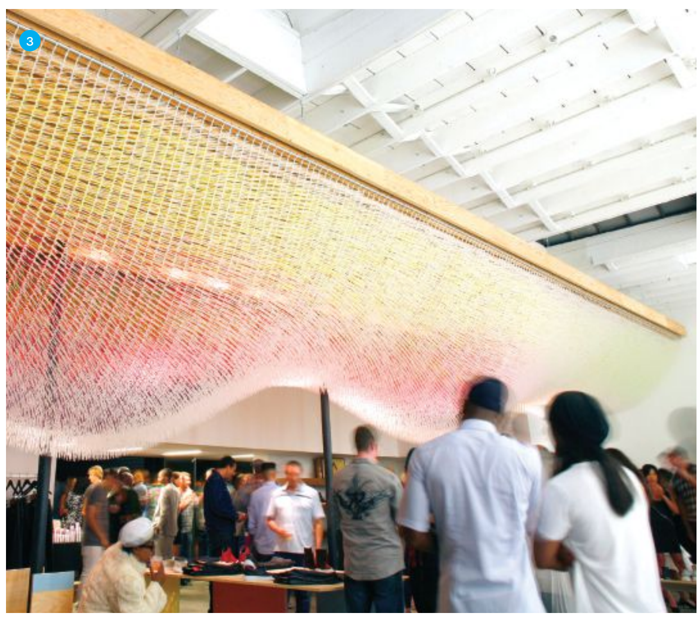
The Habitat Company is one of the nation's most respected residential property developers and managers with over $3 billion in assets and 24,000 units under management, across all multifamily classes.

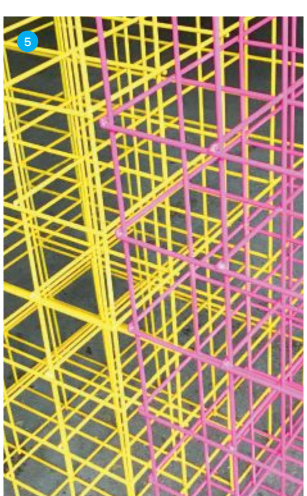
Hubbard Place—owned by The Habitat Company and designed by Solomon Cordwell Buenz—is a 43-story luxury rental community located in the River North neighborhood of Chicago. *Photo credit: Paul Morgan*

Next Progressives is a monthly presentation in ARCHITECT of an emerging designer or practice. It is proudly sponsored by VT Industries.

Next Progressives: Sports



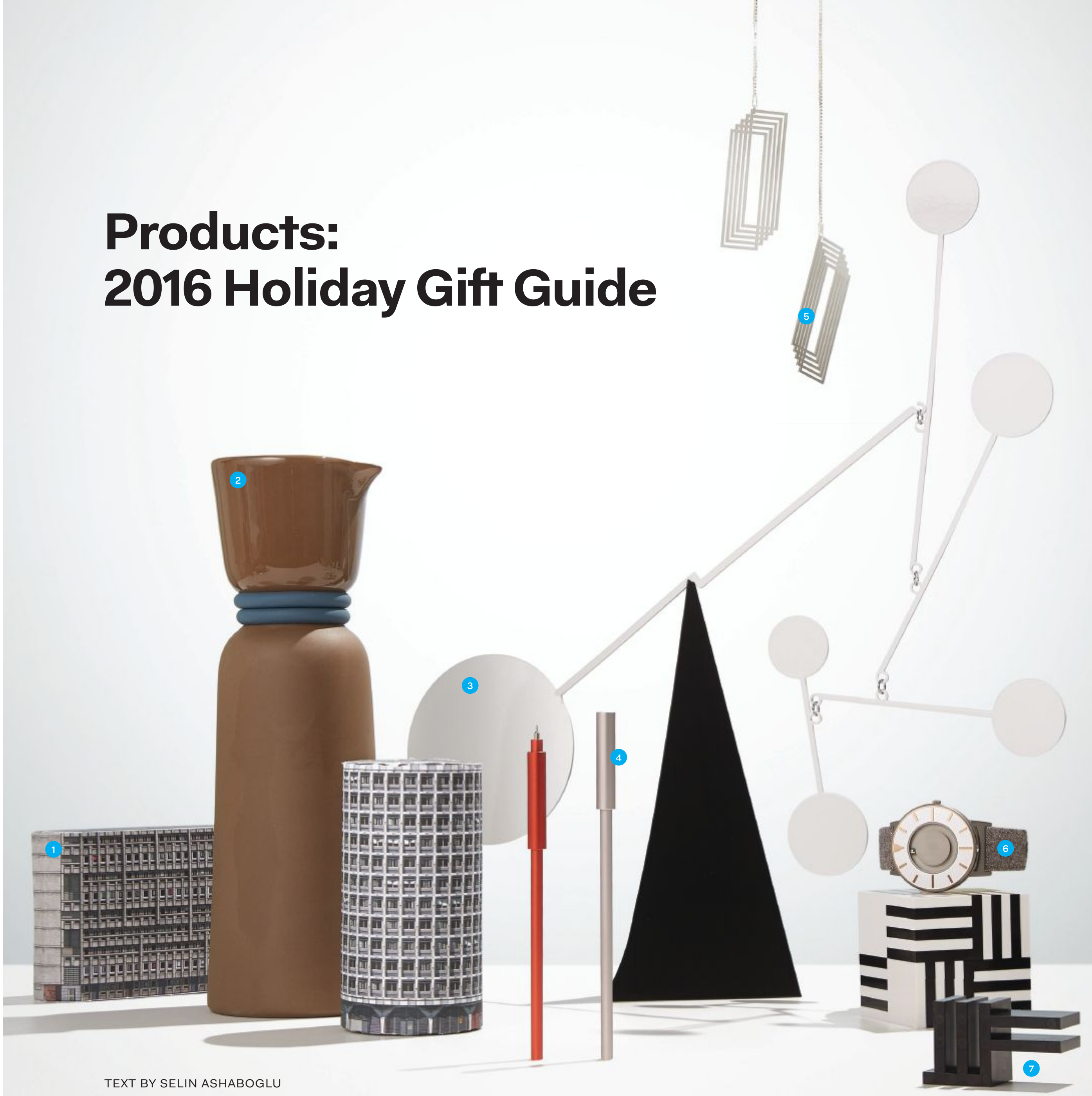




1, 4. “Myth,” installed in Chicago, re-imagines the ornate and often kitsch assembly of home shrines with suspended handmade candles that regress from a clean finish at the top to a rusticated, morphing look toward the bottom. **2, 3.** For the Revolve clothing showroom in West Hollywood, Calif., Sports crafted “Life Will Kill You,” a cloud-like volume from electrical lamp cord and more than 100,000 zip ties to contrast with the boutique’s high-end clothing. **5, 6.** “Runaway” is Sports’ winning entry for a public art pavilion that will host the Museum of Contemporary Art Santa Barbara’s 2017 “Takepart | Makeart” initiative. **7.** Sports’ mint-green, plywood-and-rubberized-stucco “Rounds,” on the grounds of the Ragdale Foundation, serves as everything from performance space to seating. **8.** The tangible qualities of candy—gumminess, color, softness, and translucency—inspired “The Sweetness,” Sports’ entry for the 2014 Louisville Children’s Museum Competition.

7: NICK ZUKAUSKAS

Products: 2016 Holiday Gift Guide



TEXT BY SELIN ASHABOGLU

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JEFF ELKINS

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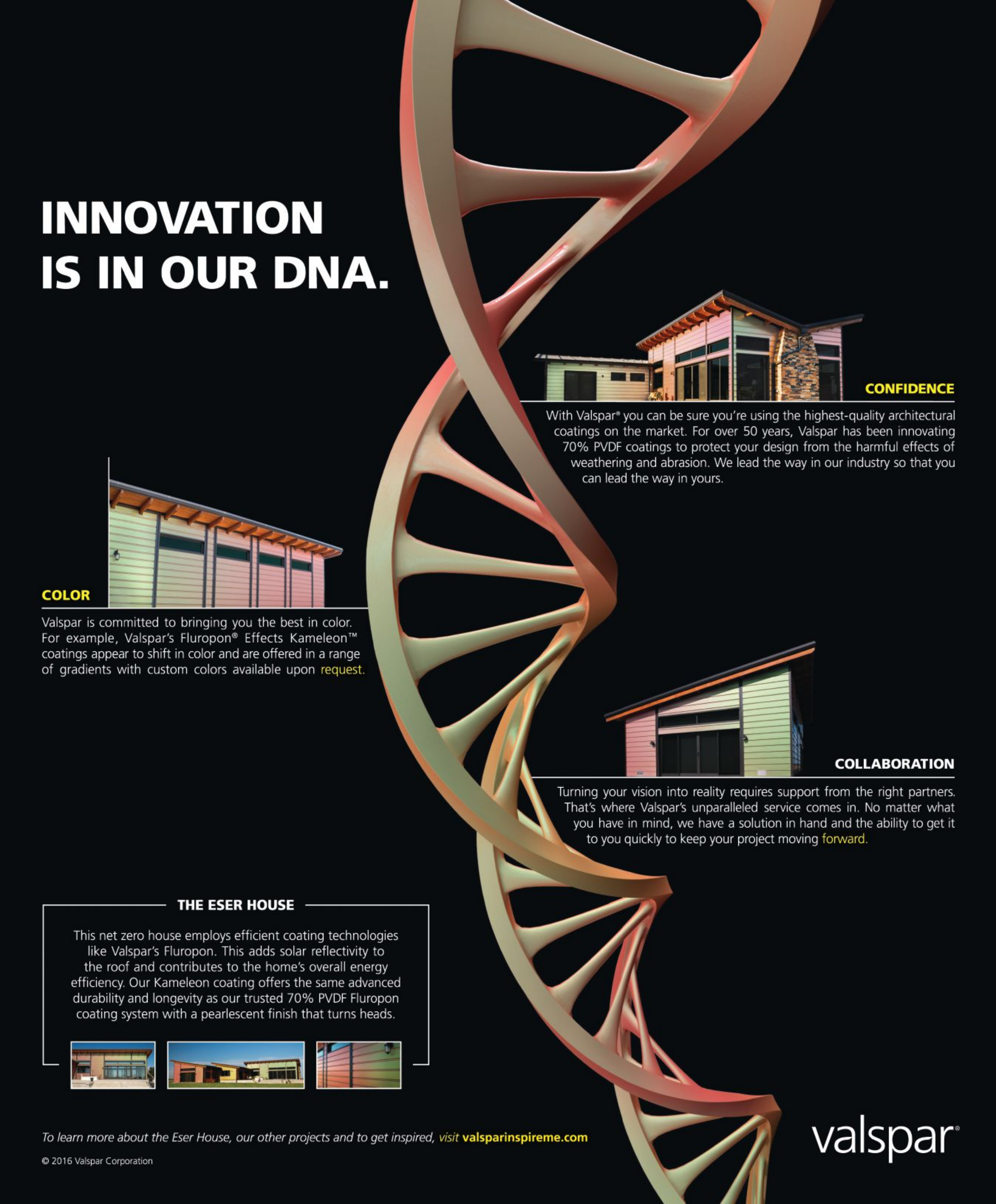
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AIA Architect

AIAVoices

PHOTOGRAPHY: CARL BOWER

Around the World and Back

From Syracuse to Ghana, a design advocate helps transform Birmingham.

Renee Kemp-Rotan, ASSOC. AIA, is the director of grants and special projects in the Office of the Mayor of Birmingham, Ala., and an urban designer who has traveled the world with an eye for architecture and social change. From studying mud-based architecture in Ghana to serving as Atlanta's liaison on the construction of Philips Arena and Centennial Olympic Park, she's been involved in nearly every type of building design imaginable. And it's all thanks to an AIA television commercial that ran several decades ago in Washington, D.C.

As told to Steve Cimino

I was at my grandmother's house during the summer before 12th grade, and noticed a television commercial that said, "The AIA is recruiting 20 African-American students interested in majoring in architecture." I wanted to be a fine arts painter, but my family of doctors, lawyers, and educators said, "No starving artists!" So architecture was the perfect compromise. I cannot put into words what the AIA's diversity scholarship did for my life. Architecture opened my eyes to the world.

I trained as an architect at Syracuse University—I was actually the first black woman to graduate from there, cum laude, with an architecture degree—but when I first arrived I was asked by students and faculty alike: "What the heck are you doing here?" The Syracuse International Studies Program saved my academic career. As an African-American woman, studying at the world-renowned Architectural Association in London for two years was life-altering. European culture was much more diverse, with more design opportunities than I would have ever imagined.

Ending up in Birmingham—after years in Atlanta as director of economic development and then chief of urban design and urban development—has given me an opportunity give back to diversity from the center of the civil rights movement. I came here to pay my respects to the memory of those who desegregated schools and helped me earn the opportunity to go to Syracuse.

My first major project was as director of master planning for Birmingham's Railroad Park. In the 1960s, the city was segregated; [then-Commissioner of Public Safety] Bull Connor shut down 61 public parks after Brown v. Board of Education so he would not have to desegregate them. Fifty years later, we now have 3,000 renters, a new baseball park, the Negro Leagues Baseball Museum, and the Rotary Trail as a result of this park, in this city where playing sports in a segregated park was once a life-threatening proposition.

And I'm here because of one AIA television commercial, one AIA scholarship, and one profession: architecture, the beloved mother of all sciences. AIA

AIANow

By Steve Cimino
Art Direction by Jelena Schulz

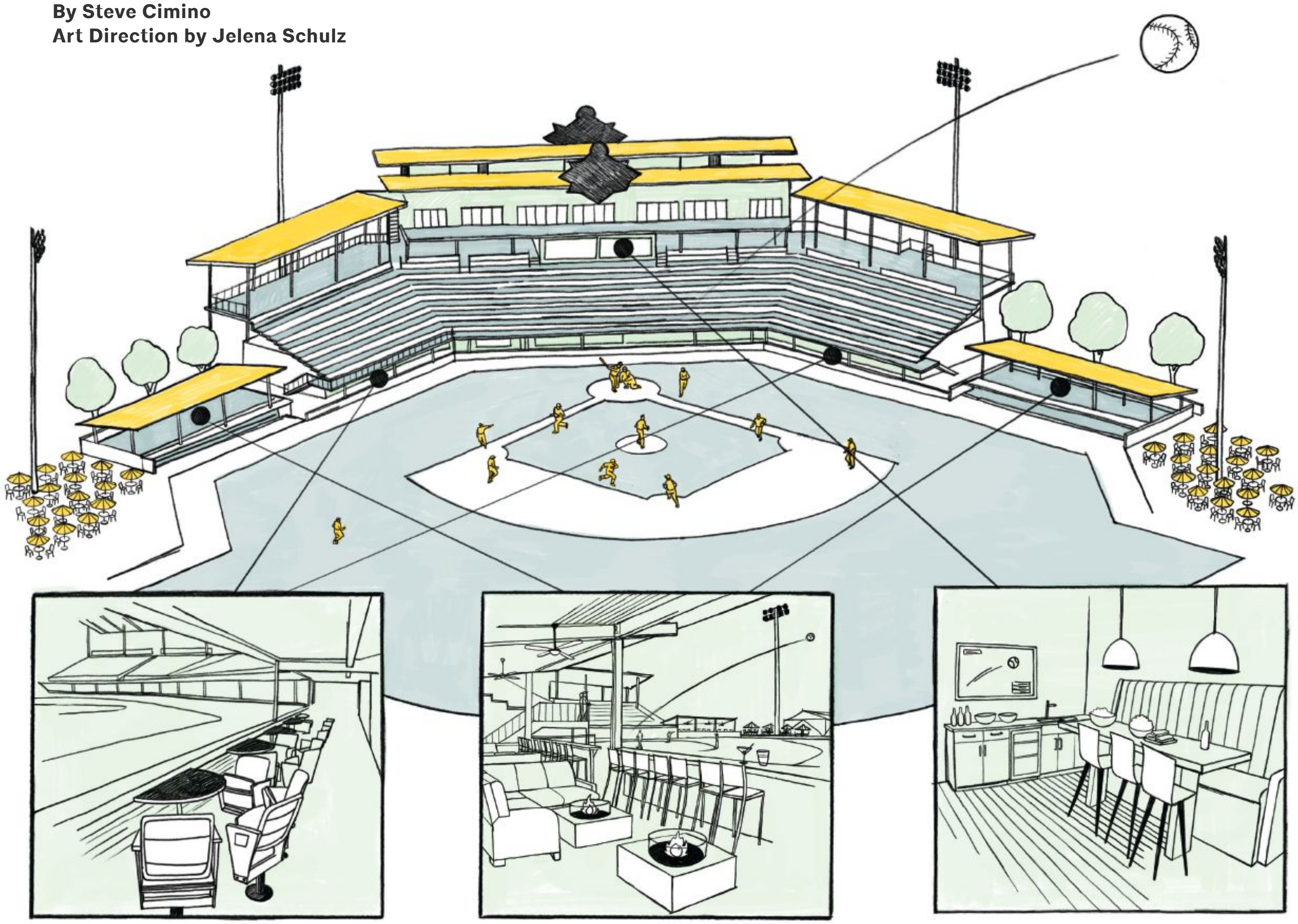

ILLUSTRATION: LAUREN NASSEF

A Stadium for Every Season

Jimmy John's Field in Utica, Mich., home of the Utica Unicorns, exemplifies a new era of smaller-scale, independently owned ballparks that evoke feelings of a bygone era while serving the distinct needs of their private owners.

"Sports franchises are no longer mom-and-pop operations," says Jonathan O'Neil Cole, AIA, founding principal of Kansas City–based Pendulum. "Many are owned by corporate conglomerates with multiple teams aimed more at profit than just goodwill. So we approach designing for them with a focus on economic sustainability; we design to a pro forma."

This means enough flexibility to incorporate opportunities for expansion and reconfiguration over time, and design decisions and sustainable systems that can last for dozens of years. Cole walks us through what factored into the creation of the Unicorns' $15 million home.

1. "What changed the stadium game? At the largest scale, Camden Yards in Baltimore, which opened in 1992. Suddenly it was a major no-no to have uncomfortable seats or sight line obstructions. It became more about the experience, which led to shifts in the baseball business model. This kind of thinking inspired our open-air, ADA-accessible Cabana Suites behind each dugout: comfortable seating, fire pits, buffet service, and a great location protected by netting."

2. "After the economic downturn, there weren't as many corporate sponsors buying suites and spending thousands of dollars on long-term leases. So we shifted our focus to small group areas and diversity in seating inventory. We encourage our clients to build smart and small, so we start with eight to 10 suites, plus party decks that can be converted to suites down the line, or a pavilion that can be modified. The important thing is to have the infrastructure in place."

3. "The term 'multiuse' used to mean stadiums that could be used for both football and baseball; now it means activating the space every day of the year, which is part of our initial design strategy. A ballpark is a unique backdrop, especially in a smaller town; you need facilities in place for community events, ADA-accessible concourses, facilities to accommodate hundreds of people, plus premium bars and legitimate catering areas."

AIAFeature

The Truth About Specification

A new report shines light on why architects favor certain materials over others, and why it matters for your architecture practice.

By John Schneidawind

ILLUSTRATION: MICHAEL KIRKHAM

Have you ever wondered why certain materials are used in buildings and homes more than others? Or why you always seem to see a specific manufacturer's brand of insulation, drywall, or exterior skin as you drive by a new development?

There's a reason, of course. It's called "specification." Whoever the architect is on that particular project is the one who has specified that particular material. But how or why an architect chooses a certain brand of product has always been a bit of a mystery, not only to the world outside of architecture but within the profession itself.

Now a major American Institute of Architects study sheds some surprising light on the issue. According to this research, what materials get specified for a project depends primarily on one factor: who you know.

That's one of the major takeaways from "The Architect Specification Journey: Understanding the Role of Building Product Manufacturers Today & Tomorrow," conducted by B2B International, an international market research firm based in White Plains, N.Y., in conjunction with the AIA, and published in November.

Relationships count big-time when it comes to the particular materials used in new construction, the AIA study found. Architects rely primarily on the existing relationships they have established over the years with building product manufacturers (BPMs).

"The majority of architects across the board will already know most of the time who they will specify, without doing any further research," says Nik Werk, manager of research for B2B. "That is huge news for BPMs. It speaks to the overall finding of this research, which is that it's an extremely relationship-driven market. There are some materials suppliers who know exactly how to do it and how to work it because they have those relationships and are pressed for time, so they often prefer to go with something tried and tested instead of spending time looking for new materials and products."

The AIA survey of 330 architect practitioners found that almost 60 percent of the time an architect already knows which materials manufacturer he or she is going to use. More than seven in 10 architects go with suppliers with whom they have an existing relationship.

"In other words, if you're a new supplier or a supplier looking to gain market share, you're going to have a really hard time getting in there with these specifiers," Werk notes.

Why is that? After all, one might naturally assume that if a building material or technology truly represents an advance, architects will flock to it like so many early adopters flock to the latest iPhone. Not necessarily so. That's because of, as the AIA/B2B research points out, a salient but often misunderstood fact: Most architects are professionally conservative.

The survey groups responders into three categories based on what the survey learned about the behavior and specification habits of architects as a group.

Forty-one percent are classified as "professionally conservative." They work at a non-core firm (any firm whose primary business is not just architecture—an architecture department within an engineering firm, for example) and are likely to be in an older age group (over 55). They are both male and female but less likely to specify products that are new to the market. They are less likely to be involved in "green" or LEED projects and more likely to be based in the Northeast and Midwest Census regions of the United States.

Thirty-three percent of those surveyed are termed "dynamists." They are significantly more male-dominated, younger, and more likely to work for a firm with an outspoken corporate culture.

Twenty-six percent of those surveyed are identified as "risk-takers." They work in firms with significantly more women. They have a mixed age demographic and are more likely to work for a multidisciplinary firm. And they are at firms with an environmental, outspoken, and experimental culture. They're also more likely to be based on the West Coast and work on up to four projects a year.

The more conservative-minded architects will likely never rely on environmental factors when specifying materials (preferring to rely on past experience). Architects who are greater risk-takers also value past experience, but they value environmental factors in a significantly higher way than their conservative counterparts. However, price matters deeply to all three groups.

What, then, is a manufacturer of a great building material product—but no existing relationships—to do? One answer, according to Werk, is to focus on the dynamists and risk-takers who together make up almost 60 percent of architect professionals.

The 40 percent of professionally conservative architects are more preoccupied with getting a project done on time and do not want to risk missing deadlines—"the process-driven, streamlined section of the market," as Werk puts it.

"The BPMs without the existing relationships should be targeting the risk-takers, and AIA findings allow those people to make those choices," he says.

There are still more obstacles facing innovative but unknown products and manufacturers seeking to penetrate an architect's consciousness. One is the very necessary (but sometimes considered boring) process that architects use to write specifications for projects. The survey found that only 26 percent write specs totally from scratch, while 57 percent copy and paste from previous specs. Because of time pressure, 16 percent reuse previous specs in their entirety.

The best advice Werk has for how to break into an architect's specification field of vision? Be an important source of information.

"BPMs are the second most important resource for learning about products and materials—after architects themselves—however, their influence varies," says Werk.

"Successful BPMs provide easy access to information, run good lunch-and-learns, and often help with spec writing. Others are passive, with cumbersome websites and poorly maintained product information."

The successful building product manufacturers are those who rank second in importance to the architect on any project, the survey shows. They often take part in writing the specs.

"If you take the architects, project managers, and designers, they make up three-quarters of everyone who'll ever be involved in a project," Werk says. "Architects are very open to the idea of BPMs being more of a partner, to providing trusted advice, and becoming more involved in the specification journey." **AIA**

AIA Practice

7 Ways to Lure the Best of the Best

For architecture firms to attract talent, its principals have to shed old assumptions.

What a difference eight years can make.

In 2008, the real estate bubble burst, the economy plunged into the Great Recession, and the architecture profession went into a deep spiral, with many observers wondering if it would ever recover. Architects nationwide were thrown out of work, credit evaporated, and projects were canceled en masse. Many young and promising but disenchanted professionals left the profession altogether.

Fast-forward eight years—an admittedly "slow" fast-forward for many—and a firm's well-being is as much about economic capital as it is about human capital. Thanks in part to the record-low interest rates that have financed huge construction projects, human capital—as well as raw and seasoned talent—is in high demand. Fees are skyrocketing, firms are expanding, and it's once again a seller's market for practitioners.

All of which makes a just-released survey of professionals by the AIA California Council, "Attracting and Retaining Talent," all the more relevant. Just as the profession itself has recovered, so has the ability for architects to choose not only where they work, but how much.

So it's no surprise that the survey of some 500 professionals found that today, more than ever before, a firm's future success depends on its ability to recruit—and retain—exceptional design professionals in architecture and closely related fields.

What Matters Most

Neither a firm's history nor its published design works seem to matter to prospective or current employees, the survey found. What matters is the firm's overall portfolio and what researchers call its "street reputation." Another notable finding is that work-life balance matters to young architects just as much as big paychecks and benefits in estimating their overall picture of employment.

"Attracting and retaining talent is a challenge when times get tough and when times get really good ... it's hard in both of those situations," notes Stephen Epstein, a consultant at Strogoff Consulting, which conducted the survey.

"When you have a recession, there are typically a lot of layoffs," says Epstein. "But when things get good again, the people aren't there to hire because they've left the profession, and people who are entrenched

ILLUSTRATION: MICHAEL KIRKHAM

start looking around for other opportunities. So retaining that very top talent is key no matter what the economy is doing."

"We see two issues that our industry is not adequately addressing," he says, "attracting and retaining talent, and providing the necessary training to our profession's future leaders."

Among the study's other major findings was that implementing a targeted recruitment and retention policy results in comprehensive operational benefits. Design professionals are also keenly interested in developing their leadership, business development, project management, and communications skills.

How to Attract and Retain

The findings lead to a series of recommendations by Strogoff, many of which are geared to attracting and retaining the young emerging professionals so crucial to maintaining a firm's collective imagination and focus. Among them:

1. Model work-life balance in their own lives and reinforce its importance in daily practice.

2. Place strong emphasis on leadership development training for emerging leaders and design leaders, as well as the firm's most senior leaders. This training should enhance traditional design leadership skills.

3. Ensure advancement by tailoring the organizational structure to create ongoing promotion opportunities worthy of pursuit by ambitious design professionals.

4. Develop a formal mentoring program specifically aimed at nurturing relationships between emerging designers and senior technical mentors.

5. Work with key employees to create a career development action plan, and then coach them throughout the plan's implementation.

6. Create a clear path for advancement by tailoring the organizational structure to create ongoing promotion opportunities worthy of pursuit by ambitious design professionals.

7. Create clear opportunities for assuming increasing levels of responsibility and cross-functional assignments.

"What was really interesting, and surprised me as one of the most important factors—not only to Millennials but all generations—was work-life balance," says Michael Strogoff, FAIA, founder of Strogoff.

"In my generation, people were much more willing to pull all-nighters, doing anything it took to work on good projects and get the experience," he says. "The younger generation is really committed to having a more balanced life." **AIA**

John Schneidawind

AIACollaboration

PHOTOGRAPHY: HENRY MCCOY

The Larkin Gibbs Memorial Pavilion was built by Arch 335 studio in spring 2014. It was the first project in the school's partnership with Medcamps and the winner of an AIA Louisiana Merit Award and Members' Choice Award. Learn more at *vimeo.com/187610691*.

The Power of Three Minutes

The winner of the AIA's I Look Up Film Challenge tells a short story with long-lasting impact.

Brad Deal is an assistant professor of architecture at Louisiana Tech University. He is also a filmmaker and the winner of both the Grand Prize and People's Choice awards for the AIA's recent I Look Up Film Challenge. His film, *Arch 335: Rebuilding Medcamps,* is the product of a lengthy collaboration with fellow professor Robert Brooks, ASSOC. AIA, and Medcamps, a nonprofit organization that provides free summer camp experiences to children with chronic illnesses and disabilities. In just three minutes and 30 seconds, Deal captures how design has impacted Medcamps' mission and how architecture's influence can lead to better lives.

As told to Steve Cimino

This film might be the first time liberal arts broke into the athletics world at Louisiana Tech. As voting for the Film Challenge's People's Choice Award was going on, they showed our film at a football game and urged the crowd to vote. It was just one specific example of grassroots community networking, something the university embraced and we're grateful for.

Arch 335: Rebuilding Medcamps is my first real film effort. I've always had an interest in photography, and the idea of making images in part powered my undergraduate days as an architecture student. Four years ago, when I started my teaching career and took over the design/build program at Louisiana Tech, I began to notice how others were documenting their projects. Other teachers had amazing video diaries on their websites, sharing their work in detailed fashion. I showed a few examples to my students and said, "We need to do a project that is worthy of videos like these."

That began the push to document everything we were doing. At the end of the project, I would collect their videos and their photos and put them together in a glorified slideshow. Over time—as I got more and more familiar with the editing software and we graduated to nicer cameras—the end product got better and better.

By the time the I Look Up Film Challenge came along, and when I saw the initial film on the outstanding work Rural Studio is doing in Alabama, we got the idea to enter ourselves. In fact, Karl Puljak, the director of our program, said, "You're already making these videos. So, why not put a little more effort and enter one into this challenge?" And now here we are.

Robert Brooks, my teaching partner, and I can stand up and speak about Medcamps for hours. We live it, we love it, and like most things that are done really well, it's a passion. In the three years that we've been working there, we kept saying, "We have to publish

AIACollaboration

"I hope anyone thinking about architecture watches our film and sees how design can create powerful solutions for all kinds of people."
—Brad Deal

this work somewhere." We would share it with colleagues in the architecture and design community, and they would say, "Why is this not out in the world?"

As a follow-up to our film's success, I was asked what I learned in the process. To be honest, I didn't learn much about architecture—I already spend my days teaching about that—but I learned the power of having a story bottled up in a three-minute package. It's incredibly accessible and perfect for getting the word out, having people embrace the power of architecture and design in a beautifully conducted way. In fact, the hardest part of the process was cutting eight hours of interviews and background details down to these few minutes.

A lot of credit for the way I've come to teach should go to my mentors, of which there were many, at the University of Texas at Austin. But in particular Steven Moore, who prioritized presenting complex ideas in plain language, and Stephen Ross, who turned every class into a life-changing experience, both had a strong impact on how I approach the work of our design/build studio. Those lessons have stuck with me, and I think they come through in the film that so many have embraced.

There are times when we interact with architects or design professionals who have worldwide influence, such as those who confront climate change for major cities or the federal government, and their mission seems so impressive. They're very far-removed from where the rubber meets the road, so to speak, but they have the potential to impact millions of people. It can make what we do feel small, but it can also reinforce the value in touching only 20 or 30 people but making such a deep imprint. I can only hope that these humble projects are planting the seeds in our students and our audience to aspire to accomplish things they truly believe in without getting bogged down in the complexities of the process.

One thing I share with my students: If you can't explain your project to your grandmother, you don't know it well enough yet. When it comes to the film, it is helping us take these smaller-scale meaningful projects to a larger audience. It's an exportable, accessible format, and thanks to the AIA it's been shared with people at all different stages of their careers.

I hope it's a reminder, for those who've been in the profession for a while, as to why they went this route in the first place. It should help us recall that we're here to solve the problems we see in the world. And I hope anyone thinking about architecture or design as a career watches our film and sees how design can create powerful solutions for all kinds of people. AIA

PHOTOGRAPHY: HENRY MCCOY

"Hero's Launch" is a fully accessible canoe and paddleboat launch designed and constructed by the 2016 Arch 335 studio. Drawing inspiration from Joseph Campbell's "Hero's Journey" narrative, this project has made adventure on the open water an accessible frontier for hundreds of campers since being built. Learn more at *vimeo.com/180056959*.

UNDERSTANDING HAZARD, EXPOSURE, AND RISK IN THE BUILT ENVIRONMENT

Presented by: American Chemistry Council

LEARNING OBJECTIVES

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

1. Understand the difference between "hazard," "exposure," and "risk "and their uses to inform material and product selection.
2. Describe the limitations of hazard-only assessment when selecting building materials and the benefits of including other factors beyond hazard in product decision making.
3. Identify appropriate tools and guidance materials for evaluating building products and materials to enhance the health, safety and welfare of the occupants.
4. Identify resources available that can help you evaluate exposure levels to ingredients in buildings products and materials.

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: ARDEC2016.5

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/AR1216Course5 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.

By Andrew Hunt

Every day, architects, builders, and other building professionals specify and use products that help them create appealing, durable, and functional homes, offices, schools, hospitals and other structures. Innovations in chemistry contribute greatly to developing building materials that help meet today's evolving needs. For example, high performance spray foam insulation helps improve buildings' energy efficiency; synthetic flooring in hospitals and operating rooms can be easily cleaned and disinfected; and plastic coatings added to metal roofing can protect the roof for years from corrosion and the physical impacts of storms and the elements.

While these innovations have tremendous benefits, there is increased interest around how building materials may affect the health of building occupants and the environment. Architects and other building professionals want to understand health and safety information about product ingredients and be able to make informed choices about the materials they select.

Balancing important factors like performance, durability, and aesthetics with health, safety, and environmental impacts can be a challenge. But an informed material selection process can help advance the health, safety and welfare of building occupants without sacrificing the quality and effectiveness of the building materials used.

This article will review basic concepts that could change how you look at materials and your materials specification processes. It begins with understanding the differences between hazard, exposure and risk or danger—the importance of considering product use and exposure and the limitations of using a hazard-only decision making process when selecting building materials. This article also will describe some tools, guidance and resources available for evaluating products and materials to help

achieve both a high quality construction project, and one that is safe for building occupants. Finally, this article will provide information to help you use building materials safely.

SECTION 1—CONSIDERING HAZARD, EXPOSURE AND RISK WHEN SELECTING BUILDING MATERIALS

Material selection is a critical aspect of the building design and construction process. The materials that comprise a building not only affect how the building looks and performs, but also can have an impact on the health, safety, and welfare of the people in the building. Increasingly, architects and builders seek to specify and provide clients with innovative materials that not only perform well, but also reduce the amount of resources consumed and improve overall health and environmental impacts.

Selecting the appropriate building materials can be a straightforward task with the proper information. But what information should building professionals consider before making a selection decision?

Defining hazard, exposure, and risk

When selecting a material or product for a building project, the core issue comes down to understanding the difference between hazard and exposure, and the relationship of both when it comes to informing risk or danger. So what goes into the determination that a material or product might cause or result in a negative impact on human health or the environment?

An easy way to think of the relationship is that a **hazard** is anything that might cause harm to a person because of some characteristic it has. **Exposure**, or contact, relates to the amount of or frequency with which a person comes in contact with the hazard. Think of exposure as "hazard in context" with use or another form of contact. **Risk** is the possibility of harm that may come from exposure to a hazard. Danger is a commonly used term to indicate risk. Alone, a hazard does not present a risk/danger unless there is contact, a level of exposure.

To put it in terms of a simple equation:
Hazard x Exposure = Risk

An example that illustrates this concept is exposure to sunshine, specifically the sun's ultraviolet rays. In temperate climates, ten minutes of direct sun exposure without sunscreen will likely not harm a person, and can be beneficial by providing a natural dose of Vitamin D. However, longer time spent in the sun—30 minutes, an hour or longer, might result in painful sunburn, and the risk of the negative effect—the sunburn—increases as the exposure time increases. Risk can also increase if the exposure is more concentrated—ten minutes of exposure in a very hot climate at the peak of summer may result in sunburn, and longer exposure will increase the risk. To take this a step further, repeated or severe unprotected sun exposure may lead to skin cancer.

We can look at chemical ingredients in building materials in a similar fashion:

- **Hazard** refers to the inherent properties of a chemical substance that makes it *capable of causing harm* to a person or the environment.
- **Exposure** describes the *amount, duration, and frequency* with which a chemical substance comes into contact with a person, group of people, or the environment.
- **Risk, or Danger**, then, is the *possibility of harm arising* from a particular exposure to a chemical substance, under specific conditions.

Evaluating hazards

In this article, we will consider two main types of hazards: human health and environmental. If direct human contact is anticipated, then questions related to human health hazards—also called the human health endpoints—are important. If direct human contact does not occur but the product or material is expected to be used or discarded in a way that impacts water, soil, outside air, or wildlife, then environmental hazards are key.

Table 1, below, provides a starting point for considering which hazards are relatively more important.

Table 1: Considering Human Health and Environmental Hazards

Hazard Endpoints	Human Health	Environmental
Chronic Effects: Cancer, Mutagenicity, Reproductive Toxicity (CMR), Target Organ Systemic Toxicity	✓	
Acute Effects: Skin, eye, or respiratory irritation, or sensitization	✓	
Chronic or acute aquatic toxicity		✓
Persistence or Bioaccumulation		✓

Scientists classify hazards based upon test results that address exposure to the chemical in its pure form. Some tests are designed to indicate chronic toxicity (longer term or recurring repeat exposure) or acute toxicity (a single or short term exposure). Generally, most chemical manufacturers are required to use the World Health Organization's Globally Harmonized System of Classification and Labeling (GHS), which provides a global framework for hazard testing, classification, and labeling. In compliance with GHS, manufacturers provide a Safety Data Sheet that identifies chemicals having a hazard classification. Most other declarations use a format similar to GHS to identify the chemical

(either specifically by scientific or by trade name) and its hazard class.

Although hazard classifications are determined based on an evaluation of the pure chemical, building materials and products may contain smaller levels of multiple chemicals that together make up the final product used in the building. Thus, the hazard of the pure chemical as classified may not apply to either the form or the level of the chemical present in the building product or material.

As an example, titanium dioxide in dust form is classified as an inhalation hazard, but when titanium dioxide is in wet form, as in paint, there is no inhalation hazard. In another example, formaldehyde in the concentrated gaseous form is an inhalation hazard, but at lower concentration levels, like that found in human breath, it is not. For these reasons, determining the form and the exposure level of an ingredient are important factors when determining danger or risk.

Limitations of hazard-only materials selection

Chemical hazard-based lists, often known as "red lists," are sometimes used to identify chemicals for reduction, phase out, or elimination.

When such lists are developed with scientific rigor and assignment of risk—based on a substance's use in a specific application—they can be a useful part of a risk-based chemical management program. However, "red lists" are often developed based on an evaluation of a chemical or substance hazard, without consideration of exposure to the chemical ingredient or how and why the ingredient is used in the product.

Moreover, some hazard scoring tools include production chemicals that have been used at some point during a product's manufacturing process but are not present in the final building product or material. For example, the chemical benzene, classified a human carcinogen, is used in the synthesis of styrene to make polystyrene, one of the most widely used plastics and deemed safe for a variety of food contact applications, such as coffee cups, plates and take-out containers. In this case, the chemicals used early in the production process are transformed into inert or benign molecules in the finished product.

To summarize, hazard assessment tools can provide useful information when used in conjunction with other information. But used alone, hazard may lead to poor product and materials selection decisions. Hazard needs to be put into the context of the product, how it is used and by whom.

Building on hazard to incorporate exposure

With the increased availability of materials disclosure information, decision makers have access to information about the ingredients and their hazard classification in building products and materials. Hazard information is important if it is likely that an ingredient in a building product or material could have exposure, i.e., human contact. Unfortunately, current disclosure forms often do not contain critical exposure information. A useful framework might ask: What is the product? Where is it used in the building? Is human contact expected during expected use? If so, what degree of contact is expected? For example, if the product or material is within the building envelope and direct contact with the building occupant is not anticipated, one might evaluate the material differently than if building occupants are in contact with the material on a daily basis.

Additional questions to ask include: 1) Is the ingredient reacted into the building product or material, or can it migrate out of the material? 2) Does the material have a physical barrier to limit or prevent human contact? 3) Does the material degrade over the expected service life of the material, allowing eventual ingredient contact? By thinking about the physical properties of the product, professionals may be able to answer these questions. If human contact is likely, then a hazard analysis for those ingredients is appropriate and informative.

Gauging appropriate exposure levels

Even with a variety of hazard information and tools available to help assess potential risk and provide guidance for safe use, practitioners may still seek additional guidance on determining appropriate exposure levels to specific chemical substances.

Safety thresholds play an important role in helping determine acceptable exposure to an ingredient or substance, and thus help determine the actual risk. In its most basic sense, a safety threshold is the point after which some degree of harm may result. It is important to realize that safety thresholds are set based upon an evaluation of the hazard of the ingredient, independent of use, and may include a number of factors that could lead to an overly low threshold for risk.

Several established safety thresholds can help when screening chemical ingredients. Acceptable Daily Intake (ADI), Maximum Allowable Dose Level (MADL), Reference Dose (RfD) and Reference Concentration (RfC) all provide useful information to screen whether the threshold of a chemical ingredient is acceptable or not without the need to more advanced assessment.

QUIZ

1. Which formula accurately portrays the relationship between Hazard, Exposure and Risk?
   a. Risk + Hazard = Exposure
   b. Hazard x Exposure = Risk
   c. Risk x Exposure = Hazard
   d. Hazard—Exposure = Risk

2. What is risk in exposure to a substance?
   a. The probability of harm
   b. The inevitability of harm
   c. The possibility of harm
   d. The presence of harm

3. How is exposure measured in a substance that comes into contact with a person, group of people, or the environment?
   a. Type and time
   b. Class and levels
   c. Detection and research
   d. Amount and frequency

4. What products are classified as a hazard?
   a. Ones that are capable of harm
   b. Ones that always harm
   c. Ones that should be avoided
   d. Ones that are always labeled in special packaging

5. What are chemical-based lists also known as?
   a. Red lists
   b. Yellow lists
   c. Orange lists
   d. Green lists

6. True or False: All chemicals listed on chemical hazard assessment tools are ones that are present in the end product.

7. True or False: Using single-attribute consideration, or lists, is an acceptable way to determine risk.

8. What does a LCA take into consideration?
   a. Chemicals present in the initial build
   b. End user chemical exposure only
   c. The environmental impacts of a product through its entire lifespan
   d. Chemical waste disposal

9. What are EPDs?
   a. Experimental Process Directions
   b. Extensive Parameter Diagnosis
   c. Electronic Performance Documents
   d. Environmental Product Declarations

10. What U.S. organization provides specific guidance around appropriate exposure levels to various substances?
   a. FDA
   b. OSHA
   c. EPA
   d. FERC

This article continues on http://go.hw.net/AR1216Course5. Go online to read the rest of the article and complete the corresponding quiz for credit.

WALL RETROFIT SOLUTIONS FOR EXISTING COMMERCIAL BUILDINGS WITH MASONRY CONSTRUCTION

Presented by:

LEARNING OBJECTIVES

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

1. Identify the primary reasons for retrofitting masonry walls in older commercial buildings.
2. Describe the evaluation process used to identify the top retrofit solutions for field testing.
3. Identify best practice recommendations for an energy efficient and cost effective retrofit.
4. Analyze potential energy savings and payback periods achievable from a retrofit.

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: ARDEC2016.2

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By Amy Wylie and Andre Desjarlais

WHY A MASONRY WALL RETROFIT?

A growing desire in the construction industry today is the retrofitting of older buildings by adding thermal insulation on the interior side of masonry walls. Internally insulating existing masonry walls requires effectively evaluating the performance of wall systems with respect to heat, moisture, and air flow across the assembly in order to avoid moisture problems and ensure durability.

Older buildings with brick walls are common in many northern U.S. cities. For example, one study indicated that 28% of the existing office buildings in the Philadelphia region have masonry construction. Most of these buildings were built prior to the 1980s and have masonry walls that are uninsulated. These buildings offer a good potential to achieve energy efficiency through effective wall retrofit strategies.

Let's look at a few other reasons a wall retrofit would be desired for commercial buildings with masonry construction.

Standard Component Retrofits Aren't Enough

Standard component retrofits such as HVAC or lighting upgrades present a limited scope for retrofit. This is because greater energy savings can be achieved when envelope retrofits are considered along with standard component retrofits. Integrated retrofits are essential to achieve more than 50% reduction in energy consumption.

Exterior Restrictions Create Demand for Interior Retrofits

An ideal solution would be to insulate masonry walls on the exterior. However, conditions such as historic preservation, space requirements, and zoning issues often require the walls to be insulated on the interior. The problem with adding insulation to the interior of an existing masonry wall is the potential of excess moisture and freeze thaw damage. To avoid this problem, an effective wall retrofit solution can potentially improve thermal performance and durability for the existing masonry wall systems.

Energy Goals Drive Need for Innovative Retrofit Designs

The Department of Energy (DOE) Building Technologies Office (BTO) has a goal to reduce building energy use by 50% by 2030. In turn, this goal drives the need for innovative wall retrofit solutions that will contribute to energy efficiency targets. To meet this need, the Consortium for Building Energy Innovation (CBEI) was formed to develop and deploy market-tested solutions for energy reduction in existing Small and Medium Sized Commercial Buildings (SMSCB). CBEI is a consortium of 14 member organizations funded through the DOE and led by Pennsylvania State University.

Plenty of Opportunities to Retrofit Old Brick Walls in Cold Climates

More than half of existing commercial buildings in the U.S. were built before 1980. This is a concern because a majority of the pre-1980s buildings with masonry construction are located in the northeast region of the U.S. Most of these old masonry walls are un-insulated. This presents a new market opportunity for retrofitting older masonry walls in American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) climate zones 4 and 5, which represent a majority of the northeast region of the U.S.

NEED FOR A MASONRY WALL RETROFIT CASE STUDY

While there are good reasons to develop integrated wall retrofit solutions, further studies are needed to evaluate the energy efficiency, cost effectiveness, and long term durability of different retrofit options prior to market deployment.

In order to achieve this objective, the CBEI targeted a few existing commercial buildings within The Navy Yard in Philadelphia as demonstration sites to deploy energy efficient retrofit technologies. One such project identified through the consortium was "Building A," a two-story, small commercial building with masonry walls constructed in the early 1940s. An integrated retrofit analysis was conducted for this building using energy modeling. This analysis looked at an energy efficient envelope (opaque and glazing), HVAC system and lighting system retrofit. Although the building owner appreciated this analysis, a change in the business strategy resulted in the owner not pursuing the proposed retrofit.

The analysis conducted through this project helped the team to realize the uncertainty associated with envelope retrofit projects and the difficulty in finding an ideal demonstration facility. The team identified the need to seek a risk-free environment to test wall assemblies to be able to provide validated field results. The intent was to use field results to accelerate adoption of envelope retrofit technologies in the market.

The "Integrated Wall Retrofit Solutions" project was funded through CBEI in response to this need. This project used the two-story Flexible Research Platform (FRP) at Oak Ridge National Laboratory (ORNL) as a test-bed to analyze wall retrofit scenarios for existing commercial buildings with masonry construction built before the 1980s.

The analysis conducted for "Building A" evaluated a large set of insulation materials. The results of this evaluation were used to narrow down the selection of insulation materials to a few energy efficient and cost-effective solutions. These down-selected retrofit solutions then formed the basis of evaluation for this project.

PROCESS USED TO EVALUATE POSSIBLE RETROFIT SOLUTIONS

Prior to the field test at the FRP, many wall retrofit scenarios were identified and vetted through an industry expert review. These scenarios were then evaluated against predetermined critical parameters using hygrothermal modeling and industry data. Three top-performing scenarios identified through this evaluation were constructed as mock-up walls and tested in the laboratory at ORNL for thermal performance and air leakage.

The laboratory test evaluations were then used to identify two top-performing scenarios, which were installed on the two-story FRP at ORNL. Field data was collected for one year, and the results were used to further refine the best-practice retrofit recommendations.

Let's take a closer look at the process used during the evaluation period of the "Integrated Wall Retrofit Solutions" project.

Identify and Vet Retrofit Scenarios

An expert review was conducted consisting of building science experts, contractors, and envelope consultants. The industry experts vetted a list of nine retrofit scenarios designed for the baseline wall assembly of the two-story FRP.

They also recommended categorizing the nine retrofit scenarios into three major types of retrofit construction:

Construction Type	Scenario No.	Scenario Description
Retain Existing Wall with Existing Insulation	1	Rigid PIR foam board (2") insulation with taped joints installed over existing insulation
Retain Existing Studs without Existing Insulation	2	Open-cell spray foam (6") insulation installed within existing studs
	3	Closed-cell spray foam (4.5") insulation within existing studs
Remove Existing Insulation and Studs	4	Blown cellulose (6") insulation
	5	Closed-cell spray foam (3.5") insulation
	6	Hybrid closed-cell spray foam (1.5") insulation and blown-cellulose insulation
	7	Hybrid closed-cell spray foam (2") insulation and blown-cellulose insulation
	8	Rigid PIR foam board (2.5") insulation with a separate air barrier layer
	9	Rigid PIR foam board (2.5") insulation without separate air barrier layer

Industry Expert Vetted Retrofit Scenarios Evaluated During the Project

- Retain existing wall with existing insulation.
- Retain existing studs without existing insulation.
- Remove existing insulation and studs.

The nine retrofit scenarios were designed to address the existing baseline for the FRP, which was built to represent the wall systems of a majority of the pre-1980s commercial buildings in the ten-county region around Philadelphia. The nine scenarios were then used to establish a matrix that allowed the team to evaluate and rank the scenarios according to expert vetted predetermined parameters.

Identify Parameters to Evaluate Retrofit Scenarios and Rank Them

The experts identified six critical evaluation parameters and assigned a weighted percent for each parameter:

- Cost effectiveness—35%
- Moisture management/durability—20%
- Thermal performance—18%
- Air leakage—12%
- Disruptiveness/constructability—9%
- Indoor air quality—6%

The nine retrofit scenarios were then evaluated against the six parameters and compiled in a final performance evaluation matrix to provide the overall performance for each scenario.

The top three scenarios in the matrix were then evaluated through the next stage. The three down-selected wall retrofit scenarios were Scenarios 1, 5, and 8.

Test Key Parameters in the Lab for Energy Modeling

The next stage of the evaluation process was to test the three down-selected scenarios, using constructed mock-up walls, in the laboratory at ORNL for:

- Thermal Performance (in accordance with ASTM C1363)
- Air Leakage (in accordance with ASTM E283)

The results obtained from the laboratory tests were then used as inputs for the energy modeling software to compute the energy savings and payback period for the three down-selected scenarios. The energy savings were computed against two baseline scenarios:

- Baseline 1: (Baseline without existing insulation) having an air leakage of 8 L/s.m^2 (1.6 cfm/ft^2) without any existing insulation (Baseline R-value: R-5).
- Baseline 2: (Baseline with existing insulation) having an air leakage of 8 L/s.m^2 (1.6 cfm/ft^2) and existing fiberglass batt insulation within steel studs (Baseline R-value: R-11).

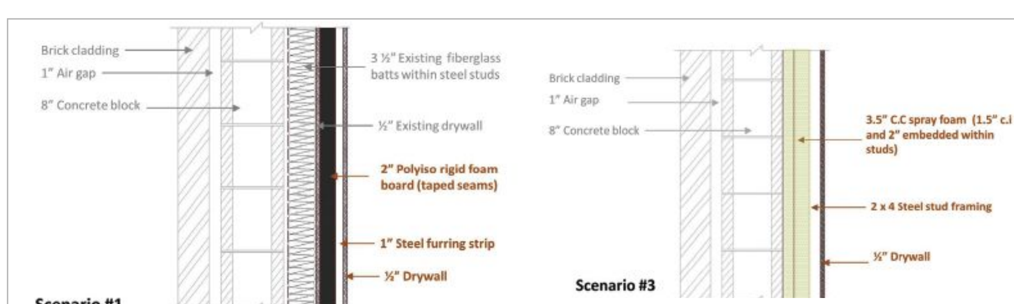
Based on the lab test results, the top two scenarios down-selected for field testing on the FRP at ORNL, were as follows:

- Scenario #1: Rigid PIR foam board (2") insulation with taped joints installed over existing insulation. Although this scenario was the most cost-effective, it is dependent on the condition of the existing insulation. Therefore, this scenario was termed as "good recommendation" or "most cost-effective recommendation."
- Scenario #5: Closed-cell spray foam (3.5") insulation. This scenario provided maximum energy savings based on laboratory evaluations and was termed as "best recommendation" or "most energy-efficient recommendation."

No.	Scenarios	Insulation type and thickness	Cost effectiveness	Moisture management	Thermal performance	Air leakage development	Disruptiveness/ constructability	Indoor air quality	Final ranking
A.	Retain existing wall (w/ existing insulation)								
1	Rigid polyiso foam board over existing insulation	2" rigid polyiso foam board	*high*	*high*	*high*	*low*	*high*	*high*	1st
B.	Retain existing studs (w/o existing insulation)								
2	Open-cell spray foam within existing studs	6" o.c. spray foam	*moderate*	*high*	*low*	*low*	*low*	*high*	
3	Closed-cell spray foam within existing studs	4.5" c.c. spray foam	*moderate*	*high*	*low*	*moderate*	*moderate*	*high*	
C.	Remove existing insulation and studs								
4	Blown-cellulose with a/b	6.0" blown-cellulose	*low*	*poor*	*high*	*high*	*moderate*	*high*	
5	Closed-cell spray foam	3.5" c.c. spray foam	*low*	*high*	*high*	*moderate*	*moderate*	*high*	3rd
6	Hybrid spray foam	2" c.c. SPF + .5" blown-cellulose	*low*	*high*	*high*	*moderate*	*low*	*high*	
7	Hybrid spray foam	1.5" c.c. SPF + 3.5" blown-cellulose	*moderate*	*high*	*high*	*moderate*	*low*	*high*	
8	Rigid polyiso foam board with a/b	2.5" rigid polyiso foam board	*high*	*high*	*moderate*	*high*	*high*	*high*	2nd
9	Rigid polyiso foam board w/o a/b	2.5" rigid polyiso foam board	*high*	*high*	*moderate*	*low*	*high*	*high*	

Final Performance Evaluation Matrix

A wall air and moisture penetration test chamber and a rotatable guarded hot box were used in the laboratory to test full-scale assemblies.



The two retrofit scenarios, down-selected for field demonstration through this project, were installed in two of the eight zones in the FRP.

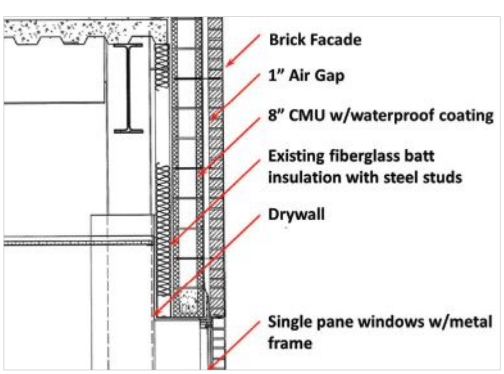
After the laboratory tests were completed, the two top-performing scenarios were installed in the two-story FRP at ORNL to collect field data.

HOW RETROFIT SCENARIOS WERE PUT TO THE TEST IN THE FIELD

After the laboratory tests were completed, the two top-performing scenarios were installed in the two-story FRP at ORNL to collect field data. The purpose of the field test was to analyze the field performance and constructability for both retrofit scenarios.

The baseline wall assembly of the FRP was built to represent the typical wall assembly for a majority of the existing commercial buildings built before 1980.

The FRP is divided into eight zones with four zones on each floor. Each zone has the capability to be monitored separately.



Retrofit scenarios were designed to address the existing baseline for the FRP. The baseline envelope system for the 2-story FRP was built to represent the wall systems of a majority of the pre-1980s commercial buildings in the ten-county region around Philadelphia.

The two retrofit scenarios, down-selected for field demonstration through this project, were installed in two of the eight zones in the FRP. The chosen zones were:

- Northwest zone on the first floor—installed with the energy efficient Scenario #5 closed-cell spray foam (3.5") insulation.
- Northwest zone on the second floor—installed with the cost-effective Scenario #1 rigid PIR foam board (2") insulation with taped joints installed over existing insulation.

QUIZ

1. One of the primary reasons for retrofitting masonry walls in older commercial buildings is that the Department of Energy has a goal to reduce building energy use by ____ by the year 2030.
   a. 10% b. 30%
   c. 50% d. 60%

2. True or False: Another primary reason for retrofitting masonry walls in older commercial buildings is that standard component retrofits, such as HVAC or lighting upgrades, have limited energy savings.

3. The first step in the evaluation process to identify the top integrated wall retrofit solutions for field testing was:
   a. Identify and vet retrofit scenarios b. Identify parameters to evaluate retrofit scenarios
   c. Rank the retrofit scenarios

4. True or False: A total of seven masonry wall retrofit scenarios were identified and vetted through an industry expert review.

5. Of the six critical parameters identified for evaluating the retrofit scenarios, which one was given the heaviest weight, in terms of importance, at 35%?
   a. Thermal performance b. Cost effectiveness
   c. Air leakage

6. True or False: Two key parameters, thermal performance and air leakage, were tested in the laboratory at ORNL to evaluate the top-ranked retrofit scenarios.

7. The baseline wall assembly of the Flexible Research Platform was built to represent the typical wall assembly for a majority of the existing commercial buildings built before _____.
   a. 2010 b. 2000
   c. 1990 d. 1980

8. True or False: Based on field test results, the rigid PIR foam board (2") insulation (with taped joints installed over existing insulations) is a recommended best practice for masonry wall retrofits in older commercial buildings.

9. One of the best practice recommendations to retrofit masonry walls is the closed-cell spray foam (3.5") insulation. One reason for this recommendation is that it offers a ______ R-value/inch compared to conventional insulation materials.
   a. low b. medium
   c. high

10. True or False: Estimated payback periods were evaluated for compliance against the previously defined metrics for the integrated masonry wall retrofit project.

This article continues on http://go.hw.net/AR1216Course2. Go online to read the rest of the article and complete the corresponding quiz for credit.

SPONSOR INFORMATION

AIR BARRIER APPLICATIONS UTILIZING INSULATED METAL PANELS

Presented by:

Image courtesy of MBCI

LEARNING OBJECTIVES

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

1. Recognize when a dedicated air barrier is appropriate and when assembly approaches are the preferred solution.
2. Learn which wall and roof assemblies work best in different climates and which can be used universally.
3. Review the best approaches to mitigating thermal bridges when using assembly approaches.
4. Learn when vapor barriers can double as air barriers and when they cannot.
5. Recognize the conditions and applications where a radiant barrier is useful.

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: ARDEC2016.3

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By Matt Sisul, PE

COURSE OVERVIEW

This course provides guidance for architects and builders on design and installation considerations relating to the use of insulated metal panels and their suitability as the air barrier assembly of a building envelope. Topics covered include an introduction to air barriers and insulated metal panels, as well as an overview of code and regulatory requirements when designing for energy code compliance and common design and installation practices and techniques.

This lesson should serve as a refresher for architects and builders on the subject of building enclosures, including their fundamental functions, how they are employed in building construction, and their component parts, with special focus on air barriers. The practicing architect or builder often has end-to-end responsibility for a project from conception to execution. There is generally a wide variety of building products available for construction, although the selection of the materials that comprise the exterior may be constrained by the local environment and climate, the building's function, the budget and the vision of the architect, builder, or owner.

With the aid of this lesson, architects and builders will be armed with increased knowledge regarding enclosures and their component parts, the various options available, the relative advantages of insulated metal panels, particularly under certain circumstances, and key specifics and guidelines for specifying metal panels for code conformance.

INTRODUCTION TO BUILDING ENVELOPE BARRIERS

Advances in building materials over the last century have revolutionized architects' and builders' relationship with buildings. At the turn of the 20th century, the architect/builder had limited options for materials, and the concept of using multiple materials to achieve optimal construction had not yet come into being. Thus, a wood building was made of wood, and a stone building was made of stone. The material selected thus served both as protection from the elements and support for the weight of the building itself. This was true whether or not the material selected was the best material for these specific and very different tasks. The invention of new materials led to innovations such as steel framing and reinforced concrete, but with these innovations came product specialization and the ability to tailor choice of material to specific tasks, such as structural support, protection from sun, air, rain and vapor, and insulation. Over time, building enclosures have continued to improve as an increasing array of new materials have been added to the available options.

In modern construction, the concept of the enclosure has been deconstructed into specific functions such that the architect/builder can handpick different materials that will best fulfill those functions. At this basic level, a building's enclosure requires:

- Cladding to protect the building and enclosure from solar radiation, wear and tear, impact, etc.
- Moisture control that keeps out both liquid water and water vapor.
- Air control that prevents unwanted airflow into the building, which often affects thermal comfort or conveys moisture.
- Structure to hold up the enclosure and give it shape.
- Thermal control to ensure buildings stay cool in hot climates and warm in cold climates.

These requirements are referred to as cladding, control layers, and structure.

A CLOSER LOOK AT CONTROL LAYERS

The rules of thermodynamics as they apply to buildings are (very broadly) as follows:

- Heat tends toward cold;
- Wet tends toward dry; and
- Air tends from high pressure to low pressure.

The control of air, water and heat is important to the architect and builder for many reasons. Foremost is protecting the buildings' structural integrity. Water infiltration into a building over time will lead to a number of structural problems, depending on the materials used in the building. Water will cause rust in steel members and steel reinforcement. Rust in steel reinforcement can cause concrete or masonry to spall or break out. Water on wood can cause rot, and water in general on surfaces can promote the growth of mold, which can be a health hazard to occupants and potentially affect the structure itself. Water and air can enter a building through the same openings, and, in addition, water can enter through air in the form of water vapor, so it is important to protect against both. Temperature plays a role too, as temperature differentials from inside and outside air can promote condensation inside the building enclosure.

Water, air and temperature controls directly affect the comfort of the building's occupants. Excessive heat or cold, humidity or mold can render a space unusable by the building's occupants. Adequate control layers defend a building against comfort issues, although a building's comfort is typically controlled primarily by the heating, air conditioning, and ventilation system (HVAC). Buildings employ mechanical and electrical means for controlling occupant comfort, and adequately installed control layers work with the HVAC.

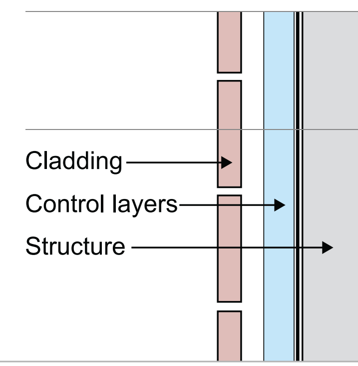
There is much discussion within the building community about the general relationship between control layers and HVAC. In many office buildings, discontinuities or gaps in the control layers lead to excessive use of HVAC energy. A building may have a tight seal preventing air and moisture, but limited insulation, leading to inefficient HVAC operation. Tall glass office buildings with windows of limited insulation result in excessive heat increases when the sun is shining.

The HVAC is necessary even when the control layers are properly designed and installed to create a seal against outside elements. A properly sealed building allows in very little outside air. As a result, the HVAC systems of commercial buildings are designed to bring in outside air to prevent the interior air from becoming stale over time and possibly developing an unpleasant odor. The unit also conditions the air to match the interior environment prior to introducing it. This may seem counterintuitive, however modern HVAC units are designed to do this in a very energy-efficient manner using a special piece of equipment called an economizer. A building with a leaky envelope short circuits this operation and leads to poor interior conditions as well as energy inefficiency.

The Proper Arrangement of Control Layers

Control layers are typically placed between the exterior cladding and the interior structure of a building's enclosure. While there are exceptions to this arrangement, for example glass curtain walls, the principles remain the same and the various components of the enclosure are still represented.

Figure 1



Components of a building enclosure/wall assembly.
Image courtesy of MBCI

The cladding is the outermost feature of the enclosure, as it protects against solar radiation, impact, wear and tear, and debris.

The water, air and vapor control layers are all located behind the cladding and outside of the structure. These three control layers are inside of the thermal insulating control layer. The thermal control layer is outside other control layers in order to properly function in all environments. The arrangement ensures that, in cold climates, the vapor control layer is the same temperature as the interior space, preventing condensation. This is true in hot climates as well, and there is also the added benefit that any condensation that does occur will occur on the outside face of the vapor barrier, where it can be drained, thus protecting the structure.

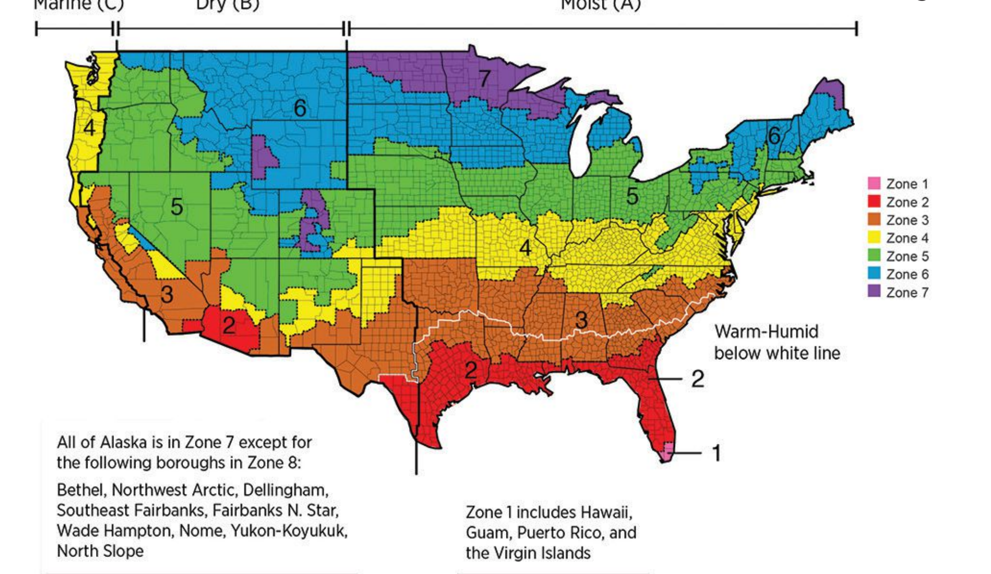
Control Layer Requirements by Climate

Buildings should suit their local environment or climate. When designing or selecting control layers, care should be taken in considering how the materials selected will perform in the local environment. For the convenience of designers, all counties in the United States are organized into a limited number of climate zones, which determine code requirements. By limiting the variety of climate zones, designers can quickly identify control layer requirements and select proper building materials. The two main factors considered in determining climate zones are temperature and moisture.

Average temperatures vary, generally increasing from north to south, but high and low temperatures also vary throughout the year, so the main consideration is cooling degree days, or number of days per year where the average temperature exceeds a given temperature. Cooling degree days are directly related to the amount of energy required to keep a building cool, so, intuitively, it makes sense that regions with a higher number of cooling degree days would require additional insulation. However, areas with a lower number of cooling degree days are typically quite cold in the winter, so insulation requirements are high in those regions as well. It is actually regions in the middle, with mid-range cooling degree days and relatively mild winters that require the least amount of thermal insulation.

Climate zones are also organized by moisture level. There are three major categories: moist, dry, and marine. Moist zones are common throughout the eastern half of the country and include areas with either high humidity or heavy rainfall. The moist zone is further divided into typical moist, which is north, and warm-humid moist, which is south. There are special considerations in warm-humid moist zones around vapor and condensation control that differs from northern climates. Dry zones are found in the western mountainous regions and marine areas are on the west coast. The International Energy Code Council has produced a map of climate zones that can be used by designers when selecting control layer requirements.

Figure 2



International Energy Conservation Code Climate Zone Map. Image courtesy of IECC

DIFFERENT TYPES OF BARRIERS/ CONTROL LAYERS

Water Barrier

It is essential that water that has made it past the exterior cladding of a building does not further penetrate the assembly. Materials that perform this function are considered water resistive barriers. These may be mechanically fastened building wraps, fluid applied membranes, cellular plastic, self-adhered, building paper, or any other material designed to resist water in its liquid form. They are used with flashing or other supporting materials to achieve a shingled effect that routes water away from exterior sheathing.

There are three methods of testing a material's water resistance. These include the boat method (ASTM D779), the "water ponding" method (CCMC 07102 section 6.4.5), and the hydrostatic head method (AATCC 127).

Air Barriers

A continuous air barrier, without gaps or discontinuities, is required to properly prevent air passage. Materials that perform this function are referred to as air barrier materials. A wide variety of materials can serve as air barrier materials, including mechanically fastened building wraps, self-adhered membranes, fluid-applied materials, insulating boardstock, non-insulating boardstock, spray polyurethane foam, poured concrete, metal and glass. Air barrier materials can be used anywhere in a building assembly where it is necessary to stop air movement into or out of a space. An air barrier accessory provides a seam between adjacent air barrier materials. Air barrier assemblies are the collection of air barrier materials that, together, control air movement.

Air can move through a material itself (air permeance) or through holes or gaps in a material (air leakage). The air permeance of a material determines whether it is appropriate to use as an air barrier material.

Vapor Barriers

Materials that reduce the movement of water vapor are vapor barriers. This is largely dependent on the thickness of the material. A vapor barrier can be a mechanically fastened sheet-material, some self-adhered membranes, fluid-applied materials, insulating boardstock or medium density spray polyurethane foam. The location of a vapor barrier in an assembly is dependent on climate. They are installed on the warm side of the insulation; in warm climates, this is the exterior, while in cold climates, it is the interior. Many, but not all, air barriers often function as vapor barriers.

AIR BARRIERS

- **Continuous air barrier:** air barrier without gaps or discontinuities, required in order to properly prevent passage of air
- **Air barrier material:** primary element providing continuous barrier to the passage of air
- **Air barrier accessory:** an air barrier component that connects adjacent materials
- **Air barrier assembly:** a collection of air barrier materials, accessories and auxiliary materials applied to walls, joints, and junctions to control air movement

In mixed climates, it is not always clear where the vapor barrier should go. Unless a building is cooled to an extreme level, like a refrigerated building, the wintertime approach of having the vapor barrier inboard of the insulation should be used in mixed climates.

In general, air barriers are designed to resist air movement across their surfaces when subjected to relatively high pressure differences, such as those created by wind blowing against an exterior wall. However, air barriers are generally not airtight materials per se. They are typically fibrous materials treated with polymers. Using fibrous materials allows the building envelope to breathe under small pressure differentials to allow any moisture trapped behind the barrier to dry.

Conversely, vapor barriers are designed to resist migration of water vapor across their surface. This migration is driven not by wind but by the vapor pressure of water, which is very small compared to air pressure differentials created by wind. Thus, vapor barriers are generally airtight materials such as polyethylene, which is why they can double as air barriers when used with certain types of insulation. This is a common approach used with closed-cell rigid foam boards (provided the joints are sealed) and IMPs, eliminating the need for a dedicated air barrier. However, this is a poor approach when using fiberglass batt insulation because air driven into the insulation greatly reduces its effective R-value.

Insulation

Thermal insulation is a material with low thermal conductivity that reduces energy consumption by preventing heat gain and loss through the building envelope. Typical materials are fiberglass, cellulose, polystyrene or polyurethane.

Radiant Barriers

Radiant barriers are materials that reflect, rather than absorb, infrared radiation. Radiant barriers are not insulation; they have no inherent R-value. However, they can be used in conjunction with insulation and air cavities to reduce transmission of heat in the form of infrared radiation. Thus, an assembly with an incorporated radiant barrier will transmit less energy overall. However, they will conduct heat so they should be installed on the cold side of an air cavity with as little physical contact with other materials as possible. This makes them ideal for attics and cavity walls to reduce cooling costs.

TYPES OF ASSEMBLIES

An assembly is a collection of materials incorporated into a single product consisting of cladding in addition to all control layers. Assemblies may be constructed one layer at a time on site, or they may be prefabricated and sold as a single unit consisting of multiple layers. Each layer is made of a different material; however, it is common for layers to repeat within a single assembly.

This article continues on http://go.hw.net/AR1216Course3. Go online to read the rest of the article and complete the corresponding quiz for credit.

QUIZ

1. The idealized arrangement of control layers in the building envelope is:
   a. Cladding, Structure, Insulation, Air/Water/Vapor Control Layers
   b. Structure, Cladding, Insulation, Air/Water/Vapor Control Layers
   c. Cladding, Insulation, Air/Water/Vapor Control Layers, Structure
   d. Cladding, Air/Water/Vapor Control Layers, Insulation, Structure

2. According to the IECC climate zone map, Chicago, IL is located in which climate zone?
   a. Zone 2
   b. Zone 3
   c. Zone 4
   d. Zone 5

3. How might a vapor barrier differ from an air barrier?
   a. Air barriers do not allow air to pass through while vapor barriers are water proof
   b. They are the same thing
   c. Air barriers resist air movement across the surface but allow the building envelope to breathe and dry
   d. Vapor barriers are both water tight and air tight
   e. c and d

4. Insulated Metal Panels are considered pre-manufactured assemblies because:
   a. They are previously manufactured components assembled on site
   b. They are manufactured of various materials and delivered to site as single units
   c. They are multiple layers assembled one at a time on site

5. Common control layer issues avoided by proper installation of Insulated Metal Panels include:
   a. Dew point within the building envelope
   b. Air gaps in the building envelope
   c. Thermal bridging
   d. All of the above

6. Why is the dew point a concern to designers?
   a. Dew collecting on the building surface may migrate into the structure in the pre-dawn hours
   b. Warm air on the interior of a building will condensate when in contact with a cool surface, leading to moisture build up
   c. Warm air on the exterior of the building may collect on the vapor barrier of an air conditioned building
   d. All of the above

7. According to the IECC and ASHRAE 90.1, which test corresponds to the strictest limits in terms of cubic feet per minute per square foot of wall area (cfm/ft² at 1.57 psf)?
   a. Air Barrier Material Testing
   b. Air Barrier Assembly Testing
   c. Air Barrier Whole Building Testing
   d. Air Barrier Component Testing

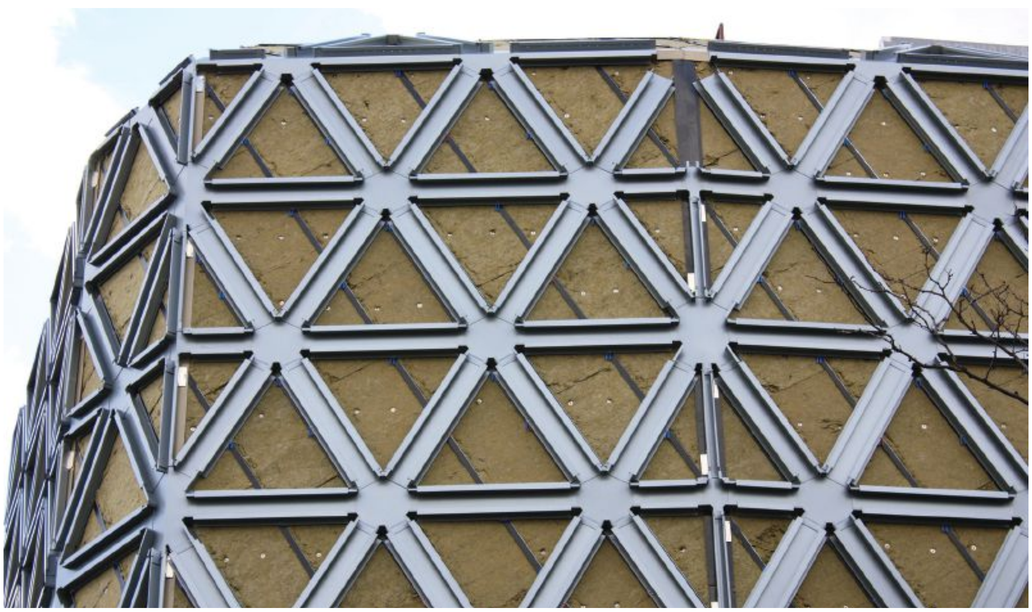
8. Insulated Metal Panels allow for faster construction because:
   a. They do not require iterative application of materials
   b. They can be assembled by fewer tradesmen
   c. a and b
   d. None of the above

9. How is thermal bridging avoided between adjacent IMP roof panels?
   a. Standing seam
   b. Exterior seal and interior seal
   c. Direct contact between thermal control layers

10. Which of the following is considered an "out-of-plane" discontinuity?
    a. Seam between panels
    b. Pipe penetrating through panel
    c. Window opening
    d. Interface between wall and roof

DESIGNING FOR ENERGY PERFORMANCE

Presented by:



LEARNING OBJECTIVES

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

- Identify the current code requirements related to energy performance of buildings.
- Determine the differences between prescriptive and performance requirements.
- Strategize how to best meet the intent of the code based on site specific conditions.
- Understand the roles that insulation, air barriers, and vapor retarders serve in energy performance.

CONTINUING EDUCATION

CREDIT: 1 LU/HSW

COURSE NUMBER: ARdec2016.6

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/AR1216Course6 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.

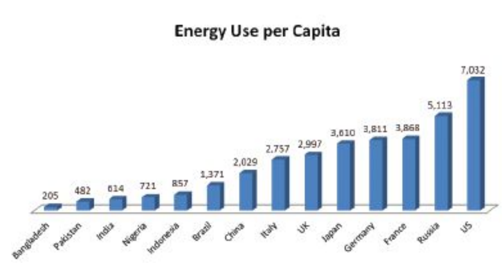
By Peter Babaian and Ken Lambert

INTRODUCTION

Most, if not all, architects and contractors are aware of the strong push being made over the past several years towards greater energy efficiency and a reduced carbon footprint in the United States. Worldwide geopolitical pressure has helped to steer the U.S. in this manner, as it is often noted that the U.S. uses more energy than any other nation per capita.

One specific example of this directive is Executive Order 13514, signed in 2009, that mandates that federally-owned buildings drastically improve their energy efficiency by the year 2030. The U.S. government is the largest consumer of energy in America and has roughly 500,000 buildings; most of these buildings are not energy efficient. Many states and cities have followed suit for their own public properties.

For the past decade plus, energy codes continuously increased their requirements for energy efficiency of buildings to reduce the estimated 40 percent total energy consumption in the United States related to the building stock. Codes began by increasing insulation requirements and recently added an air barrier requirement to reduce air leakage of conditioned air. As more and more states adopt the latest I-Codes, these requirements will become ubiquitous.

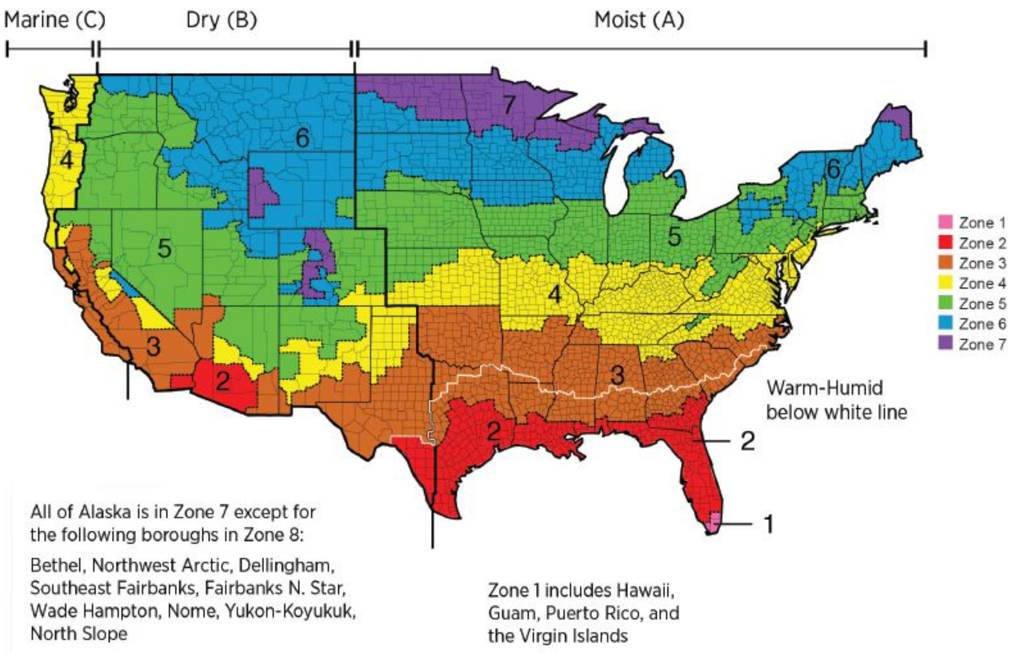


The U.S. uses more energy than any other nation per capita. Image courtesy of Wikimedia Commons

The codes include prescriptive and performance requirements; however, the prescriptive requirements are what most designers utilize. Following the prescriptive requirements without consideration of the environmental conditions, both exterior and interior, can result in unintended consequences for wall and roof systems. Misuse of air barriers and vapor retarders can result in unintended system deterioration. "Systemization," having an understanding of, and specifying the performance of, the entire system is essential. This article will discuss the current state of the code requirements, both prescriptive and performance, as well as when prescriptive requirements may result in inadequate system performance.

FACTORS AFFECTING ENERGY PERFORMANCE

Many factors affect the energy performance of buildings. For this course, we will highlight several other factors besides the building enclosure that should be included as part of the design consideration and how they interact



International Energy Conservation Code Climate Zone Map—Energy consumption necessary to maintain comfortable ambient indoor temperatures and humidity levels will vary based on region. Map courtesy of IECC

with the building enclosure. We will then cover the building enclosure in more detail.

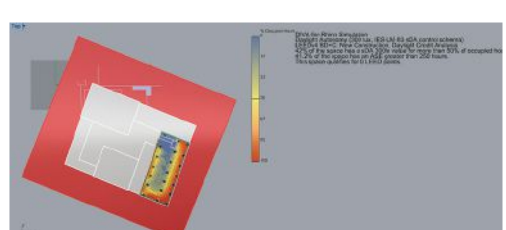
Location and Climate Zone

Location, and more specifically climate zone, is the first key step in proper design for buildings. ASHRAE (American Society for Heating, Refrigeration, and Air-Conditioning Engineers) publishes a US climate zone map, adopted into the International Energy Conservation Code. Energy consumption necessary to maintain comfortable ambient indoor temperatures and humidity levels will vary based on region. The same building with the same design, construction, and enclosure solutions in Texas will perform differently when placed in North Dakota. So all buildings must be designed based on location-specific climate information. Locales where the climate is nearly perfect year-round, such as San Diego, should result in less energy use for buildings. Of course, since we cannot all live in San Diego, we need to adapt our building enclosure to the specific location of the country.

Siting

Siting can have a major impact on the building's energy performance. Buildings at elevation, in locations of high wind exposure, subject to direct sunlight, etc., can require more energy to operate. Utilizing natural surroundings to shelter buildings or balancing the exposures can

Siting can have a major impact on the building's energy performance. Photo courtesy of de Oliveira Castro Arquitectos



Where the building faces in relation to the arc of the sun, and how this relates to the length and size of roof overhangs, can make a significant difference. Image courtesy of Simpson Gumpertz & Heger

be very beneficial in reducing energy use. For instance, daylighting can reduce a building's need for energy to power lighting systems. However, it can also lead to solar heat gain and increased cooling loads. But done in a cold environment, this can also result in lower heating loads. The building enclosure solution needs to account for these possibilities and balance the competing requirements.

Where the building faces in relation to the arc of the sun, and how this relates to the length and size of roof overhangs, can make a significant difference. The specialization of passive solar heating, for example, intertwines with all of these listed energy efficient subcategories.

Lighting

Lighting is often the most significant energy load in a building. The lighting system selection is critical to energy usage. In existing buildings, it is often the easiest place to find energy savings by switching from energy intensive fixtures, such as incandescent light bulbs, to compact fluorescent lamps to light emitting diodes (LEDs). In new buildings, the need for lighting can be significantly reduced by siting the building in such a way as to allow for significant daylighting to the interiors. The building enclosure design, as previously mentioned, needs to consider the opportunity for daylighting the interior and accommodate it accordingly.

Mechanical Systems

A multitude of mechanical systems exist for mechanical engineers to design for a building, including boilers, chillers, heat pumps, and packaged units, just to name a few. These systems can have variable fuel sources, efficiencies, and controls that can affect their performance and energy consumption. In addition, they are sized based on certain assumptions made by mechanical engineers, including the overall thermal performance and expected air leakage of the building enclosure. As a result, a building enclosure solution that does not perform as well as expected can result in a mechanical system that cannot perform, resulting in wasted energy and money.

It is critical that the architect, the overall building designer of record, takes into full account the planned mechanical design—which typically will come from a 3rd party MEP engineer. In some cases where there is not adequate communication and crosschecks between these two professionals, unforeseen building problems can arise.

In either case, be wary of circumstances, especially in MEP design/build projects, where a HVAC subcontractor and/or HVAC equipment supplier is fully designing the building's system. In both cases, this "designer" has a direct incentive to sell and install larger equipment—which may not be needed and could in fact be a waste of energy.

Building Enclosure Solutions

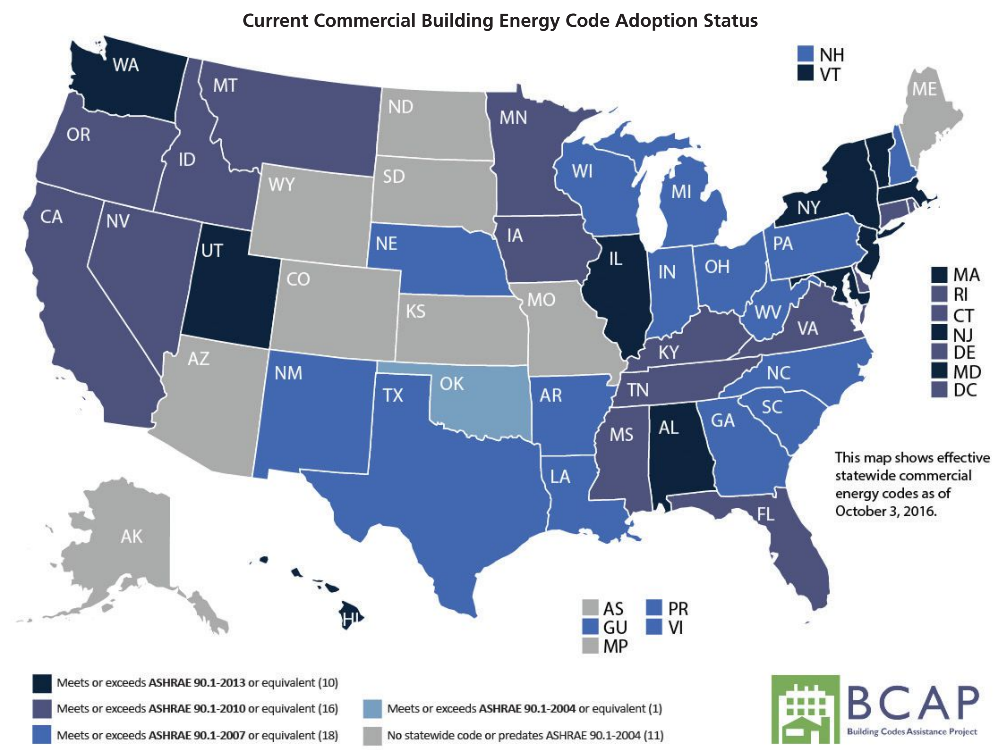
Finally, the building enclosure itself has an impact on the energy performance of the building based on its interactions with the other factors mentioned above as well as its own design and performance. A building that is 250 years old will perform differently than a building designed and constructed in the 1970s or something more contemporary currently in design or construction. Over the years, the industry has moved from heavy, bulky buildings with little to no fenestrations through the enclosure and minimal roof insulation to lightweight and open buildings with a lot of glass and significant amounts of roof insulation.

Glass alone is an enormous factor when it comes to energy consumption, efficiency, and comfort levels. Options for glazing can include: clear, opaque, single pane, double and triple pane, tintings, low-E coatings, argon gas-filled cavities, and various sizes. Each option affects condensation, drafts, heat gain, and indoor temperatures.

The performance of the building enclosure changes with the design. Older, mass masonry buildings rely on the thermal mass and single pane glazing for their insulating capabilities while today we include cavity and/or continuous insulation in our opaque systems and have ever increasingly efficient glass systems for insulation. As a result, the building enclosure is now more complicated than ever to design and construct, resulting in many opportunities for building enclosures to perform below the performance expected of them, which in turn may lead to increased energy use directly or indirectly by affecting one of the previously identified factors. The truth is that understanding only one or two of the "energy criteria" is not enough, and in fact could be detrimental to the building at large. A designer must be cognizant of all major sub-categories and of how systems are specified to ensure maximum performance and code compliance.

CURRENT CODE REQUIREMENTS

The predominant energy codes in use today are ASHRAE 90.1 and the International Energy Conservation Code (IECC). The most commonly used IECC versions are either the 2012 or 2015 edition, however in some states or localities older IECC editions are accepted. The International Building Code and most, if not all, state or city specific codes reference these



Map courtesy of Building Codes Assistance Project

two documents (referred to in aggregate as the energy codes). In addition, there are some city or county codes which can add more stringent design or performance requirements.

The energy codes have insulation, vapor retarder, and air barrier requirements that the local jurisdictions can then adopt or modify as they see fit. The energy codes also provide three distinct paths to compliance, including meeting prescriptive requirements, utilizing trade-offs in prescriptive and performance requirements, and a performance approach.

Prescriptive Approach

The prescriptive approach is found in the IECC and mandates that the designer meet a certain prescriptive U-value or R-value (see sidebar to the right) for each enclosure system. In order to use this approach, certain other conditions must be met, including a limitation on fenestration area to total vertical building enclosure area, presently 40 percent, limitations on the solar heat gain, and limitations on the skylight area to the total roof area, presently 3 percent.

The codes have tables of U-values, which are both prescriptive and performance. The reason it can be deemed "performance" is because you actually have to calculate the rate of heat loss/gain to verify that this wall system meets

R- Values: The R-value is a measure of resistance to heat flow through a given thickness of material. The higher the R-value, the more thermal resistance the material has and therefore the better its insulating properties.

U-Values: The U-value of a building element is the inverse of the total thermal resistance of that element. The U-value is a measure of how much heat is lost through a given thickness of a particular material, but includes the three major ways in which heat loss occurs—conduction, convection and radiation. U-values will vary based on the exact point where one is measuring and analyzing. For instance, the U-value at the center of a window will be much different than the U-value and heat transmittance for the window unit as a whole (glass + weatherstripping/gasketing + frame/sash material, etc).

the listed U-value. It's not acceptable to merely add up the U-values of the different materials. The assembly is analyzed as a system to ensure that everything in that assembly from exterior cladding to the interior drywall, including all attachments and fasteners, work as an overall U-value for the assembly.

This U-value for an assembly is more of a performance-based approach than a simple prescriptive measure. It is not as simple as stating and checking off a box for the R-value of each building element.

Building construction over the past several years has been leaning more and more towards systems. Many of these system approaches are marketed using products from just one manufacturer. More complete enclosure system performance can be attained through companies that have partnered to cooperatively provide a more complete array of products that address all aspects of system performance. The U-value for enclosure assemblies tie-in well with this overall systems construction approach.

For products or pre-manufactured assemblies such as fenestrations, there exists a specific and clear required U-value. One typically uses the U-value from a product manufacturer, whether it's a window, curtain wall, skylight, etc.

Trade-Off

The trade-off approach is found solely in ASHRAE 90.1. The trade-off approach allows the designer to compensate for lesser performing components by adding better performing components elsewhere on the building. This often involves increasing the fenestration area, which has a higher U-value than opaque walls, by either increasing the insulation in the opaque walls or the roof. The Department of Energy publishes programs, called COMcheck and REScheck, that perform the calculations for the trade-offs based on the insulating value and relative areas of the systems in question. As the names indicate, COMcheck is utilized primarily for commercial design and construction and REScheck is utilized primarily for residential design and construction.

Performance Approach

Both the IECC and ASHRAE 90.1 allow a performance based approach to show compliance with the building energy performance requirements. However, they take different approaches to the performance modeling. IECC establishes an annual energy cost of a standard reference design and requires the proposed design to be less than 85 percent of the reference design cost. ASHRAE 90.1 provides an energy cost budget method approach to the performance design compliance path. Under ASHRAE the building is modeled two ways. The first is the proposed design model, which is the building as designed and intended to be constructed. The second is the budget building design, which is the building as designed only with the ASHRAE prescriptive requirements for system performance. The first model must have a lower energy cost than the second model.

QUIZ

1. True or False: The U.S. government is the largest consumer of energy in America.

2. True or False: Most designers use performance requirements, but following the performance requirements without consideration of the environmental conditions, both exterior and interior, can result in unintended performance of wall and roof systems.

3. True or False: In new buildings, the need for lighting can be significantly reduced by siting the building in such a way as to allow for significant daylighting to the interiors.

4. The energy codes provide _______ distinct paths to compliance.
   a. 2 b. 3
   c. 4

5. Which path to compliance is found solely in ASHRAE 90.1?
   a. Prescriptive requirements b. Trade-offs
   c. Performance requirements

6. Which materials are primarily designed to keep liquid water from entering the building enclosure?
   a. Water resistive barriers b. Vapor retarders
   c. Air barriers

7. True or False: Combined air barriers, vapor barriers and water resistive barriers can be provided in a single material/product.

8. True or False: Because vapor retarders only prevent diffusion through a material, they must be perfectly continuous, free of holes, lapped, and sealed.

9. True or False: A good vapor retarder can also be an air barrier, but not every good air barrier is a good vapor retarder.

10. Which of the following is defined as "insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings"?
    a. Polyiso insulation b. Continuous insulation
    c. Exterior insulation d. Contiguous insulation

BUILDING ENCLOSURE PERFORMANCE DESIGN

Energy codes require not only energy performance of a building, but also include requirements for vapor retarders and air barriers. These two membranes limit water vapor migration, by affecting different transport methods of that migration. In addition, building codes require water-resistant barriers (WRB's)—which can sometimes be confused with the other guidelines and product lines.

Visit http://go.hw.net/AR1216Course6 to read more and complete the quiz for credit.

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LIQUID OR POWDER?

SPECIFYING ARCHITECTURAL COATINGS FOR METAL BUILDINGS

Presented by:

valspar

The Smithsonian's new National Museum of African American History and Culture is distinguished by a three-tiered envelope covered in 3,600 filigreed cast-aluminum panels, colored bronze with advanced PVDF liquid coatings. Photo credit: Alan Karchmer

LEARNING OBJECTIVES

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

1. Discuss the main coating types, end-use applications and coating application methods for liquid and powder architectural coatings.
2. Describe differences in performance and aesthetic capabilities between liquid and powder architectural coatings.
3. Define sustainability considerations when deciding between liquid and powder architectural coatings.
4. Indicate differences in warranty, touch-up, maintenance, and applied cost between liquid and powder architectural coatings.

CONTINUING EDUCATION

AIA CREDIT: 1 LU
AIA COURSE NUMBER: ARDEC2016.4

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By Kathy Price-Robinson

Some of the world's most distinguished buildings—from the Smithsonian's new National Museum of African American History and Culture, to Dubai International Airport in the United Arab Emirates—share one common feature: a coated metal exterior. These exteriors can be vibrant, richly toned, shimmering, elegantly muted, or even have a color-shifting appearance that changes with the lighting. Metal coatings not only provide weathering performance for the building's exterior, but also allow nearly unlimited aesthetic options. From classic colors to innovative new special effects, metal coatings are extremely versatile and can even replicate the look of other building materials such as wood or marble. Coating selection criteria ranges from aesthetic options to performance specifications. While there is a wide range of metal coating options, for most architectural projects the selection is between 70 percent PVDF liquid coatings or polyester powder coatings.

Liquid coatings are the standard technology for aluminum extrusions in North America. More than 90 percent of the time aluminum extrusions for monumental buildings are coated with liquid coatings. For more than 50 years, 70 percent polyvinylidene fluoride (PVDF) resin-based liquid coatings have enhanced the appearance and performance of exterior metal building products on North America's buildings.

Polyester powder coatings are the popular finish choice in Europe for aluminum extrusions and have been evolving over the past 40 years. The drivers for this choice include cost and environmental consciousness. The markets in Asia and the Middle East are divided between liquid coatings and powder coatings.

This course compares many factors when considering PVDF liquid and polyester powder architectural coatings for exterior metal building products. These include: suitable uses, composition and application, color choices and appearance, performance specifications, sustainability, maintenance and warranty.

SUITABLE USES

Architectural coatings are specified and applied to exterior metal building products to convey an intended appearance and to provide durable performance. Examples include:

- Curtainwall systems
- Aluminum window and door framing
- Roofing, soffits, gutters, and fascia
- Metal wall panels and façade cladding
- Sunshades, louvers and grills

COATING TYPES AND METHODS

Coil Process and Coatings: Liquid Coatings for Aluminum or Steel

Coil-coated, architectural building products start out as coils of metal. Substrates may include pre-treated, hot-dip galvanized steel (HDG), steel sheet coated with aluminum-zinc alloy (Galvalume®) and pre-treated aluminum. In a continuous process, the coil is unwound, cleaned, treated, primed and painted before being rewound on the other end and packaged for shipment. After arriving at the fabricator, the coils are unrolled into flat, pre-painted, metal sheets and are formed into shapes, such as roof panels, wall panels and gutters. In general, liquid coatings are more flexible and allow for post forming while powder coatings are more appropriate for pre-formed metal building products.

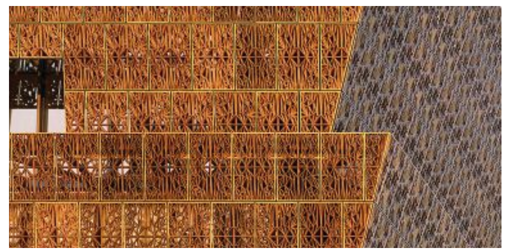
Extrusion Process and Coatings: Liquid or Powder Coatings for Extruded Aluminum

The aluminum extrusion process forms the metal products by pushing a heated billet of aluminum through a die before a finish is applied. The shape of the die determines the shape of the extrusion. Fenestration products are among the most common examples of extruded aluminum, such as framing for windows, curtainwall, storefront and entrance systems.

Liquid Spray-Applied Extrusion Coatings

Liquid coatings are spray-applied in a factory-controlled environment to aluminum extrusions or preformed metal panels to be used on buildings ranging from monumental

CASE STUDY: THE NATIONAL MUSEUM OF AFRICAN AMERICAN HISTORY AND CULTURE



Bronze colored panels cover the tiered exterior of the building, perforated in patterns that reference the history of African American craftsmanship. Photo credit: Alan Karchmer

Each panel that was custom cast was finished with five different coating layers, each a different color of the coating, to achieve the exact bronze shade desired by the design team. Photo credit: Alan Karchmer

With its nearly 400,000 square feet of space on 10 levels, and its 33,000 pieces of artwork and historical objects inside, the newly opened the National Museum of African American History and Culture has received a surprising amount of attention for what's on the outside.

Situated on the last open site on the National Mall, the museum's three-tiered envelope is covered in 3,600 filigreed cast-aluminum panels. A corona reminiscent of an African crown is colored bronze with an advanced PVDF liquid coating that has won praise from critics.

"In full shadow it's a workmanlike brown, the color of shoe leather," wrote Christopher Hawthorne, the Los Angeles Times architecture critic. "In direct sunlight the shade is closer to bronze. Late in the day its western edge, turned toward the Washington Monument and the Lincoln Memorial, begins to reflect the setting sun and turns a surprisingly bright gold."

To ensure the success of this prominent project, many partners were called together to work collaboratively during the design and construction phases; each brought a different expertise to the project. Three American architecture firms, The Freelon Group, architect of record and design team leader (and now part of global design firm Perkins+Will), Davis Brody Bond, with extensive experience in museum projects, and the local D.C.-based firm SmithGroup, joined forces. David Adjaye, lead designer of London-based Adjaye Associates, was the last to join and brought an international design element to the project. Together, they formed a group named "Freelon Adjaye Bond/SmithGroup" (FABS) and worked cohesively to create a world-renowned museum that would accurately tell the story of the African American experience.

The building design features three distinct elements: the shape and form of the corona (the three-tiered filigree envelope that wraps around the structure), the porch extension that merges the building into the surrounding landscape, and the bronze color of the corona that provides a distinctive look and strong presence on the National Mall.

The bronze wash of the metal panels was a monumental component of the design. Lead project manager Zena Howard AIA, of Perkins+Will, explained that the color choice was discussed over the course of many years with all parties involved in the design process. Ultimately, bronze was selected as the team determined it would remain "an enduring and permanent color that would command respect for the building and the exhibits housed inside."

Once the final color idea was identified, the new challenge of obtaining the perfect hue began. Three custom shades and one standard shade of black coating were used on the massive aluminum panels, each weighing around 200 pounds and stretching 4 by 5 feet.

Each 4-by-5 foot panel, weighing 200 pounds, was custom cast and finished with five different coating layers. Layering these five different colors was the method used to achieve the exact bronze shade desired by the design team. Eventually, the final color was created and earned the name of "Artisan 3.5." The individual coatings needed to hold their color across every layer on the panels, as each new additional color is built off of the last to create the final shade. The 70 percent PVDF resin-based liquid coatings was the best product for this complicated job due to its durability and color retention, which will help showcase the vivid color for many years.

Extensive testing was done during the coating application process due to the size of the panels, and because of the intricate design already cut into each piece. The coating was applied entirely by hand, and each color layer was carefully inspected to make sure every part of the coating process was on track. The coatings team worked to finish the panels in an identical fashion and ship them from the workstation in Portland to the project site in Washington D.C. After a bit of back and forth, the panels and their many layers of custom colors were approved and were deemed ready for installation. "What we ended up with gave us the look of real bronze, a luminous feeling that created a dynamic and beautiful façade," said Howard.

The filigree is an eye-catching adornment that both draws visitors in and sets the stage for the rest of the journey throughout the museum. It combines polish, artistry, creativity and persistence, just like the art, history and culture memorialized within the building. The museum itself is a work of art, one that stands out among the historic structures to its left and right, and will act as a physical representation of the historical past of African Americans.

and commercial to residential. These coatings may be formulated to meet a wide range of performance specifications, outlined by the American Architectural Manufacturers Association (AAMA).

Powder Extrusion Coatings

Polyester powder coatings can be factory-applied to aluminum extrusions to meet AAMA 2603, 2604, and 2605 standards. Typical applications in North America include residential windows, pool enclosures, storefronts, and handrails. These powder coatings may also be selected for high-traffic surfaces such as storefronts, as the hardness of these coatings helps prevent scratches. The harder the finish and higher film thickness results in decreased flexbility. This makes powder coatings more prone to chipping, especially on the edges of window and curtainwall framing. Chipping can expose small areas of aluminum that may create an environment for corrosion, especially in seacoast environments.

COATING COMPOSITION

Resins, pigments and additives provide the formulation for both liquid and powder coatings.

- Resins serve as the binder that forms the paint film and are the principal components that determine the durability of the coatings, their appearance, and their performance.
- Pigments provide the color and can influence the coating's durability, specifically for weathering characteristics.
- Additives affect the paint application, cure time and surface appearance.

Both liquid and powder coatings require cleaning and pre-treating of the metal to prepare it for coating. Each are applied in a factory-controlled environment to deliver a consistent appearance and performance as specified.

Liquid Coatings—To meet the industry's superior performance standards of weathering for architectural metal products, 70 percent PVDF resin-based coatings are recommended. The remaining 30 percent of the binder is composed of proprietary acrylic formulations developed by the coatings' manufacturers. Pigments, solvents and additives also are included in the formulated liquid product. Solvents maintain the liquid state and influence the ease of application. During the curing process, solvents evaporate, while the resin system adheres to the metal.

A 70 percent PVDF liquid coating may be formulated for either spray applications used on aluminum extrusions or for coil applications. Regardless of the application method, PVDF resin-based liquid coating systems begin with pretreatment to clean the metal and prepare it for the coating process. This is followed by a two-coat system:

1. Primer: enhances corrosion resistance and determines adhesion quality.
2. Topcoat: determines the color, contributes to weathering performance, and can provide other coating characteristics.

Beyond two-coat systems, some liquid coating systems have a three-coat process that includes an additional paint layer or clear coat to enhance color or weathering performance. However, testing according to real-world exposure demonstrates that many two-coat systems weather equivalent to a three-coat system. Both two- and three-coat metallic coatings in liquid formulations offer outstanding weathering. Metallic coatings are known to have excellent weathering performance and can look new even after 20 years of outdoor exposure.

Powder Coatings—For ease of application, polyester powder coatings are typically one-coat systems that rarely use primers or clear coats. Powder coating is a dry film process, using finely ground particles of resins, pigments and additives. The solvent used in liquid coatings is omitted. The mixture is melted, extruded, cooled, cut into chips and ground into powder. The powder is electrostatically charged and sprayed onto the electrically grounded extruded aluminum. The charged powder particles adhere to the metal, and are held there until melted and fused into a uniformly flowing coating in a cure oven.

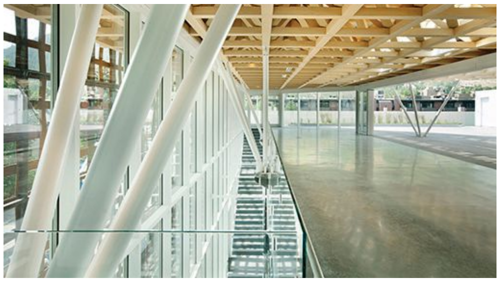
To create a bright metallic powder coating, a clear coat is required to seal the aluminum particles and keep them from oxidizing. Using a clear coat with powder coatings is impractical. It can make the total coating system too thick for the extrusions to fit together properly and, in many cases, will lead to cracking and filiform corrosion. In addition, such an approach would be too costly compared to available liquid coating alternatives.

AESTHETIC APPEARANCE

Color, form, space and light are principle components of an architectural project. Color is the one element that most affects the others. It is the first thing that people see and influences their experience of a space. For exterior architectural building components, colors trend toward a more conservative, classic

LIQUID AND POWDER COATING COMPARISON

	POLYESTER POWDER	70 PERCENT PVDF LIQUID
PERFORMANCE	Limited Performance. Exceptional hardness makes powder coatings appropriate for high-traffic areas.	Provide best available performance for color and gloss retention, corrosion resistance and weatherability.
AESTHETICS	Standard color range available with slight orange-peel texture.	Available in nearly limitless aesthetic options, including standard colors, bright metallics, special effects, varying gloss levels, and more.
SUSTAINABILITY	Powder coatings have sustainability advantages such as zero VOCs at the application site.	Liquid coatings require less energy to manufacture than powder coatings, and do produce VOCs, but they can be captured and reused in an energy-efficient manufacturing process.
MAINTENANCE	Cannot be applied outside of a factory setting. Can be touched-up with liquid coatings, although it is not recommended due to possible color differences.	Touch-up options may be available with liquid coatings in the same technology and offering similar performance.
WARRANTY	Up to 25 years with limitations and restrictions.	Up to 30+ years. Depending on coating manufacturer, warranty covers full cost of claim plus color and gloss retention.
APPLIED COST	Lower applied cost compared to liquid PVDF.	Higher applied cost than polyester powder due to the higher price in superior-performing PVDF resins.



The Aspen Art Museum features an iconic, composite geometric screen that drapes the museum's bright glass and white metal exterior on two sides. The curtainwall, window, sliding door and skylight systems were finished with 70 percent PVDF coatings. Photo Credit: Derek Skalko

palette. Whites, beiges, metallics and grays have been the most popular color choices for many years, but bolder colors are increasingly being used for accents on framing and larger surfaces including cladding and roofing. High-performance architectural coatings should be specified to ensure the colors maintain their intended appearance.

Liquid coatings offer nearly unlimited color and aesthetic options. They are available in a wide range of colors, gloss levels, effects and textures. A wider range of aesthetic options are available with liquid coatings than powder coatings, especially with metallic, special effects colors, and gloss levels. Liquid coatings can achieve a very smooth finish that appeals to architects.

Polyester powder coatings are available in a range of solid and pearlescent colors. The method of powder adhering to aluminum creates a slight orange peel texture. Compared to liquid coatings they are more aesthetically limited due to the lack of metallic and multi-layer capabilities available with powder coatings.

In Europe, most suppliers keep an invetory of RAL stock colors in powder coatings. RAL is a color matching system used in Europe that is created and administrated by the German RAL Institute. In the middle east, preferences are divided between custom color and selecting from a standardized color chart.

This article continues on http://go.hw.net/AR1216Course4.
Go online to read the rest of the article and complete the corresponding quiz for credit.

QUIZ

1. Which coating type is known for it's hardness, making it appropriate for high-traffic applications such as storefront?
   a. Liquid Extrusion Coatings b. Powder Extrusion Coatings
   c. Both coating types are equally hard d. Neither are used for this application

2. True or False: For more than 50 years, 70 percent PVDF resin-based liquid coatings have enhanced the appearance and performance of exterior metal building products on North American monumental buildings.

3. Which type of coating offers a wider range of aesthetic options including bright metallic colors, special effects, and varying gloss levels?
   a. Polyester powder coatings b. Liquid coatings
   c. Polyester offers a slightly wider range d. They both offer equal colors and effect

4. Which building mentioned in the article is composed of curving curtainwall systems featuring high-performance PVDF coating systems in nine bold colors selected by the architects to give the exterior a vibrant, welcoming appearance?
   a. Guthrie Theatre in Minneapolis b. Mandalay Bay Resort and Casino
   c. Children's Hospital of Philadelphia Buerger Center d. Dubai International Airport

5. Of the three American Architectural Manufacturers Association (AAMA) 2603, 2604 and 2605 industry specifications for performance requirements and testing procedures for architectural coatings, which is the most stringent?
   a. AAMA 2603 b. AAMA 2604
   c. AAMA 2605 d. They are all equally stringent

6. To meet AAMA 2605 standards, finishes are subjected to the equivalent of ____ years of South Florida exposure for weathering including gloss retention, fade-resistance to ultraviolet (UV) light, plus 4,000 hours of humidity and 2,000 hours of salt fog endurance for corrosion resistance.
   a. 10 b. 20
   c. 30 d. 40

7. To create a bright metallic powder coating, a clear coat is required to seal the mica and keep it from oxidizing. However using a clear coat with powder coatings is impractical. Why is that?
   a. It would make the total coating system too thick for the extrusions to fit together properly b. In many cases, it will lead to cracking and filiform corrosion
   c. Such an approach would be too costly compared to available liquid coating alternatives d. All of the above

8. True or False: Liquid coatings are made with solvents that contain VOCs, but a thermal oxidizer can be used to convert VOCs into harmless water vapor and carbon dioxide, and reuses the heat generated from that process in the paint coating process.

9. Which type of coating mentioned in the course cannot be applied outside of a factory setting, which means it cannot be used for touch-up or repair after the finished building components have been installed?
   a. Liquid b. Powder
   c. Both of the above d. None of the above

10. Through the decades, 70 percent PVDF liquid coatings have proven to have superior performance in resisting chalking, fading, and corrosion, and in retaining gloss, color and other performance factors under harsh conditions. In which environment are they particularly resistant to corrosion when compared to powder coatings?
    a. Desert environments b. Artic environments
    c. Tropical environments d. Seacoast environments

INTEGRATING STRUCTURAL ELEMENTS FOR INNOVATIVE DESIGN

Presented by:

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Courtesy of Holcim Foundation and Wikimedia Commons

LEARNING OBJECTIVES

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

1. Understand how architects use structural elements to define space and articulate design concepts.
2. Examine the issues of structural complexity arising from new technologies.
3. Explore how BIM technology supports the design and presentation process.
4. Analyze examples of architectural work that rely on modern building technology for structural integrity design decision-making.

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: ARDEC2016.1

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/AR1216Course1 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.

By Aphrodite Knoop, LEED Green Associate

STRUCTURAL ELEMENTS USED TO DEFINE SPACE AND ARTICULATE DESIGN CONCEPTS

Some of the most powerful examples of architecture are those that exploit and celebrate the components of their construction. These are buildings where the structure does not lie buried behind gypsum board, veneers, and other materials, but rather is revealed and articulated in all its fittings, joists, trusses, columns, studs, and connections.

Among the most inventive and impactful architects are those who have demonstrated successfully that structure is not something to be applied to the design; it is the design.

Although the technology and boldness of expression continue to evolve, structural expression in design has been with us for as long as there have been man-made environments.

For example, Santiago Calatrava's iconic body of work, much like the Gothic cathedrals of earlier centuries, is a seamless expression of structure as design. His futuristic aesthetic, born out of his dual training as an architect and engineer, is one of soaring forms and curves that captivate the imagination. Also a painter and sculptor, Calatrava is known for starting his projects with sketches of natural elements and human forms, then transforming those into evocative, organic structures that embody culture and place. The following projects illustrate his organic vision in design:

- **The Lisbon Oriente Station** is a lattice of glass and steel that recalls both a canopy of trees and Gothic arches.
- **The Quadracci Pavilion at the Milwaukee Art Museum**, overlooking Lake Michigan, spreads its wing-like structure to shelter visitors and artwork while also tapping into nautical themes that give a nod to the lakeside setting.
- **The Tenerife Auditorium**, off the coast of Morocco, is known for its gravity-defying

suspended arch, which resembles a wave swelling out and over the amphitheater below.

- **The World Trade Center Transportation Hub in New York City** captures the spirit and form of a bird taking flight and presents an organic silhouette in contrast to the linear city grid backdrop.
- **The Dubai Observation Tower** is a contest-winning design that will take Calatrava's structural expression to dramatic new heights. When completed, it will surpass the Burj Khalifa's 2,722 feet. Here, Calatrava drew inspiration from the minaret forms of Islamic culture.

Like Calatrava, other modern architects have earned renown by using structural technology to solve multilayered design problems in high-profile locations.

The John Hancock Center, the first mixed-use tower in the world, is a prime example of early integration of structure-led design and close collaboration between the architect (Bruce Graham) and structural engineer (Fazlur Khan). The structural members are exposed, making for dramatic architectural expression. The 100-story tower was designed to taper toward the top to accommodate different floor functions. The steel-frame structure is a tube in which exposed diagonal members provide reinforcement and stiffness where needed. Structural floors intersect with the diagonals and the corner columns and the exterior frames serve as bearing walls, which distribute loads among the columns. Although this building was designed and built long before the advent of building information modeling (BIM), the technology and collaboration involved lend well to the BIM process, which arose from the need to better manage the multitude of layers and processes in design and construction.

Another example of aesthetic shaped by structure is the Hearst Tower addition by Foster & Partners. This is the first U.S. office building to receive a gold rating from the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program. The original limestone clad building sits beneath the 46-story steel addition—a striking glass tower supported by a steel diagrid and 12 mega columns. A diagrid (from the merging of "diagonal" and "grid") structure is a framework of diagonally intersecting structural members that are mutually reinforcing to brace against building loads and stresses. The key

The Beekman, designed by Gerner Kronick + Valcarcel, Architects, converted a historic hotel into a greener, safer, and more cost effective structure. Photo courtesy of Vectorworks

benefit of a diagrid structure is that it requires fewer internal supports and less space and building materials than traditional high-rise structural systems. In the Hearst Tower, Foster & Partners went with a diagrid configuration to better reinforce the building against seismic and terrorist events. BIM modeling helped generate structural analyses and identify potential pitfalls. It also helped the design team identify efficiencies, one such being that the diagrid structure uses 20 percent less steel than conventional framing.

The Beekman by Gerner Kronick + Valcarcel, Architects (GKV), a restoration and adaptive reuse project in New York City, is yet another structure-led design. Here, GKV was tasked with converting a historic hotel to a 68-unit condominium complex that offers residents modern conveniences and amenities. For this landmark location, GKV adapted roadway construction technology to the architecture, which allowed for a new aesthetic and a building that is greener, safer, and more cost effective. GKV principal Randolph Gerner explained that this level of exploration and innovation would not have been possible without the use of BIM.

Advances in digital technology, such as building information modeling (BIM) software, have enabled architects to bridge the gap from theoretical, seemingly impossible ideas to high-performance built environments that are cost effective, efficient, and comfortable.

ISSUES OF STRUCTURAL COMPLEXITY ARISING FROM NEW TECHNOLOGIES

Architectural design and structural technology are continually evolving, giving rise to myriad interwoven layers of systems and processes. This growing complexity, though full of possibilities, also presents significant challenges from the very start of a project.

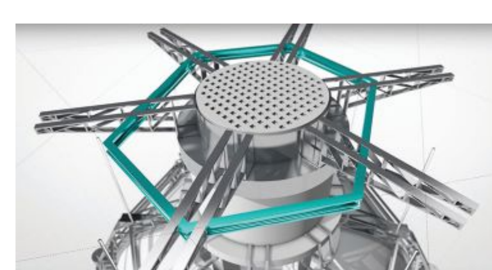
For example, large complicated projects (much like the ones described earlier) are a convergence of different systems, multiple stakeholders, and high stakes. Changes or challenges, when they arise, can greatly compromise schedules, budgets, efficiency, and jeopardize the overall project.

Without adequate means of managing and leveraging this complexity, project teams may face the following issues resulting from unclear ownership paths and lack of coordinated information:

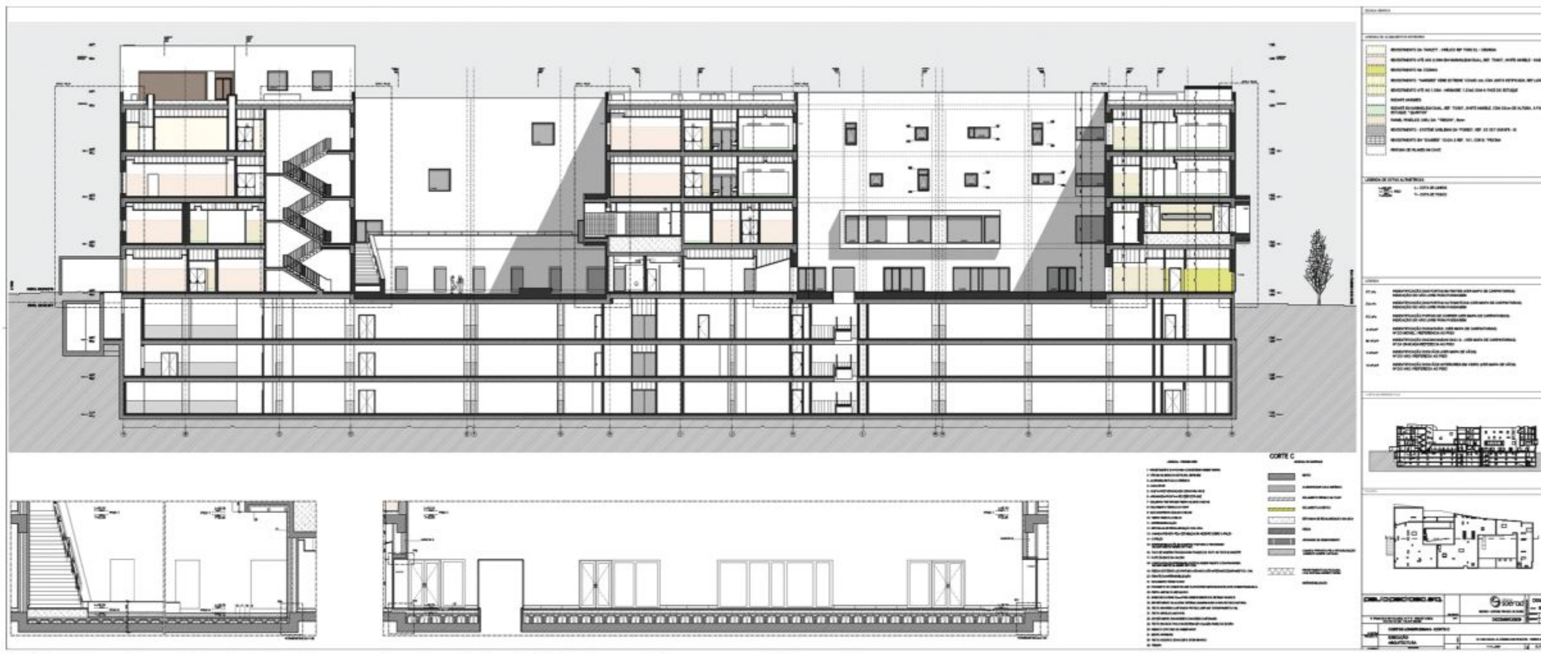
- Poor documentation and version control
- Ineffective transfer of data and communication
- Inadequate teamwork and silo mentality
- Contentious scenarios
- Muddled logistics
- Greater potential for errors and lawsuits

Lacking the right tools to visualize and manage all the pieces of information and processes, project teams also risk systems clashes. For example, an architect may want higher ceilings or more open spaces, but may lack the data to visualize how those choices impact existing mechanical systems and structures. This could lead to bad decisions and costly errors that don't reveal themselves until a project is well underway.

In cases where the structure is particularly complex or novel, it becomes imperative to analyze all the forces and loads acting on a building, and understand where and how the different systems intersect. Also, if a contractor surveys the project during construction and calls for modifications that affect the plan, those changes will have a rippling effect and raise numerous other challenges and issues



Architects can visualize and manage the structural elements of their designs with BIM workflows and structural member modeling tools. Photo courtesy of Vectorworks



Building information models make it possible to encode and manipulate building elements. Photo courtesy of Vectorworks

because of the way in which structures and systems are so intricately layered.

In more complicated projects and workflows, architects may find it difficult to explain or justify ideas to clients who struggle to visualize all the components and implications. This alone could put the project at risk and prevent it from moving forward.

On the other hand, adopting a BIM-focused approach empowers architects with transparency and easily accessible information, freeing them to pursue bold high-performance structural and design solutions.

UNDERSTANDING BIM

BIM is both a process and data. As a process, BIM enables architects to take a project from design, analysis, and execution to delivery and management. The technology supports a highly collaborative, well-integrated project team that encompasses designers, builders, and owners.

BIM technology makes it possible to encode and manipulate building elements to conceptualize, collaborate, analyze different possibilities quickly and efficiently, identify potential problems early in the process, and pursue creative new approaches.

BIM begins in the design phase where all team members can collaborate openly and effectively in shared and open file format to contribute to their expertise. The technology enables the entire team to share in a project's risks and rewards and make value-based decisions resulting in streamlined execution with fewer problems and waste as well as lower costs throughout the entire process.

As data, BIM is the 3D geometry and chunks of information that represent a project's design, construction, and facility management information. All of a project's data may be represented by one model or a network of multiple domain models. Data can be exchanged as a whole or in units with other project stakeholders.

Designers use this information, not just for generating design ideas, but for project management, and construction. BIM technology helps project teams in a number of ways:

- Model initial concepts and changes
- Work collaboratively from remote locations
- Identify and resolve issues in BIM prior to implementation
- Maintain information about components, materials, schedules, structural loads, and so forth
- Track energy use
- Ensure LEED compliance
- Support facilities management

In addition, BIM technology makes it possible to maintain an object library and baseline legacy system where data lives on and can be retrieved and used for additions, renovations, and new projects.

DESIGN AND PRESENTATION PROCESS USING BIM DESIGN SOFTWARE

The more sophisticated BIM technologies can help architects generate and analyze new design ideas quickly and model complex structures more accurately.

Designers have greater creative freedom and the communication tools to get all stakeholders involved in the project for a more efficient workflow where they can project construction costs, analyze quantities of materials, and increase efficiency.

Working in BIM virtual environments, distributed teams can leverage processes with a flexible, file-based form of data referencing where any number of files can be combined into a unified project file. BIM further supports simultaneous editing by multiple users on each of the files, with automated or manual updates of the other referenced files.

With BIM, documentation is automatically updated. Architects can model common structural elements easily and accurately. They can also create curved structural members, edit interactively in 3D views, and manipulate a network of structural elements.

Architects can attach information to any design element, generate schedules and reports from a model, and share their work with all stakeholders. They can also be interoperable across programs and platforms by import/export of common file formats.

Go from Concept to Reality

BIM enables tremendous design flexibility. Any shape that designers can conceive, they can make. Whether they're creating building shells, components, or fixtures and furnishings, architects can model them at any stage and at any level of detail because BIM can support a vast array of forms and geometries:

- Extrusions
- Surfaces of rotation
- Sweeps
- Non-uniform rational basis spline (NURBS) curves and surfaces
- Variable edge radii
- Protrusions
- Shape projections
- Shelling
- Manifold solids from surfaces
- Constructive solid geometries

Translate Complex Forms to Intelligent Objects

Architects can use BIM technology to translate complex forms to building components, including semantic data and attributes, so they can identify and communicate them in the correct context.

Because of the parametric capabilities of BIM, any changes made to one element will automatically produce changes to associated elements. This feature reduces human error and saves project teams time and money. For instance, walls and wall components can be linked dynamically to the height of any level. Walls detect the other walls they're joined to and thus maintain a network of walls that can be drag-edited and reshaped.

In addition, objects inserted into walls know the height, thickness, material layers, and other information about that wall. They accommodate changes when the wall is reset.

With BIM software, architects can easily import and export IFC files (an open source file format read by all BIM authoring tools) and share BIM data with a range of applications to design, simulate, analyze, construct, and manage a project.

QUIZ

1. Structure as design is best suited to which building type?
   a. Residential complexes
   b. Civic buildings
   c. Commercial developments
   d. All of the above

2. True or False: Structure-led design is only possible with futuristic building technology.

3. The acronym "BIM" stands for which of the following?
   a. Building industry modeling
   b. Building information modeling
   c. Building information metrics
   d. Building implementation model

4. Which of the following does not enhance structural innovation?
   a. BIM software
   b. Building technology
   c. Compartmentalized workflow
   d. Architectural vision

5. Which of the following is not a benefit of modern structural technology?
   a. Has very specific applications
   b. Maximizes usable space
   c. Enables greater design flexibility
   d. Provides greater efficiencies

6. Which elements can BIM update automatically?
   a. Plans
   b. Door schedules
   c. Cost estimates
   d. All of the above

7. Architects can use BIM technology to support which of the following?
   a. Legal documents
   b. Creativity
   c. Marketing
   d. Flexible updating of singular elements

8. In which of the following applications have architects demonstrated successful integration of BIM?
   a. Design of modular structures
   b. Maintenance of large object libraries
   c. Collaboration with remote design project teams
   d. All of the above

9. Which of the following would not be a use for BIM software?
   a. Track energy use
   b. Model project changes
   c. Identify and resolve communications issues
   d. Support facilities management

10. True or False: BIM can help model complex geometries.

This article continues on http://go.hw.net/AR1216Course1. Go online to read the rest of the article and complete the corresponding quiz for credit.

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INDIAN MOUNTAIN STUDENT ARTS & INNOVATION CENTER
Wood was the natural building material of choice, selected to inspire warmth and reflect the school's natural setting and commitment to the environment. Glulam beams provide the principle means of framing and glulam columns provide lateral support for the curtain wall window system.
Location: Lakeville, CT
Architect: Flansburgh Architects
Photographer: © Robert Benson Photography
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NIGEL YOUNG/FOSTER+PARTNERS

Special Section: 2016 Innovative Details

INTRO BY WANDA LAU

TEXT BY TIMOTHY A. SCHULER

Wood offers endless opportunities in architecture. It can be cut, carved, planed, milled, bent, joined, glued, nailed, bolted, laminated, spliced, pulled, pushed, and weathered. As the 12 projects on the following pages demonstrate, no matter how demanding the task, wood can deliver.

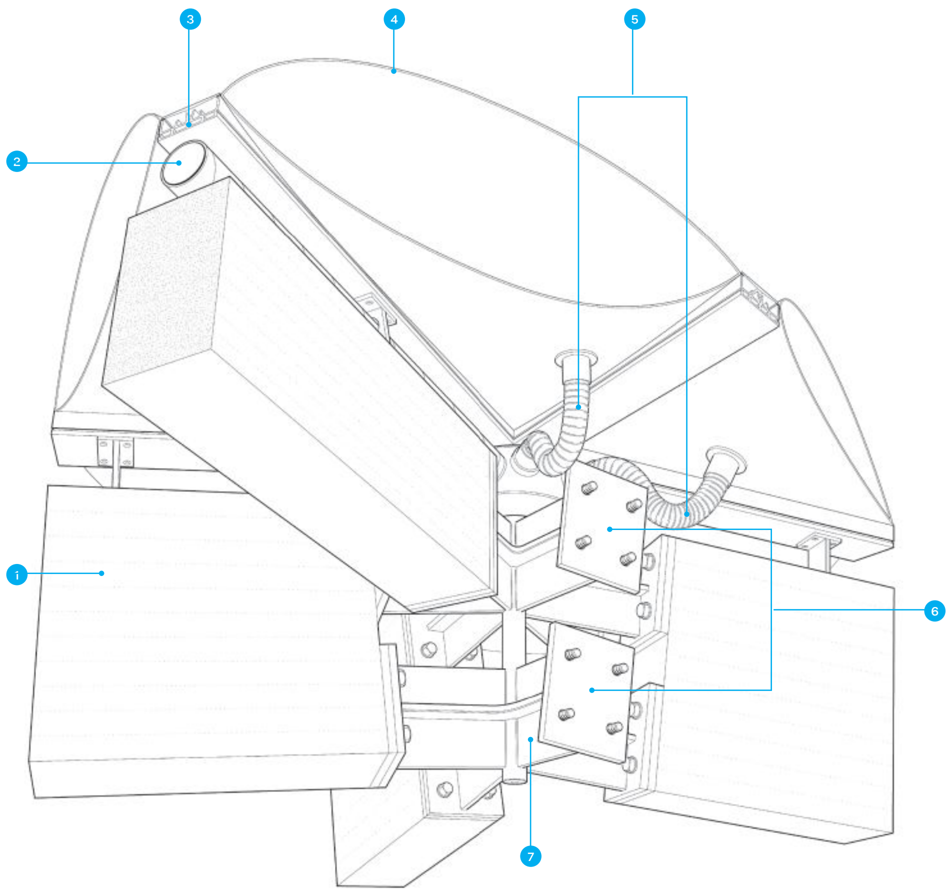
Crossrail Place at Canary Wharf Lattice Roof

NIGEL YOUNG/FOSTER + PARTNERS

Though permanently moored among the docks of London's Canary Wharf, Crossrail Place has a central role in the city's bustling transportation and trade networks. Designed by Foster + Partners (F+P), the long, tubular structure contains one of nine new railway stations for London's new Elizabeth line, due to begin operating in 2018, as well as a shopping center and a public park. In all, the enormous, ship-like building includes more than 100,000 square feet of retail and restaurant space and 45,000 square feet of green space across seven stories, four of which are below grade and submerged underwater.

Topped by an arched lattice roof with a tessellated ETFE (ethylene tetrafluoroethylene) skin that responds to climatic conditions in real time, the futuristic form and materiality of Crossrail Place are a direct response to the area's maritime history; its barrel vault of crisscrossing glulam spruce and billowing, triangular ETFE cushions recall the dozens of wooden clippers that once docked in this part of the city.

The lattice roof spans the concrete box structure's 112-foot width and 1,017-foot length (longer than three football fields) and comprises 1,418 glulam beams and 564 custom steel nodes, 348 of which are unique in shape. The diagonal glulam members tie into the reinforced-concrete slab that supports the center's elevated park, while the glulam beams running parallel to grade are spaced every 6 meters (19.7 feet). Where the vault roof appears



1. 10" × 33" glulam timber beam, 13' to 25' long
2. Primary air pipe
3. Extruded aluminum mullions
4. ETFE pillow
5. Air pipe to individual ETFE pillows
6. Galvanized steel end plate
7. Galvanized steel node

to continue below the park level, the timber suspends from the slab and is structurally isolated from the roof. Fourteen diamond-shaped openings, each nearly 40 feet wide, cluster along the roof's apex.

According to Austrian timber contractor Wiehag, Crossrail Place's roof is the largest timber project in the U.K. Its success, says Ben Scott, F+P's partner-in-charge for the project, is the result of an extraordinary collaboration between the architects and the builders, including Seele, also in Austria. Through a series of intensive work sessions, both in the U.K. and in Austria, the team developed a specialized method for the exchange of 3D information. "All the nodes, beams, cushions, and flashings were designed and fabricated as one parametric family," says F+P associate and computational designer Jonathan Rabagliati. "This permitted the exchange of data sets and geometric rules facilitating the gradual refinement of the design through successive digital and physical prototypes."

Although the vault roof is curved, the individual glulam beams are straight. F+P explored two possibilities: double-curved beams with simpler steel-node connections or straight beams with more complex nodes. "The question was really where to put complexity and where to put simplicity," Rabagliati says. Wiehag made the case that the latter option would be more cost effective, noting that the production of straight glulam beams could be almost completely automated.

Even then, the dimensions of the timber are hardly standard, ranging from 13 feet to almost 25 feet in length. The diagonal beams in the roof lattice are 33 inches deep, while the horizontal beams are half as deep, at approximately 18 inches. Both average 10 inches in thickness. At the east and west ends of Crossrail Place, a double-curved steel ring beam and two pairs of curved timber members help create the roof's approximately 100-foot cantilever over a series of restaurant terraces.

Still, the steel node connections were by far the most challenging aspect of the project, Scott says. The nodes connect up to six glulam members, each bolted to a pair of steel plates, and position the timber at the angles necessary to create the roof's overall curvature. To design the nodes, the architects built 3D prototypes and, eventually, a full-scale mock-up. In general, the nodes resemble two toy jacks fused together, but they vary in size, shape, geometry, and number of connections.

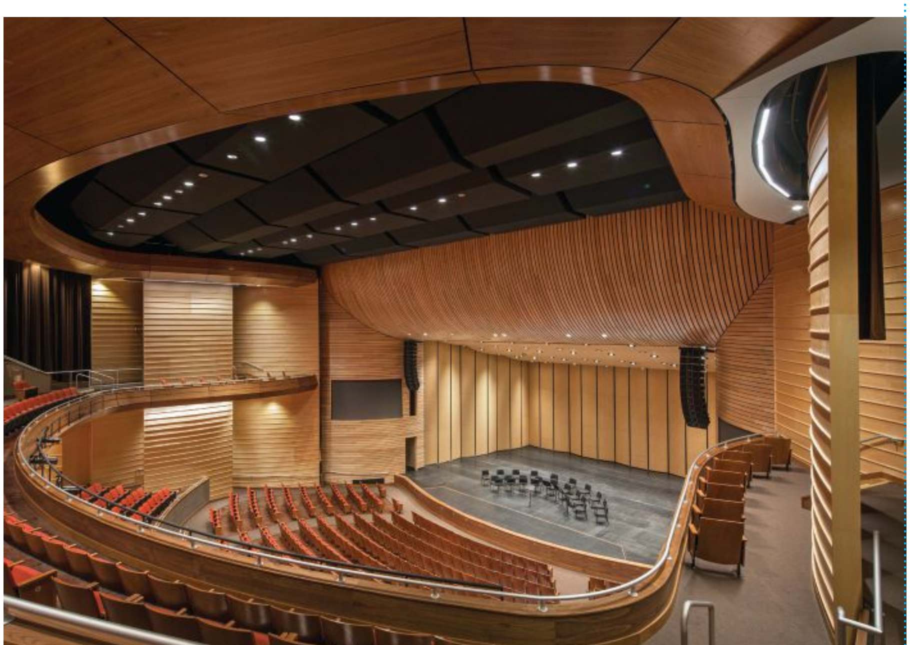
Austin ISD Performing Arts Center

Majestic Proscenium

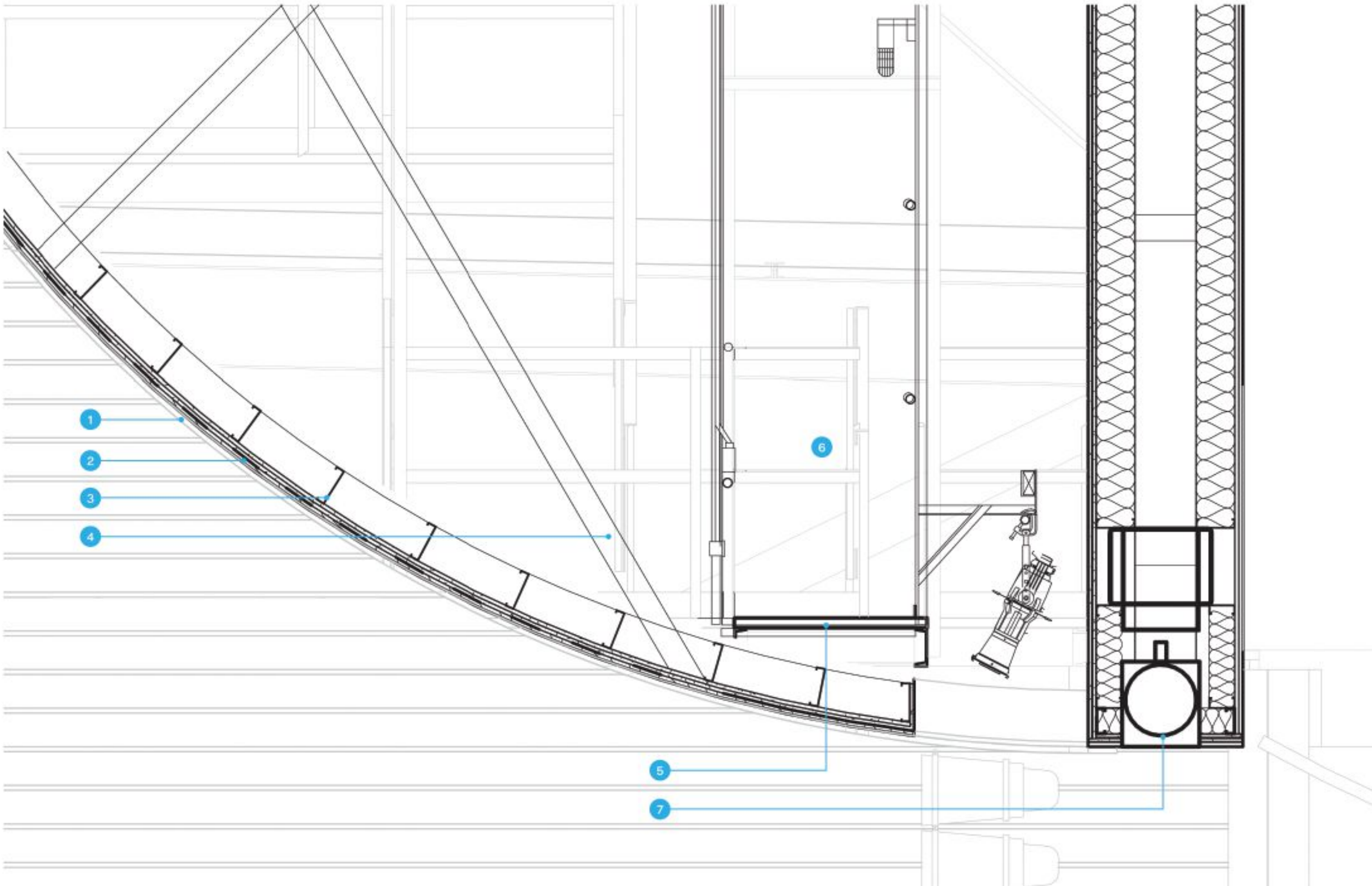
The main auditorium of the Austin Independent School District's performing arts center, in Austin, Texas, exhibits the form and craftsmanship of a violin or cello. With its elegant curves and rich material palette, the 1,200-seat venue, visible from the street through the glazed curtainwalls of the center's lobby, appears as an object on display in a glass case.

Stepping inside the auditorium is like slipping into the wood body of a stringed instrument. Nearly every exposed surface is wood, including the venue's double-curved balcony and mirroring soffit overhead, both finished with a walnut veneer, as well as its curved walls, which are clad with ¼-inch-thick maple prefinished plywood—8,600 square feet in all. "When you think about musical instruments, wood is the first thing that comes to mind," says Juan Miró, FAIA, founding principal of local firm Miró Rivera Architects, which designed the 60,000-square-foot center with Pfluger Architects, also in Austin.

And like an instrument whose form is driven by function, the design of the auditorium was driven by performance. Its swooping ceiling and angled walls serve an acoustical purpose, as does the wood itself. Even the geometry of the 60-foot-long, 19-foot-tall curved maple proscenium soffit—the venue's showstopper—was informed by the orchestra shell, an off-the-shelf plastic laminate product from Wenger that reflects the sound out toward the audience during musical performances.



THOMAS MCCONNELL

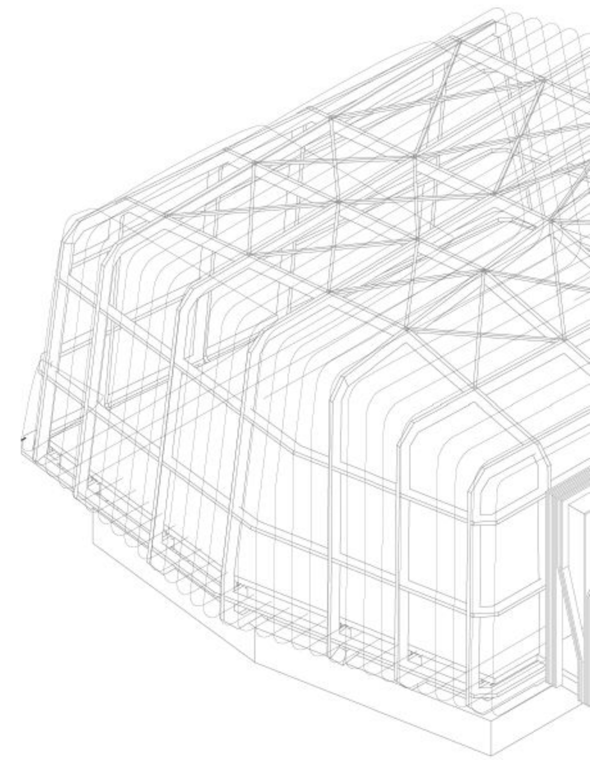


Hovering 30 feet above the stage, the proscenium soffit, which ties into the building's steel structure and features integrated stage lighting, comprises metal-framed construction finished with vertically mounted maple 1×6s screwed to gypsum wall board, painted black. "That's how you get that little bit of texture there," says Pfluger project architect and principal Jessica Molter, AIA. To create the soffit's 18-foot-radius curve, Keystone Millwork, in Bryan, Texas, had to rout each 1×6 lengthwise with two 1.75-inch-wide, 0.5-inch-deep gouges, like two tire tracks running the length of the wood. Keystone owner and president Bob Kraus says this sufficiently weakened the wood, allowing workers to bend it along the framed curve and secure it with glue and nails.

Local contractor American Constructors erected scaffolding in order to complete the soffit and constructed the flanking curved walls from the top down, a process that took a little more than two months. To ease the replacement of lamps integrated into the proscenium ceiling, the architects ensured the light fixtures were accessible from the catwalk above.

Changing the acoustics of the space is even simpler. Heavy acoustical curtains hidden in pockets behind the balcony walls can be deployed with controls located backstage and in the sound booth, allowing the facility to serve all types of performances equally. The system's sophistication gives Miró and Molter a great deal of satisfaction. "Seeing the culmination of all this work in a facility where all of the students who come and play all feel like it's something special for them ... that's one of the most rewarding things to me," Molter says.

1. 1×6 maple slat, routed and curved by hand to an 18' radius and secured to framing with glue and nails, holes plugged
2. Two layers of ⅝" gypsum wall board, painted black
3. 6" metal stud framing
4. Metal-framed bracing support to structure above
5. Steel plate
6. Catwalk
7. Roll-up projector screen



La Cigarra Café
Entry Pavilion

Every spring, artisans in Valencia, Spain, sculpt giant caricatures of historical and mythical figures—and then set them ablaze. The tradition is part of Las Fallas, a week-long festival. Several years ago, Tomás Amat, founding principal at Tomás Amat Estudio de Arquitectura, recruited renowned wood-falla artist Manolo Garcia for a new café project in his hometown of Alicante, a port city on the country's Mediterranean coast.

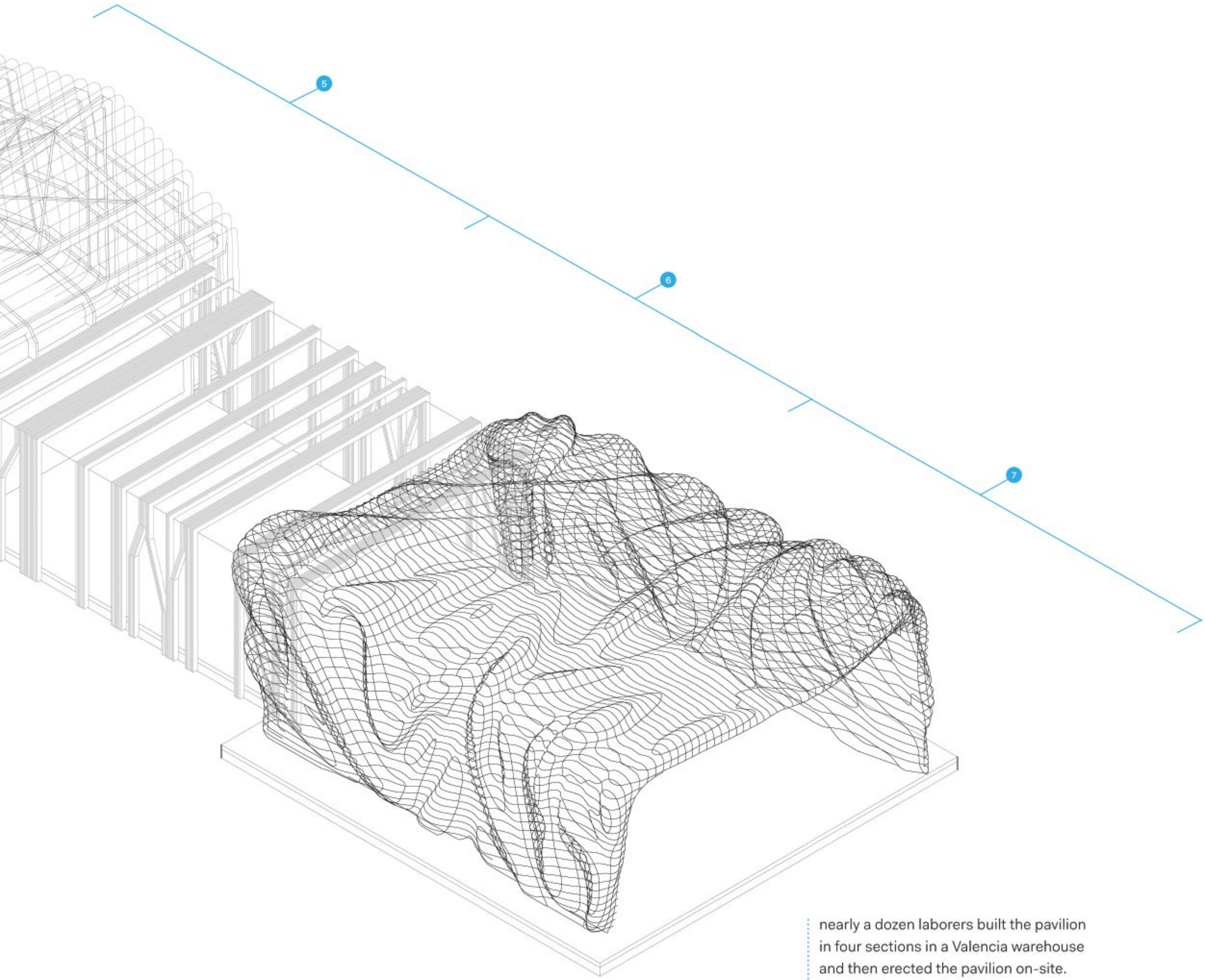
Inspired by Barbarela Studio's nearby Jardin Vertical, Amat envisioned the 2,600-square-foot café as an insect in a garden. He designed a long, low structure split into three parts: "head" (kitchen), "body" (seating area), and "tail" (entry pavilion). A pair of tall steel beams bent like a cricket's hind legs flank the structure, completing the allusion.

Designed for Alicante's mild winters and hot summers, the 600-square-foot tail is covered by a free-form wood shell, crafted by Garcia. "There's nobody [in] the world who could make it like him," Amat says. Garcia began by sculpting a 1.5-foot-long plaster model based on a digital mock-up by Amat. As the basis for everything else, the model had to be perfect, the Spanish architect says. He and Garcia even tweaked the curves and wrinkles by hand, creating a piece that looks like an insect's molted skin, scrunched up and discarded.

Garcia then blended digital fabrication technology with traditional craftsmanship. The plaster model was digitally scanned and then transversely sliced into a series of sections, which were then exported to CNC-milling machines, which cut five transverse frames and 48 longitudinal purlins that serve as the pavilion's structure. The pine purlins are screwed directly into the transverse frames.

This wooden skeleton is then wrapped in approximately 10-foot-long strands of unfinished elm, each of which is submerged in water for an hour before being stapled to the wood frame. The shape of the swirling skin follows the contours of the underlying structure, but each strand is placed "sobre la march," Garcia says—or "on the fly." He and

DAVID FRUTOS



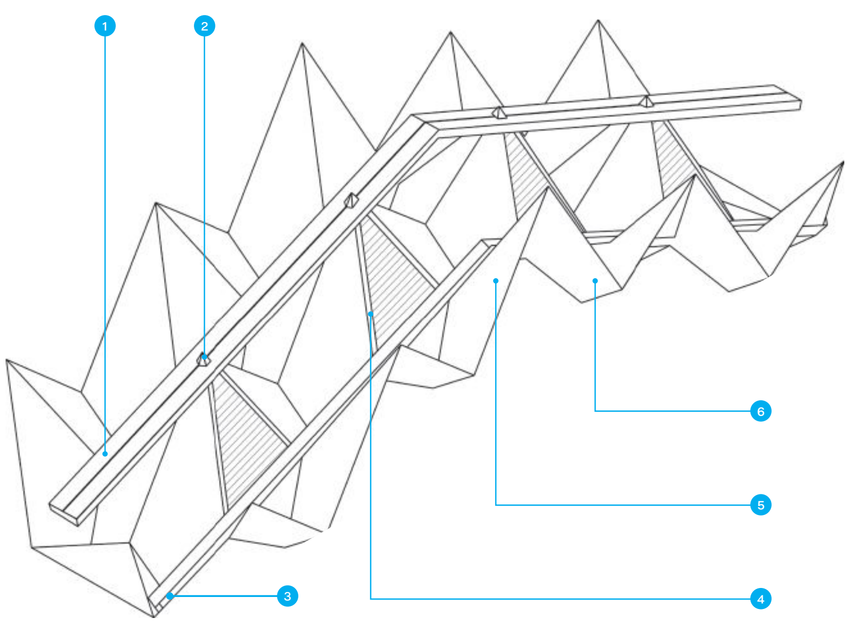
1. Polyurethane finish (not visible)
2. Elm strands, 0.5" × 0.1" × 10'
3. Pine purlins, 1" × 4.5" × 32' at 10" o.c.
4. Transverse wood frame (typ. 5)
5. Head
6. Body
7. Tail

nearly a dozen laborers built the pavilion in four sections in a Valencia warehouse and then erected the pavilion on-site. The shell is protected with a spray-applied polyurethane finish.

The café opened in 2015 and is now known as La Cigarra (The Cicada). To fund its construction, Amat proposed a public-private partnership and secured donations from local companies whose logos adorn the building's head and body.

The tail is unbranded except for a series of inconspicuous, laser-cut wooden tags running down the side of one of the pavilion's many folds that display only two names: Manolo Garcia and Tomás Amat Estudio de Arquitectura.

Miyahata Jōmon Museum Ceiling



In 1998, workers constructing an industrial park on the outskirts of Fukushima, Japan, made one of the largest archaeological discoveries in the country's modern history: the ruins at Miyahata, which date back to Japan's Jōmon period (circa 12,000 B.C. to 300 B.C.), populated by a hunter-gatherer culture credited with making some of the world's earliest ceramic pottery. ("Jōmon" is derived from the cord markings of the civilization's ornate pots.)

Japan's first museum dedicated to this period opened on that site last year, about 15 years after the original design competition was held. The winners, Tokyo-based Furuichi & Associates with Suzuki Sekkei, designed the 12,400-square-foot museum as a two-story, concrete structure whose main entrance hall sits atop the excavated ruins, which are illuminated and on display via an expansive glass floor.

Mirroring the irregular terrain of the exposed ruins is a dramatic ceiling-scape made of jagged wood panels that recalls the cave dwellings first used by Jōmon societies. The ceiling panels are structural, acting as truss-like members in a complex space frame and creating one of the first true wood-panel structures in Japan. "Even architects … ask me, 'Is it just a ceiling?'" says Tetsuo Furuichi, the firm's founding principal. "I say, 'No, this is structure.'"

The architects abstracted the flared shape of a "flame pot" (named for its flame-like ornamentation) into a hexagonal pyramid, forming an inverted

SHIGEO OGAWA

1. 12" × 6" pine glulam top chord (2)
2. Notch for pyramid apex
3. 14" × 4.7" pine glulam bottom chord (2)
4. 2 × 4 nailer (typ. at panel joints)
5. 1.2" medium-density fiberboard, 6'–12' long by 4'–9' wide
6. 5mm plywood veneer, flame-retardant (finished face)

wooden cone that they repeat to create the tessellated structure, which supports a gable metal roof that floats above the 2,900-square-foot entrance hall.

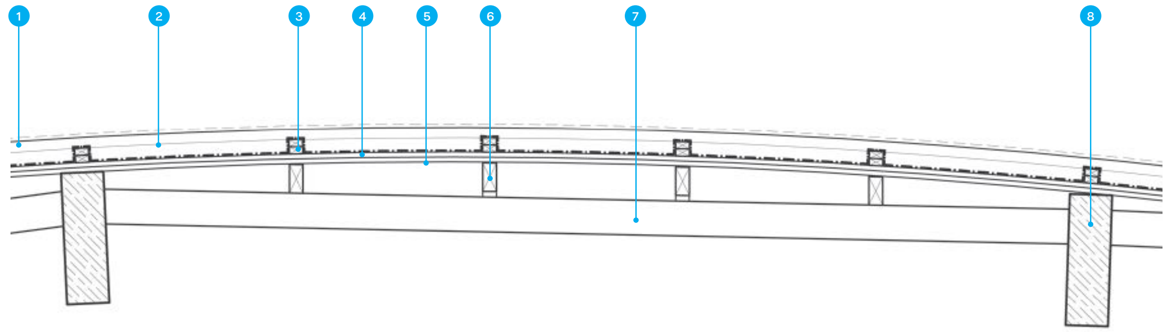
Designing the panel structure was as complex as it looks. "We were very confused at first," Furuichi says, "but with the help of the computer, we found some rules." The architects used Vectorworks to create a structure from three unique types of cones, each of which is made up of six kite-shaped panels, but the digital model was still too abstract. "We couldn't understand the actual space on the computer so we started making a [physical] model," Furuichi says. "We made many models."

However, the models weren't enough to prove the design's structural soundness to local government officials, who refused to issue a building permit until Masahiro Inayama, a well-known structural engineering professor at the University of Tokyo and timber expert who had collaborated on the museum's final design, personally reassured the officials of its integrity. The museum's future was also imperiled by the 2011 earthquake that destroyed the Fukushima Daiichi Nuclear Power Plant, just 40 miles to the southwest. Before construction began in 2013, the museum's site was stripped of its soil and tested for radiation.

Once the design was approved, it took three months to build the wood roof structure. Comprising pine-glulam top and bottom chords, offset approximately 9 feet, the base truss ties into the museum's primary concrete structure via two wide-flange steel beams that top the walls flanking the entrance hall. The chords are concealed from visitors below, preserving the crystalline effect of the repeating cone shapes, which are roughly 8 feet tall and 9 feet in diameter.

Each panel ranges between 6 and 12 feet long, and between 4 and 9 feet wide. Fabricated 20 miles from the site, the panels are glued together and screwed into perimeter 2×4s. The panels' edges are mitered to make the joints appear seamless, though many of the angles were adjusted on site by the general contractor, Ando-Gumi.

Inside, the panels are finished in a plywood veneer. Furuichi wanted to leave structural panels exposed, in a nod to the rough timbers used in Jōmon pit-houses, but building codes required a fire barrier. "I'm a little bit disappointed," Furuichi says half-jokingly. "This wood structure is too beautiful."



Sandibe Okavango Safari Lodge Wall

1. Cedar shingles
2. Pine battens
3. 2mm × 22mm × 44mm blocking
4. Roll-on acrylic waterproof membrane
5. ½" × 3" pine strips, 12' to 18' long
6. Secondary wood arch, 600mm o.c.
7. Twin 2 × 6 pine cross-bracing
8. Glulam pine portal arch frame

From the air, the Okavango River valley is a green gash through the arid grasslands of northern Botswana, about 50 miles east of the Namibian border. It was within this ecologically rich landscape—inscripted as a UNESCO World Heritage Site in 2014—that Nicholas Plewman was commissioned to design a luxury resort with minimal site impact.

The region is familiar territory for Plewman, the director of his namesake firm in Johannesburg, South Africa, who had built the property's existing lodge 16 years before. The area's landmarked status, however, imposed severe design and construction limitations on the new 11,500-square-foot resort, which includes 12 freestanding bungalows and a lodge, with a restaurant and lounge. Nearly all building materials would have to be biodegradable, and waste from the resort would have to be treated on site.

The design team, which included London-based architecture firm Michaelis Boyd Associates, turned to wood. "Timber became the necessary building material because of its biodegradability," Plewman says.

The family of intimate, wood-shingled structures nearly disappear into the riparian landscape and operate off the grid. The main building, an undulating, animalistic structure, winds through a copse of trees and comprises a "cocktail of timber," which Plewman says includes pine, cedar, eucalyptus, and massaranduba, much of which was sourced locally.

Rising 27 feet from the forest floor to its peak, the lodge is essentially an upside-down hull supported by large parabolic portal frames made from glulam pine. The frames are bolted to concrete footings—which were exempted from the biodegradable material requirement—and cross-braced with twin pine 2×6s. Secondary arch ribs, soaked in a nearby river and bent on-site, help support the butt-jointed pine strips that form the structure's wooden skin, "like the timbers of a boat," Plewman says. This plank sheathing is finished with a roll-on acrylic waterproof membrane and cedar shingles, which were sourced from Canada because of its limited availability locally.

The asymmetry of the portal frames caused many headaches. Each frame had to be broken into three sections—to maintain the specified radius per section and then joined with steel plates. "In total, 10 different radii were used, which meant that 10 different jigs were required by the manufacturer," Plewman says.

But when the timber arrived on site after a journey of more than 800 miles, at least half of the portals had warped. With the help of De Villiers Sheard Consulting Structural and Civil Engineers, in Cape Town, the architects drew the supplied sections in CAD and determined the new radii that would allow for a smooth form and be structurally sound. Local contractor Lodge Builders Botswana re-cut the glulam frames.

Such unexpected moments, Plewman says, can give a building texture and a more lifelike energy—which is what he wanted in the first place.

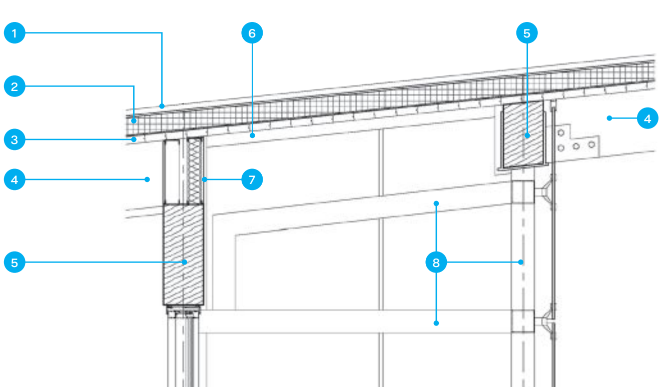
DOOK

Amazeum
Lobby Roof

The pristine slice of Ozark countryside set aside for the Scott Family Amazeum, in Bentonville, Ark., was rife with potential. But there was one design caveat. The 50,000-square-foot children's museum would sit at the entrance to the campus anchored by the iconic Crystal Bridges Museum of American Art, by Moshe Safdie, FAIA. But Memphis-based Haizlip Studio still wanted the new museum to be distinctive in its own right, so it topped the three-story main entrance and lobby atrium with a soaring glulam-pine butterfly roof.

Steel columns spaced every 30 feet tie together glulam joists that span across the lobby's 25-foot width. The joists subsequently support the four glulam beams that appear to run continuously along each side of the 150-foot-long lobby before turning up to create the gentle swoosh of the roof. In reality, these 30-foot-long segments butt together at the joists, tapering from 24 inches deep at the apex of the concave curve to 14 inches at their exposed ends at the roof eaves, and are capped with zinc cladding. The studio features zinc throughout the project because of Northwest Arkansas' former history as a hub for zinc and lead mining.

Transitioning between the stacked roof assembly inside and the composite wood structure outside created a challenge at the curtainwall façade. The complex detail occurs where the outermost glulam joist also appears as a fascia above the entrance. Between the joists and the roof deck, filling the interstitial spaces between the beam members, is a metal stud wall finished in exterior sheathing wrapped with a continuous weather barrier and zinc cladding. The metal studs attach to, and are aligned with, the width of the glulam joist below and a deflection head track that ties into the wood decking above. Reb Haizlip, AIA, the studio's founder and design principal, says, "It was that moment of, 'I've got to make this work.'"



1. Standing-seam metal roof in glacier gray, over 0.5" cover board
2. 4" polyisocyanurate insulation
3. 3" T&G pine decking with three coats of spar urethane varnish
4. 10.5" glulam beam, 14" to 24" deep
5. 10.5" glulam joist, 18" deep
6. Aluminum deflection head track
7. Zinc cladding and weather barrier over 0.625" exterior sheathing with metal framing
8. Structural steel framing (beyond)

JEFFREY JACOBS

Fondation Jérôme Seydoux-Pathé Headquarters Vault

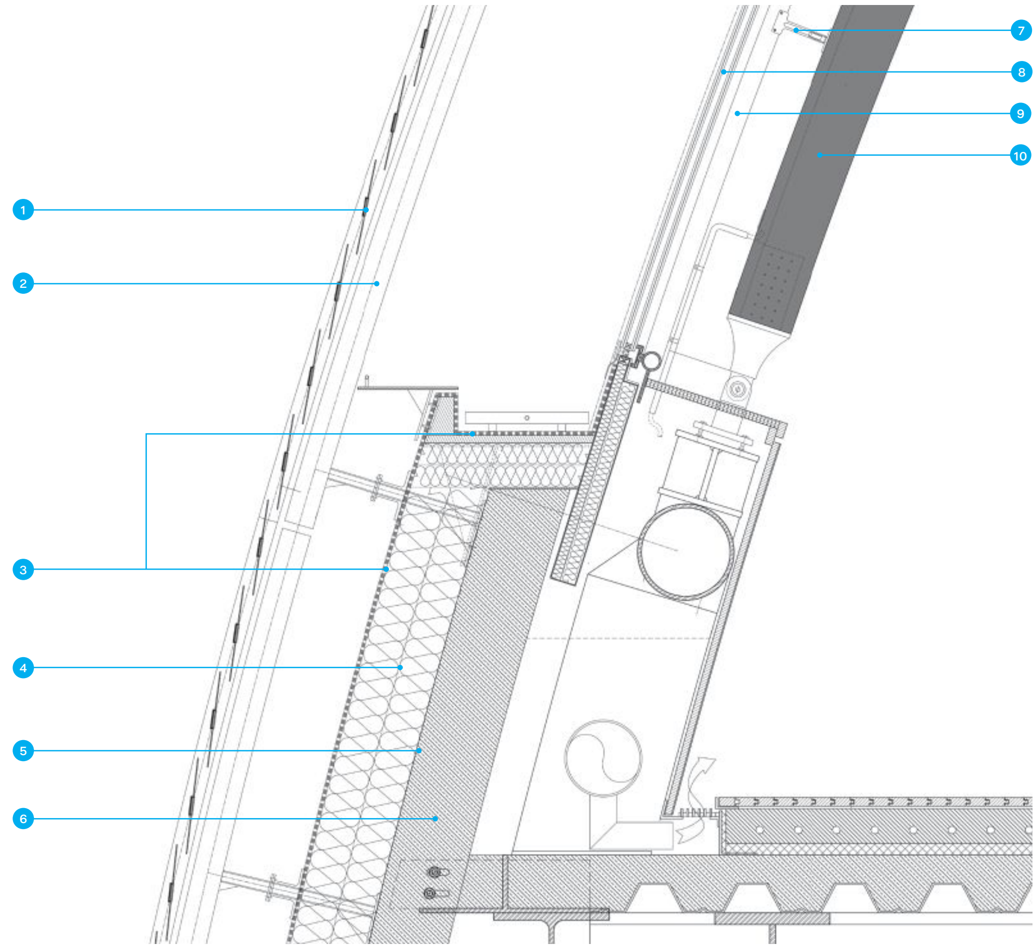
Necessity is the mother of invention, and at the new headquarters of the Fondation Jérôme Seydoux-Pathé, in Paris, a complex site with severe constraints gave rise to a shiny, bulbous, but elegant building that some critics have called one of Renzo Piano Building Workshop's (RPBW's) best works. The 23,000-square-foot, five-story structure houses offices, archives, exhibition space, and a 70-seat screening room for the foundation, which is dedicated to celebrating the legacy of the pioneering French film company.

Located on the historic Avenue des Gobelins, the 9,000-square-foot site widens and bends as it extends away from the street, and is hemmed in by a collection of mid-rise apartment buildings. Inserting a traditional, box-shaped building onto the site, says RPBW associate and architect-in-charge Thorsten Sahlmann, would have obstructed views and cast hard shadows onto neighboring structures. The design team began imagining how a creature might adapt itself to the site.

Completed in 2014, the result is a long, organically shaped, glass vault clad in perforated aluminum panels. The bulk of the structure's volume is concentrated near the site's center, where it rises five stories at its crest and then dips dramatically at its ends, rendering itself nearly invisible from the street.

Perhaps the building's most transcendent space is the fifth-floor research center, housed in the voluminous vault with 32 exposed

MICHEL DENANCÉ



parabolic wood arches, with spans ranging from 10 feet to upward of 50 feet. The longest arches assume a banana-like cross-section in midspan due to a 4-inch increase in depth as compared to the base, a structural requirement.

RPBW chose laminated larch wood for the arches, for both its look and flexibility. Sahlmann flew to the timber contractor Rubner Holzbau's fabrication facility in Bressanone, Italy, and approved each arch before it was transported to the site.

Given the site constraints, the largest arches had to be delivered in two pieces and then joined by embedded steel plates and bolts. The arches tie into a steel beam that runs the building perimeter and is braced by a double-curved steel superstructure, which ties into the concrete shell.

The vault shell, which comprises double-curved glass, creates a 100-foot-long domed skylight. Seven thousand curved aluminum panels, or lamellae, form an outer skin over the glazing, diffusing sunlight and shielding Pathé employees from curious neighbors.

Despite its similarity to an armadillo's plated carapace, Sahlmann maintains that any resemblance is coincidental—call it accidental biomimicry. Even the structure—with its rib-like glulam arches, double-curved glass shell, and overlapping aluminum scales—approximates the animal, whose armor consists of a bony bottom layer topped with keratin scales, or scutes. "When we designed the grid of the façade, it took us a little time to [reach] the current design," Sahlmann says. "Maybe we should've looked at [armadillos] earlier."

1. Perforated aluminum panel, 250mm
2. Painted steel tube, Ø 76mm
3. EPDM gutter and membrane
4. Insulation, 20mm thick
5. Vapor barrier
6. Concrete shell
7. Fabricated steel tie, length variable
8. Insulated glazing, double curvature
9. Painted steel tube, Ø 50mm
10. Glulam arch beam, dimensions variable

1. 2" × 10" roof rim joist
2. 2" × 6" pine slat (16" o.c.)
3. 6.75" × 16.5" glulam beam
4. 6" × 16" glulam central rafter
5. 6" × 16" glulam joist
6. Ø6" steel tube column (typ. 6)
7. White acrylic panel (beyond)
8. 1" × 3" cedar slat (3.5" o.c.)
9. 6" × 22" glulam floor beam
10. Ø4" Cor-Ten tube column
11. Galvanized steel cross-bracing

Mid-America Science Museum Treehouse

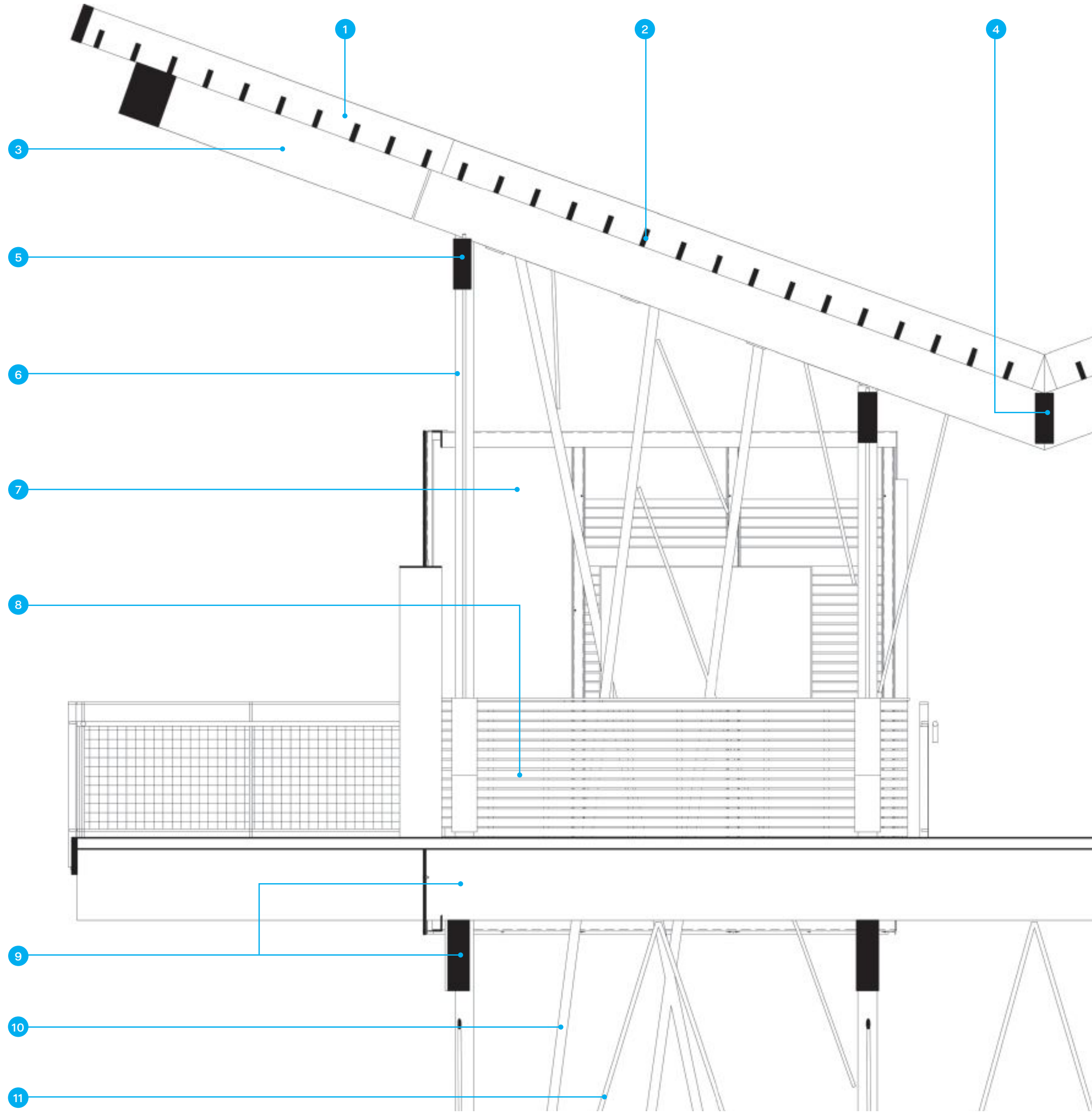
Nestled into the Ouachita Mountains just east of the Oklahoma border, an evanescent treehouse greets visitors on the skywalk of the Mid-America Science Museum, in Hot Springs, Ark. Designed by Little Rock–based Wittenberg, Delony, & Davidson Architects (WD&D), the 275-foot-long elevated walkway takes museumgoers from the main building, which opened in 1979, up into the forest canopy, through the treehouse, and to a spiral platform and net suspended 30 feet above a stream.

The 10-foot-by-24-foot treehouse takes on a winged form, inspired by the insects of the Ouachita National Forest. WD&D director of design and project co-leader Chad Young, AIA, wanted it to look as if "it could take flight." When illuminated at night, the treehouse appears like a firefly with its white skin, dramatic butterfly-roof canopy, and cantilevered viewing platform.

Its ephemerality is amplified by the lightness with which it sits on the landscape. "It was a balancing act of making sure it's a little bit hidden, and a little mysterious, but still very prominent and a real draw for museum visitors," Young says.

Completed in 2015 as part of the museum building's renovation and expansion, also by WD&D, the skywalk and treehouse were first proposed

DERO SANFORD



by Oakland, Calif.–based museum-exhibition design studio Gyroscope in a 2010 feasibility study. Early drawings showed a silver spaceship-like treehouse, but WD&D felt that the space needed to reflect the beauty of the site's 10 acres of oak and yellow pine.

The firm chose a material palette of pine, cedar, and Cor-Ten steel, and scaled back the size of the treehouse to simplify its engineering and to preserve existing trees. White acrylic panels and a bevy of galvanized steel turnbuckles provide lateral bracing (although some turnbuckles provide only visual contrast). The architects designed the treehouse in Autodesk Revit but also built a scale model illuminated by LEDs to test different lighting effects.

The treehouse's steel frame was the most challenging design aspect, Young says. The thicket of small Cor-Ten tube columns sprouts from a series of monolithic, 6-foot-deep concrete footings. "There are no right angles," he says. The southern wing of the butterfly roof cantilevers 22 feet, while the northern wing extends 15 feet.

Construction took roughly five months and was complicated by the site's running stream, not to mention the structure's complexity. "Nothing was repetitive," Young says. "We had to give [the steel erectors] a little tolerance on their connections to the wood beams."

The treehouse is a multisensory experience. Spray misters cool visitors during Arkansas' hot summer days, shrouding the treehouse in a dreamlike fog, and a bench plays ambient music when visitors touch both armrests, completing the electrical circuit. Throughout the project, Young says there was an atmosphere of discovery even among the design team: "You're imagining what it's like to experience science from a kid's point of view.

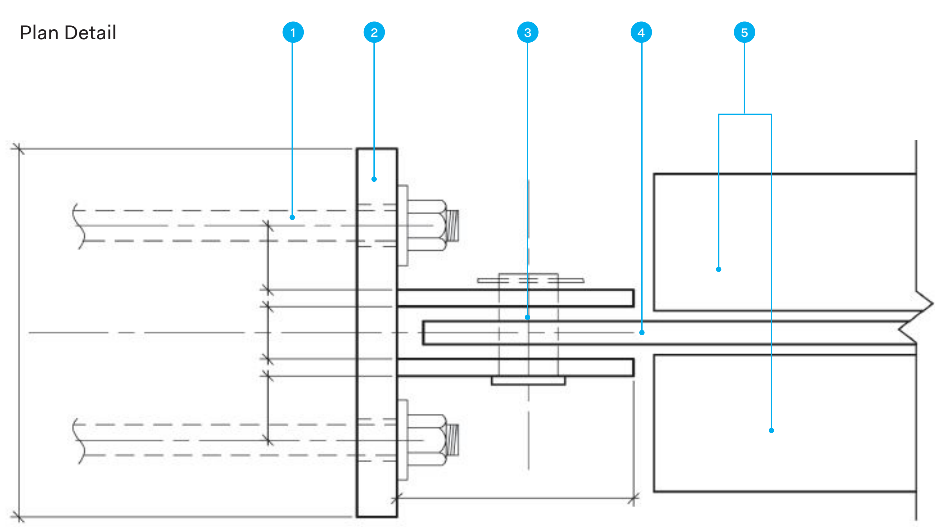
Grandview Heights Aquatic Centre Roof

The cables supporting the Grandview Heights Aquatic Centre's undulating roof, in Surrey, British Columbia, were designed as steel, to be anchored into concrete capitals atop V-shaped concrete pylons to form a catenary structure, with wood infill. Then Vancouver-based structural engineering firm Fast + Epp noted that wood alone could support the roof's tensile loads. This "aha" moment, says HCMA managing partner Darryl Condon, also in Vancouver, prompted the designers to ask, "Why don't we just use wood?"

The result is the world's longest-span timber-catenary roof, supported by what look like ribbons of Douglas fir up to 188 feet long. The cables enable a remarkably thin roof that defines the 95,000-square-foot structure.

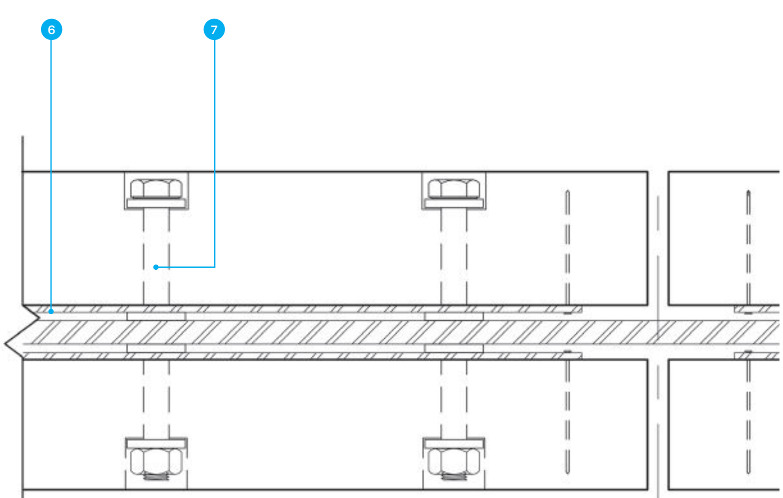
In fact, the thinness of the roof system was more critical than its clear span. A deeper structural system, Condon says, increases the potential for corrosion and condensation buildup due to high humidity of natatoriums. At 18 inches deep, which includes the wood roof deck, the thin roof was easier to sculpt, says Condon, who employed the catenary to express "a fluid form, something that would be reflective of the idea of water in motion."

Plan Detail



JOSHUA PETER ESTERHUIZEN

1. Ø29mm × 1500mm steel rod (typ. 2) anchored into concrete slab and 25mm nonshrink grout (not shown)
2. 38mm steel plate
3. Ø57mm pin and 16mm plate (typ. 2)
4. 22mm × 200mm steel plate
5. 5" × 10" deep Douglas fir glulam
6. 220mm × 800mm nailing plate (typ. 2)
7. Ø25mm ASTM A325 bolts, hot-dipped galvanized (220mm o.c.) with wood plugs



The architects modeled the structure in Autodesk Revit, varying the height of the roof according to the building program: higher for the diving platforms, lower for the entrance. Dozens of papier-mâché models followed, with HCMA settling on a sculpted roof form 380 feet long and 150 feet wide, interrupted only by the central concrete tower.

The final roof system is supported by more than 100 glulam cables, coupled and anchored into the post-tensioned concrete supports. By altering the cable lengths and bearing points (which range from more than 70 feet above finished floor to less than 30 feet), HCMA achieved its desired sculptural form using a single radius of 32 feet (down from more than a dozen radii in earlier iterations), lowering the cost of production significantly, Condon says.

Despite its unusual form, the roof was erected in just 12 days. The glulam cables, split into roughly 60-foot sections (for transportation purposes) were joined with a series of steel pins, whose holes were plugged with wood pegs, and lifted into place. The real challenge, Condon says, was getting the contractors and local code officials "to accept [an] unconventional structure. Whenever you try to do something different, you get a lot of resistance."

Condon hopes the center will further demonstrate the potential of timber structures. Architects "need to be more daring with wood," he says. "We need to challenge ourselves and challenge the industry to push its limits."

WOOD: HOSPITALITY FLAIR AND PERFORMANCE

Guests strolling the lobby of the 92-room Candlewood® Suites at Redstone Arsenal in Huntsville, Ala. will probably never know it's the nation's first hotel built with cross-laminated timber.

The first thing that strikes you about this particular four-story, 62,688 square foot Candlewood Suites hotel is … well, how typical it is. It looks just like hundreds of other Candlewood Suites facilities worldwide. It's exactly the brand experience Candlewood Suites guests expect.

A guest would never guess this all-cross laminated timber (CLT) structure was built in just 10 weeks with a crew of just three carpenters and eight laborers, slashing construction time by 37 percent and crew size by 40 percent.

They would never suspect the 1,200 CLT wall and floor panels used to build it were milled to within a 2-millimeter tolerance (less than 1/16-inch). Or that the hotel not only complies with all applicable building code but also meets the rigorous Anti-Terrorism Force Protection Standards administered by the U.S. Army Corps of Engineers Protective Design Center of Excellence.

More for Less

"It's just a stronger, better building that stores carbon. It lives up to our goal of doing more with less, a building built with fewer people in less time," says Lendlease program manager—construction, Jeff Morrow.

Lendlease is an international development, construction, and investment company. By agreement, Lendlease owns nearly 13,000 hotel rooms on 41 military installations as part of the Privatization of Army Lodging (PAL) program. The Intercontinental Hotels Group, which includes the Candlewood Suites brand, manages the PAL hotels.

The typical CLT floor panel of the Candlewood Suites hotel at Redstone Arsenal is 8 feet by 50 feet and 7 inches thick, weighing 8,000 pounds. The stairwell walls are 37.5 feet tall and weigh 3,626 pounds. The structure will sequester more than 1,600 tons of carbon, the equivalent of 349 passenger vehicles per year. All wood is third-party certified from North American forests.

Just three carpenters and eight laborers were required to build the 92-room structure. The laborers were recruited from the Still Serving Veterans organization and were up-skilled as CLT installers with on-the-job training. "As the construction industry continues to experience labor shortages, CLT helps Lendlease deliver a superior, innovative, and sustainable product in an exceptionally timely manner," says Lendlease program manager—construction, Jeff Morrow.

"We started looking at CLT as a good way to build some of our military base hotels," Morrow says. "The more I researched CLT, the more I liked it. One of the first places we considered was the hotel at Redstone Arsenal. The U.S. Army is always looking for ways to improve their built environment on a sustainable basis. They agreed with our CLT ideas."

Lendlease also built Forte, Australia's first luxury timber high rise apartment building at nine stories, with CLT. A 5 Star Green Star Project, the Australian green building rating system similar in concept to LEED, Forte delivered time savings of 30 percent over concrete and reduced 1,451 tonnes of $C0_2$—equal to taking 345 cars off the road for a year.

Labor Saver

"Today a lot of construction projects are slowed down because you don't have the right pros to finish the job," Morrow observes. "At Redstone, we only needed three carpenters from our 11-man crew because the panels were fairly simple and easy to install." Morrow said every piece arrived by truck "in reverse order of when we needed it. Every piece had a number and a specific location. I would call it a prefab structural frame."

For a labor-strapped construction industry, CLT represents a powerful way forward, says Morrow. "We shaved over a month off the critical path just for framing alone and finished it with a smaller crew. CLT construction allows you to build faster and safer than previous methods.

The Redstone project consisted of 1,200 CLT panels, 11 columns, 44 beams, and more than 201,000 CLT fasteners. All window and door openings were precut. To meet Army requirements, CLT exterior wall panels are 5 inches thick, with 3- and 4-inch interior walls, and 7-inch-thick floor slabs. The project delivered in March 2016.

Telltale Clue

To meet Candlewood Suites brand standards, the CLT walls and floors are covered in gypsum board and carpet, encapsulating the timber effect. So staff and guests may never suspect "the secret" behind their unique hotel. However, there is one telltale clue according to Morrow: quiet.

"The hotel significantly exceeds sound performance requirements. You will notice the silence right away but you won't know why. You won't hear your neighbors. You won't hear people walking overhead," Morrow says.

Just the Beginning

The Redstone facility is the fourth CLT project Lendlease has delivered worldwide. "Right now we're talking with several clients around the country about CLT projects. We're currently pricing up multiple projects and looking to do more.

"I love CLT. It's a great new way of moving forward."

Owner: Lendlease

Architect: Benham (formerly Leidos of St. Paul, Minn.)

General Contractor: Lendlease

Photo Credit: Lendlease

Location: 3440 Aerobee Road, Huntsville, Ala.

Year Completed: 2016

About Lendlease

Lendlease is a leading international property and infrastructure group. Listed on the Australian Securities Exchange and with circa 12,000 (June 2016) employees worldwide, Lendlease's capabilities span the property value chain.

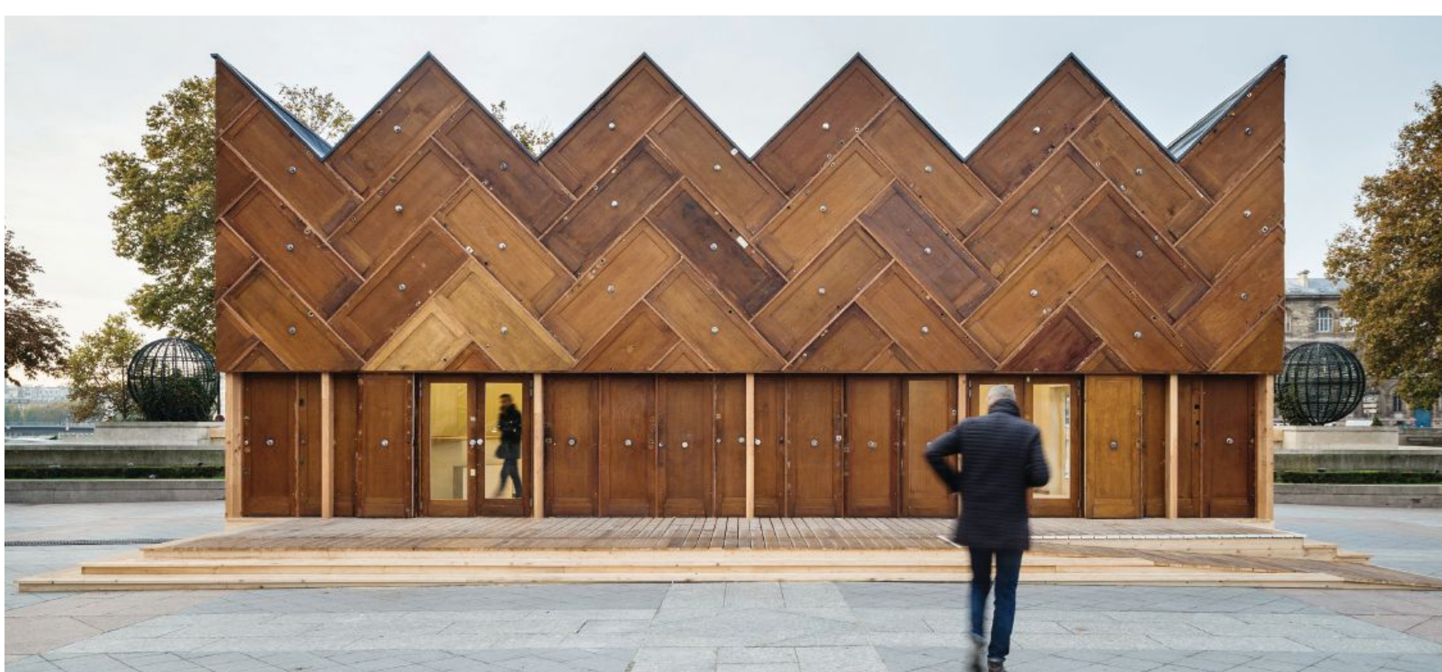
The Americas region, headquartered in New York, offers core capabilities in development, construction, communities and investment management services.

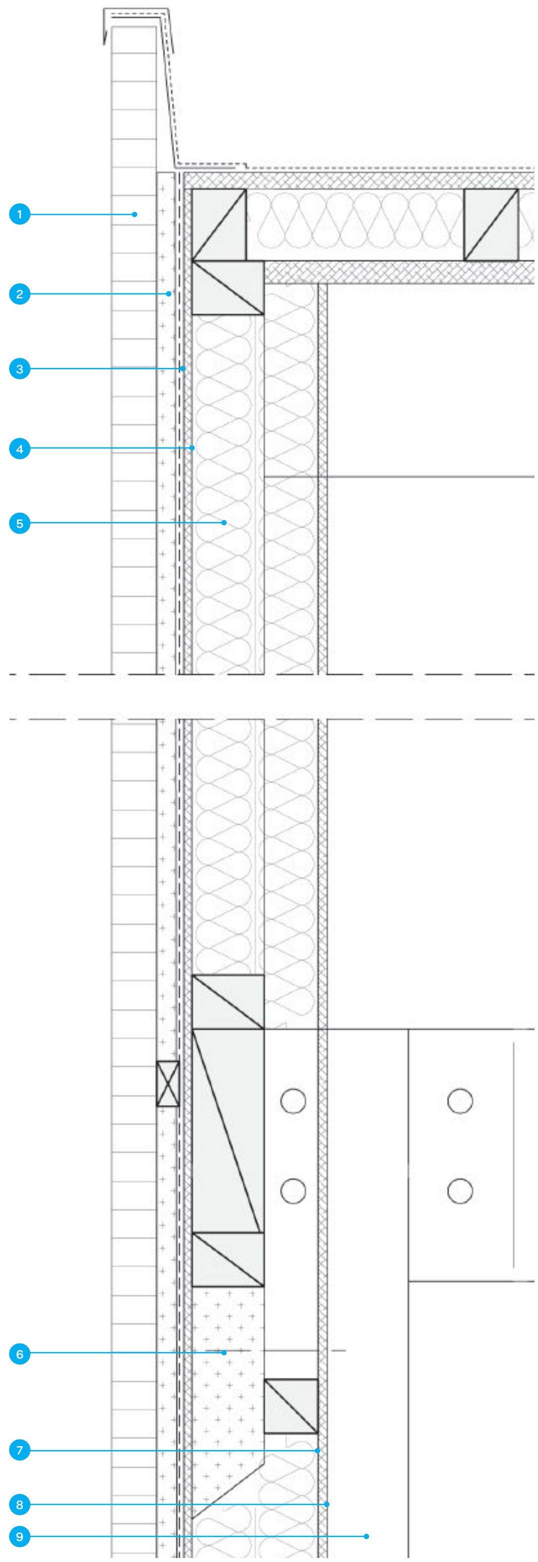
Circular Pavilion
Façade

With the exception of nearly 180 doorknobs, the Circular Pavilion is anything but round. The skin of the 750-square-foot polygonal café and event space in Paris comprises reclaimed doors salvaged from a public housing project in the city's 19th arrondissement. Rather, the temporary structure designed by local firm Encore Heureux and erected in front of City Hall is named for the aspirational circularity of the life cycles of its components.

Reclaimed materials make up 80 percent of the open, stick-framed pavilion with a sawtooth roofline and 20-foot-high ceilings. It is a statement about global sustainability—the pavilion was on display during the Paris Climate Conference a year ago—but it is also an experiment in allowing found materials to drive the design process and to create networks between the building industry and public services.

The project emerged from Encore Heureux's 2014 exhibition "Matière Grise" ("Grey Matter"), which explored the often invisible impacts of a building, such as waste. Partnering with the city, which helped sponsor the exhibition, the firm engaged municipal personnel





1. Solid oak door, 38mm
2. 25mm × 50mm wood slat (60mm o.c.)
3. Waterproofing membrane
4. 9mm OSB sheathing
5. 70mm mineral wool insulation
6. Spruce frame
7. Vapor barrier
8. Reclaimed wood panel, painted
9. 100mm × 240mm Douglas fir post

into realizing the pavilion. Maintenance workers and garbage collectors, for instance, helped divert chairs from the city's curbside furniture pickup service.

And then there's the envelope of doors. In May 2015, three months away from the pavilion's scheduled opening, Encore Heureux got a call from the city: It was removing 400 wooden doors from a 1936 housing project. Immediately, firm architect and partner Nicola Delon went to see the doors. "Wow," he said. "They're perfect."

Encore Heureux worked with the city to time the housing project's deconstruction with that of the pavilion's construction, arriving onsite on the day the doors were removed. The doors were trucked to a city facility, stripped of hinges and locks, and then shipped to the pavilion site.

To account for variances in the sizes of the doors, some of which were significantly warped, the designers left a 0.75-inch joint between doors, filling the gaps with scrap wood painted to match. "The people from the city are good at making the right color because most of the time they work with historical buildings," Delon says.

The pavilion will soon be moved to its new home along the Petite Ceinture, a former railway that encircles the city. Delon hopes the structure has made an impression. "When you find ways to not waste, you find positive energy," he says. "Two centuries ago, we'd go to the forest. Now, we go to the city. It's a change in paradigm."

CYRUS CORNUT/MATIGNON

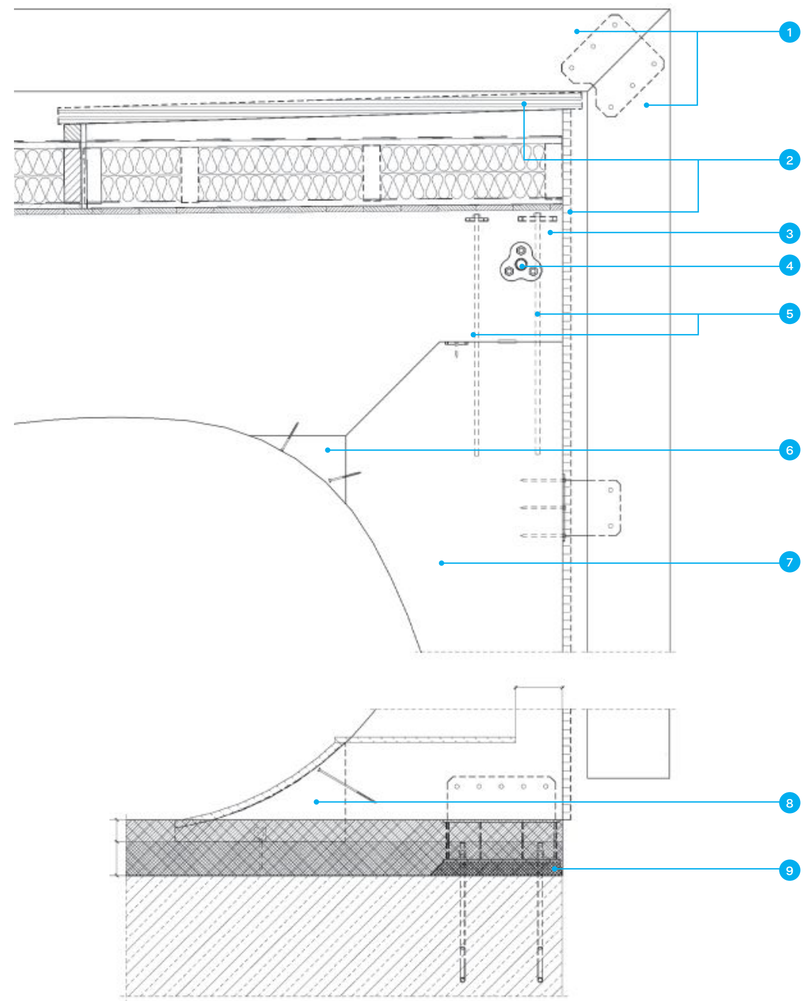
Guastalla School
Portal Frame

STUDIO MAGGI / MORENO MAGGI

In Carlo Collodi's *The Adventures of Pinocchio*, published in Italian in 1883, the puppet reunites with his father in the belly of a giant whale, a metaphor for a mother's womb. The scene inspired Bologna, Italy–based Mario Cucinella Architects (MCA) to craft a continuous volume of open play spaces defined by cutouts made in a series of 50 wall planes, or ribs, for a nursery school in Guastalla, a town in northern Italy.

The rectangular larch glulam portal frames, spaced approximately 4.5 feet apart, define the exterior of the 230-foot-long southern half of the 15,000-square-foot facility. Matching glulam roof and wall fins give the appearance of the frames projecting beyond the building's glazed envelope. Inside, the whimsical curves appear to continue into the oak flooring, creating play surfaces and half-pipe-like slides that students can climb. "Every element," says MCA founder Mario Cucinella, "takes into account the pedagogical and educational [needs] related to the growth of the child, from the shape and the organization of the interior, to the choice of materials." The wood not only offers students myriad tactile and sensory experiences, but also as a connection to a nearby forest.

Each 160-millimeter-thick glulam frame comprises three primary pieces—a 15-foot-tall exterior column, an 11-foot-tall interior column, and a 59-foot-long beam—that were assembled on site. The beams span over the interior column of the portal frame to top the northern half of the



1. Exterior glulam roof and wall fins
2. Insulated glass panel and curtainwall
3. 160mm larch-glulam beam, 59' long
4. Ø16mm steel rod
5. Embedded threaded rod and knife plate
6. 160mm larch-glulam wedge
7. 160mm larch-glulam column, 15' tall
8. 160mm larch-glulam wedge
9. Metal shoe isolation pad

school building. MCA used generative algorithms in Grasshopper and Rhino to create the unique cutout shape in each frame. To maintain structural integrity, the team fixed the shape of the wall bases from the floor to 3.5 feet above finished floor and specified that columns had to be at least 1 foot wide. "The last parameter was 'aesthetics,' but there's no command for it in Grasshopper," Cucinella says.

For the beam-to-column joint, MCA worked with Bressanone, Italy–based timber fabricator and supplier Rubner Holzbau to detail a connection of embedded threaded rods in the glulam wood that bolts to the roof. "No metallic element is visible," Cucinella says. The glulam columns are braced with steel rods for lateral stability and seismically isolated from the concrete foundation with metal "shoes," which are then anchored to the foundation.

Fabricators used CNC machines to cut the glulam beams and columns, but Cucinella says the equipment was not accurate enough to navigate the curves at each beam-to-column and column-to-floor joint without the risk of ripping the wood at these thin transition points. Instead, the wedges were cut separately, which also help ensure the frames' safe transport to the site. The wedges, which taper to a fraction of an inch, were then finished with a triangular piece of larch.

The school was originally housed in two facilities, both of which were badly damaged in earthquakes that struck the country in May 2012. During the rebuilding effort, classes were held in the local city hall. "[The nursery] was built with some urgency," Cucinella says. Once the project began construction, in 2015, it was completed in just eight months.

Lot.1 Interior

BRETT BOARDMAN

For many American tourists in Australia, the "flat white" is a curious staple of Sydney's coffee culture. In the flagship restaurant and café of coffee roaster Primo, the latte-like drink that combines espresso and milk served as the inspiration for its interior design, by local firm Enter Projects.

Lot.1 occupies two levels of a former warehouse space in a late Victorian building on York Street, in the city's central business district. To juxtapose the existing brick and sandstone walls and timber beams, Enter Projects inserted a multistory 3D ribbon of wood that swoops and spirals from the café to the restaurant, as if it was poured into space and given a stir. The wood assumes multiple dimensions and functions, including a partition, shelving, seating, and the main bar top.

The idea came during a meeting with the client, says Enter Projects director Patrick Keane, an Australian who studied architecture at Princeton University. "I looked at my [freshly poured] latte and said, 'Why don't we do that? ... It's a 3D billboard for what you guys do.'"

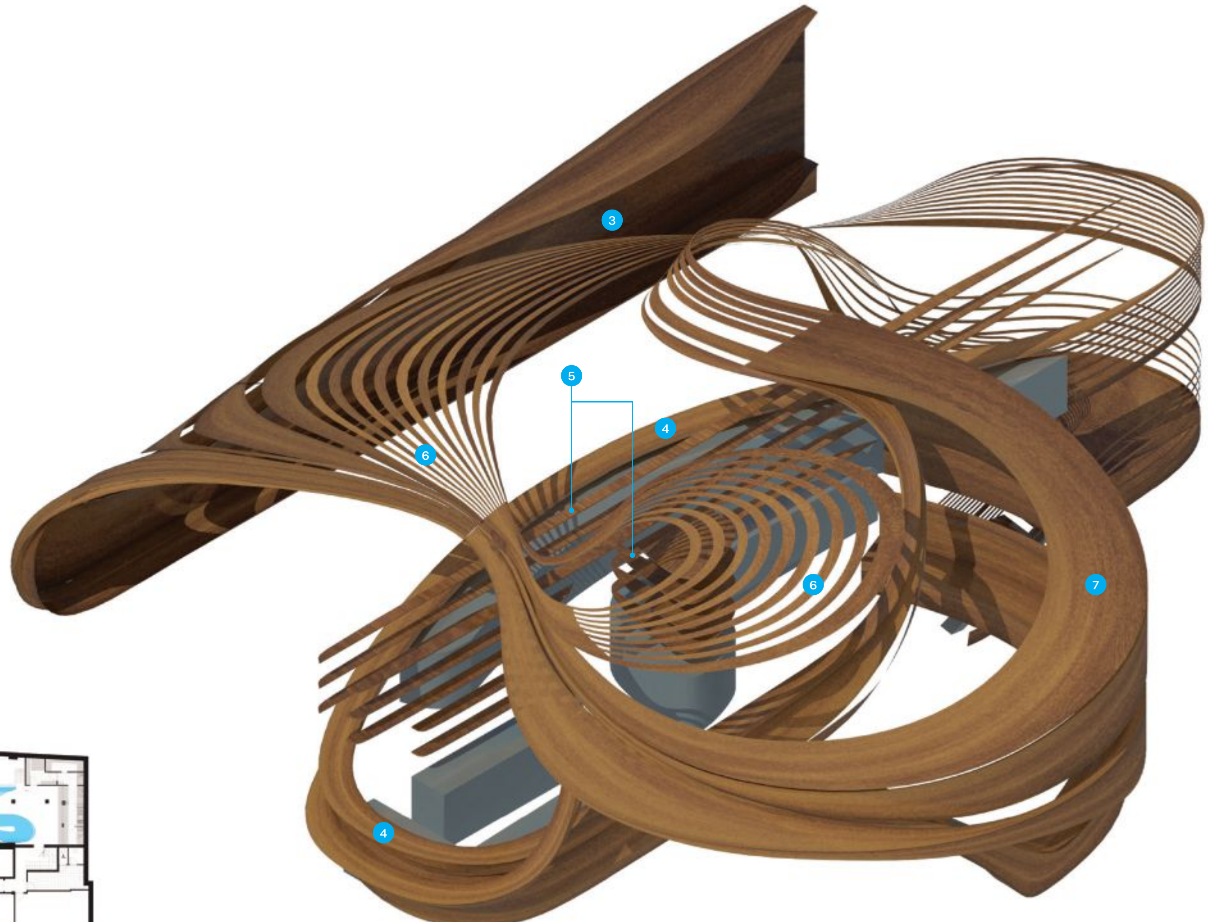
To test how this idea would work physically in space, Keane drew a single circle in Maya and began duplicating it, overlaying the resulting shapes onto a plan of the space. He found that, in addition to being a centerpiece, the ribbon created "elastic geometries"—non-uniform, curvilinear spaces—that made circulation more natural.

Wood was chosen for its caramel color, which matches the tone of espresso's rich crema, and its natural grain, which adds visual interest. Sydney also has a bounty of boatbuilders, whose techniques and technologies would be vital to realizing the structure—and who would know when "the right angle is the wrong angle," Keane says.

One unexpected finding was that the piece could be almost self-supported, though at its highest points, the wood is tied into the building with black threaded steel rods for additional support.

The resulting form comprises a thin, workable skin of plywood, totaling 1,500 linear feet, with a veneer made of native Australian blackbutt (a type of eucalyptus) around a skeleton of structural plywood ribs. Spaced every 10 or 20 inches, the abstract and curved ribs were reverse-engineered from the firm's 3D model using Grasshopper.

To fabricate the curving and twisted elements, the curving geometries had to be "unwrapped," Keane says, flattened, and sent to Lasermade, a local CNC-milling company that specializes in boat manufacturing. Lasermade cut the individual components, including the 9-millimeter-thick ribs and the



Floor Plan

1. Restaurant
2. Café
3. Banquet seating with slotted wood feature wall
4. Hardwood bar top
5. Shelving
6. Decorative soffit
7. 3mm-thick plywood with blackbutt veneer cladding over 9mm-thick plywood ribs (dimensions vary)

3-millimeter-thick plywood and veneer puzzle pieces, from roughly 4x8 panels. The final shapes range from 3 feet to just 9 inches in width.

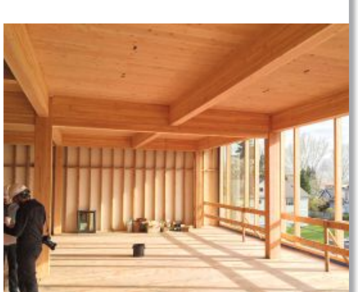
Starting with a single plywood layer, the ribs were secured with the traditional boatbuilding method Keane facetiously describes as “glue and screw.” Some elements, such as a suspended waffle ceiling above the bar, were prefabricated on site. Nylon zip ties held the curved panels together while the glue dried, and then were removed after 48 hours.

Ensuring individual elements of the complex sculpture didn’t “clash or intersect” was a challenge, Keane says. “You’ve got pieces twisting and flying around all over the place. We were on site a lot.”

Using laser dimensioning, the team turned the site into a giant 3D grid in order to cross-reference the location of individual pieces. “It was a bit like *Tron*,” Keane says, referring to the 1982 sci-fi film in which characters battle inside a video game–like grid.

The final product is mystifying, which pleases Keane. “There’s a sense of the infinite or the impossible to it, and I think architecture needs to possess those qualities a bit more,” he says. When something appears to contain intrigue or magic, he adds, “that brings a lot of visual entertainment to the public.”

Mass Timber in North America



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“These questions of affordability, access, and class segregation are significant enough that it somehow pushes architects to try to justify their work.”

The Myth of Trickle-Down Innovation by Elizabeth Greenspan

In late October, PennDesign hosted a daylong series of panels on innovation in urban housing design, and the first one, "Super-Hot: High Pressure Economic Markets," showcased some of New York City's most spectacular and expensive new condos. There was Zaha Hadid's West 28th Street residence—the $50 million penthouse is "still on the market, actually," firm director Patrik Schumacher said—Herzog & de Meuron's "Jenga Tower" at 56 Leonard, and ShoP Architects' superskinny aerie on West 57th. Part of the symposium's novelty was that it brought together architects, scholars, developers, and investors, or, as Barry Bergdoll, professor of art history at Columbia University and the first panel's moderator, put it, "voices that generally speak separately." This meant that the gorgeous renderings of New York City supertalls were interrupted by a PowerPoint presentation from Mark Willis, senior policy fellow at New York University's Furman Center on Real Estate and Urban Policy, who noted that ultraluxury housing constitutes only 2 percent of sales in Manhattan.

It was a striking counterpoint, a reminder that the opening panel was dominated by such a tiny sliver of New York's highly pressurized housing market, and during his moderating session, Bergdoll seized on it. "Is innovation only going to be at the top 2 percent of the market?" he asked. Chris Sharples, AIA, co-founder of SHoP, jumped in. "It's really hard to finance affordable housing," he said. To make it easier, "we need to break out of the conventional way of building. … High-end has more room to do that, and it should trickle down on affordable." His fellow panelists nodded.

> "Is innovation only going to be at the top 2 percent of the market?"
>
> —Mark Willis, senior policy fellow, Furman Center on Real Estate and Urban Policy

Sharples' claim that innovation will "trickle down" from luxury projects to affordable ones inevitably brings to mind President Ronald Reagan's discredited idea that cutting taxes for top earners generates wealth for those of us in lower income brackets. But perhaps it's worth considering the claim more generously: after all, big budgets may enable designers to experiment more freely with expensive materials and technologies, and maybe, over time, these innovations will become cheaper and more relevant for less-expensive projects. At least, that's the theory. Are there examples of innovation trickling down? Designers at Penn's symposium quickly moved on to other topics, leaving that question unanswered.

Innovation Through Constraint

I called Michael Maltzan, FAIA, who won this year's AIA Los Angeles Gold Medal, the chapter's highest honor, partly because he has pioneered housing concepts for formerly homeless populations, and partly because he did not participate in the PennDesign symposium. He was skeptical that innovations can trickle down. "Perhaps they do," he said, gingerly.

Maltzan said he thinks creativity emerges more from on-the-ground constraints, from "responses to very specific social, political, and economic lifestyle questions." He cited his firm's New Carver Apartments, one of four projects they've done with the nonprofit Skid Row Housing Trust. It's a 97-unit, six-story building for formerly homeless elderly and disabled individuals, located immediately adjacent to the Santa Monica Freeway—or as Maltzan put it, "the round one." The building, completed in 2010 at a cost of $18.4 million, has a unique cylindrical form which blunts noises from the highway. "The round cylinder was a direct result of trying to present the smallest amount of the façade to the cars as possible," Maltzan said. In addition to managing acoustics, the circular design creates a central courtyard that hosts community spaces, and, as importantly, catches drivers' eyes as they zoom past on the highway. "For that formerly anonymous community," Maltzan said, "it is saying, 'We are here.'"

As we spoke, I was struck by how many of Maltzan's projects have required creative workarounds because of regulations. When the architect began designing the Star Apartments, another Skid Row Housing Trust project, completed in 2014 at a cost of $40 million, the city of Los Angeles did not allow multifamily prefabrication. It quickly became clear to his team, however, that prefab would enable them to build more quickly and therefore more cheaply. "The first thing we did was work with the city to create a pathway, to create a pilot project," Maltzan said, for multifamily prefab. More recently, the firm's Crest Apartments, which re-imagines LA's "dingbat" style, in which a few floors of apartments sit over parking spaces, required similar negotiations. For the project, completed last year at a cost of $22 million, Maltzan and the Skid

> "We need to break out of the conventional way of building. … High-end has more room to do that, and it should trickle down on affordable."
>
> —Chris Sharples, AIA, co-founder, SHoP Architects

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Row Housing Trust wanted to devote the first floor to a park rather than parking, as is traditional. "The building is still lifted up," he said, "but the whole ground floor becomes a very porous, into the ground, outdoor community green space." To enable this new take on the form, he and the Housing Trust convinced the city to reduce the parking requirements for the site.

Oddly enough, Maltzan's stories reminded me of the way that Chris Sharples of SHoP described his firm's work when we spoke after the symposium. The key to design innovation, Sharples kept telling me, is "the process" rather than "the product." SHoP spends about 12 to 15 percent of its budget on research and development, and Sharples said that most of this investment goes towards rethinking the ways the firm collaborates with the multiple teams that help build a building. "It's how we negotiate relationships between trades, design, and construction process," he said. Consider SHoP's 57th Street supertall, the world's skinniest residential building, whose delicate terra-cotta façade required close work with manufacturers. First, Sharples told me, the firm consulted with the manufacturers to learn more about the material. "Then, we developed models, and we shared these models with them, they came back with feedback, and we evolved the design based on how they're going to fabricate. It's a very circular, iterative process," he said. Both SHoP's superskinny tower and Maltzan's residences with the Skid Row Housing Trust made difficult sites livable by challenging or changing habits, regulations, and norms through mundane, time-consuming back-and-forth between teams.

These iterative communications aren't always smooth, of course, but even those instances underscore the importance of collaboration. Brian Phillips, AIA, principal of Philadelphia-based Interface Studio Architects, a lecturer at PennDesign, and one of the symposium's organizers, told me about

his firm's 100K home. After the recession in 2008, Interface worked with developer PostGreen to design a 1,000-square-foot energy-efficient townhouse for just $100 per square foot. Keeping the price low required, among others things, an open floor plan with only one interior door. Buyers jumped at the contemporary design, but some had trouble securing a mortgage; banks thought the open plan was too risky. Phillips said that in some instances they built walls to satisfy the banks, and then tore them down after closing. "I feel very strongly that designers have their most intense potential to impact innovation in being able to speak the languages of the legal team and the finance team," Phillips said. "There's a lot of architects—frankly, there's a lot of clients—who say, the architect is the artist. Let's figure our stuff out, and we'll call the architect to make it look nice." Phillips believes it's time for architects to rethink and broaden their role.

A Question of Inequality

Which, perhaps, includes thinking more fully about how housing design intersects with today's real estate market. Notably, no one I talked to managed to provide a specific example of innovation trickling down from luxury to affordable housing. Even Sharples seemed more interested in discussing collaborative processes than his trickle-down comment. But the rhetoric itself is timely. A few days after the PennDesign symposium, Patrik Schumacher, at the World Architecture Festival in Berlin, made news for a provocative but retrograde eight-point plan to remake urban housing through privatization and deregulation. (He was more conciliatory at PennDesign.)

Does there need to be a relationship between high-end and affordable housing design? Maltzan told me he doesn't think so. "It is interesting that this question of affordability, access, and class segregation is significant enough that it somehow pushes architecture and architects to try to justify their work," he said. "I think architecture is broad enough to work with many different types of economies, and that's okay."

At a time when so many people lack access to good quality homes, perhaps the claims of trickle-down innovation reflect just how pervasive the problem of inequality is. Architects may want to play a greater role in alleviating unequal access to housing, and they might harbor an understandable unease with luxury projects at a time of increasing urban inequality, but that doesn't change the way that innovation actually works.

“It is also, as a work of architecture, the most thoughtful, the least predictable, and the most encouraging about the trajectory of American architecture.”

SO–IL’s Shrem Museum at UC Davis by Christopher Hawthorne

Three new museum buildings and one high-profile museum addition have opened in California over the last 15 months: The Broad in Los Angeles and the University of California Berkeley Art Museum and Pacific Film Archive, both by Diller Scofidio + Renfro (DS+R); the expanded San Francisco Museum of Modern Art, by Snøhetta; and the Jan Shrem and Maria Manetti Shrem Museum of Art at the University of California at Davis, by Solid Objectives–Idenburg Liu (SO–IL) with Bohlin Cywinski Jackson (BCJ).

The Shrem Museum, which opened on Nov. 13, is by a significant margin the smallest (at 30,000 square feet) and the least expensive (at $30 million) of the four. It is also, as a work of architecture, the most thoughtful, the least predictable, and the most encouraging about the trajectory of American architecture. A single-story structure wrapped in pre-cast corrugated concrete and curving walls of glass that is topped (and from certain angles nearly concealed) by a sloping white canopy of triangular, perforated-aluminum beams, it is not a perfect building by any means, or even an especially consistent one. It is very much the product of an emerging firm, SO–IL, that is trying to find its voice and shrug off the influence of the Japanese office SANAA, where its two founders, the married architects Florian Idenburg, INTL. ASSOC. AIA, and Jing Liu, were both employed when they met in 2001. (Idenburg is 41 and Liu 36, which makes them still very young by architectural standards.) The shadow of SANAA's 2006 Glass Pavilion at the Toledo Museum of Art, a project both architects worked on, falls unmistakably on the Shrem.

What it has that those three other California museum projects do not is some authentic—which is to say some genuinely tentative and unfinished—feel for the future of museum design. It is a building that plants seeds as much as it reaps the benefits of an established point of view. Rather than rushing to win old arguments or finding ways to express in built form unrealized ideas from earlier projects (the latter of which has become an unfortunate DS+R trademark), SO–IL has suggested new avenues with the Shrem, especially in terms of something we might best identify as tone.

Unusual Freedom for a University Project

The museum occupies the southern edge of Vanderhoef Quad, just outside the campus proper and backing up against some train tracks and Interstate 80. (On the other side of the freeway lies an open, largely agricultural landscape.) Next door, on the western edge of the quad, is the Mondavi Center for

The Shrem Museum, which is located about a 10-minute walk from the center of UC Davis' campus

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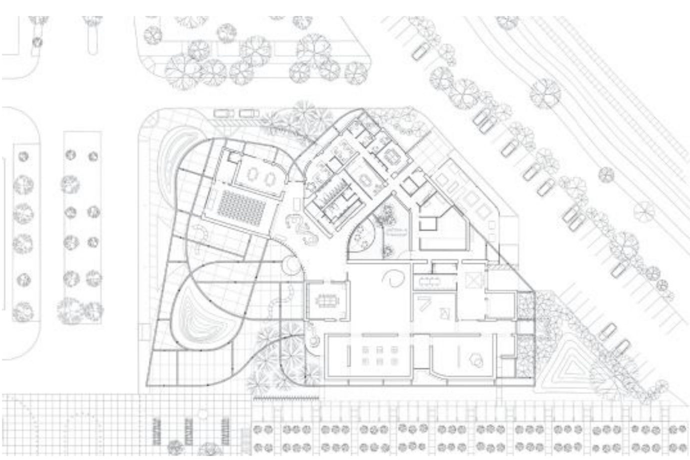
the Performing Arts, a stocky, broad-shouldered 2002 building by Portland, Ore.-based Bora Architects.

UC Davis, which is located 15 miles from the state capitol building in Sacramento and about an hour's drive from San Francisco or Berkeley, and which enrolls a total of 35,000 students, has never before had a purpose-built art museum, though the roster of artists who've either studied or taught there is impressive, including Robert Arneson, Wayne Thiebaud, William T. Wiley, Bruce Nauman, Deborah Butterfield, and Manuel Neri.

After settling on the site on the edge of Vanderhoef Quad—about a 10-minute walk from the center of campus—the university launched an architecture competition for the museum, ultimately narrowing its list to WORKac, the Danish firm Henning Larsen, as well as SO–IL and BCJ. The competition was organized to produce a design/build team for the museum; SO–IL and BCJ joined with construction-management firm Whiting-Turner.

Though the location is not ideal in terms of its proximity to campus, the site and its relative lack of immediate architectural context did allow the finalists an unusual amount of freedom for a university project. The shortlist—varied but within a fairly narrow range—signaled that the university and its



Site plan for the museum

campus architect, Clayton Halliday, AIA, knew what they were doing. I visited UC Davis when models by the three teams were on display; unlike the way Eli Broad kept the design competition for his downtown Los Angeles museum entirely under wraps, this one was meant to be public at nearly every step.

SO–IL and BCJ won the competition in the spring of 2013 with a proposal for what Idenburg described at the time as "a patchwork of geometric forms that refers to the agricultural landscape and the vast horizon that you have here." The goal was both to knit the design into its site—on a joint between campus and open farmland—and to suggest some new flexibility in museum architecture, what Idenburg called "a stage on which all these different things can happen."

The final product is somewhat less graceful and light on its feet than the design that prevailed in the competition. For seismic reasons, the columns holding up the canopy are thicker than originally planned, with makes the entire courtyard somewhat more earthbound than I'd hoped. (This is an example less of dreaded value-engineering than plain old engineering-engineering, not to mention a reminder of what goes into the mastery of an office of perfectionists like SANAA.) Still, as a welcoming and public-minded gesture—the roofline reaches out toward the sidewalk, ringing the museum site and bringing visitors beneath its protective embrace—it has real power. The remarkable, shifting shadows cast by the beams above and the peaked opening at its center are also suggestive of a range of successful metaphors, endorsing the idea of a fluidity, permeability, and difference as opposed to the fixed canon of both architectural and art-historical ideas that once shaped most museums. This is an especially important set of ideas in California, and at a university associated with a group of artists whose work was eager to break from rigid East Coast and European formulas.

The plan of the museum resembles a four-leaf clover, with the courtyard beneath the canopy making up the first leaf. Inside, three modestly scaled wings splay out behind a small but not cramped entry hall, which is edged by curving floor-to-ceiling glass, the clearest echo of Toledo. A large multipurpose room is off to the left, museum offices and art studios in the middle, and roughly 10,000 square feet of gallery space to the right. A smaller interior courtyard fills the space between the office and gallery wings. In elevation these three interior wings read as separate boxes, of different heights, separated by circulation areas lined in glass and brought into some kind of alliance by the canopy.

The galleries themselves, with mechanical systems visible above a metal-mesh ceiling, are arranged in a tight loop, sending visitors away from the sunlit entry hall toward the rear of the building and then back again. (The galleries vary in height, with the tallest reaching 17 feet.) This path ends in a small but dramatic gallery looking out over the main entry plaza.

The intelligence of the completed museum lies in its sobriety and directness, and perhaps most of all in its interest in stripping away the layers of mannerism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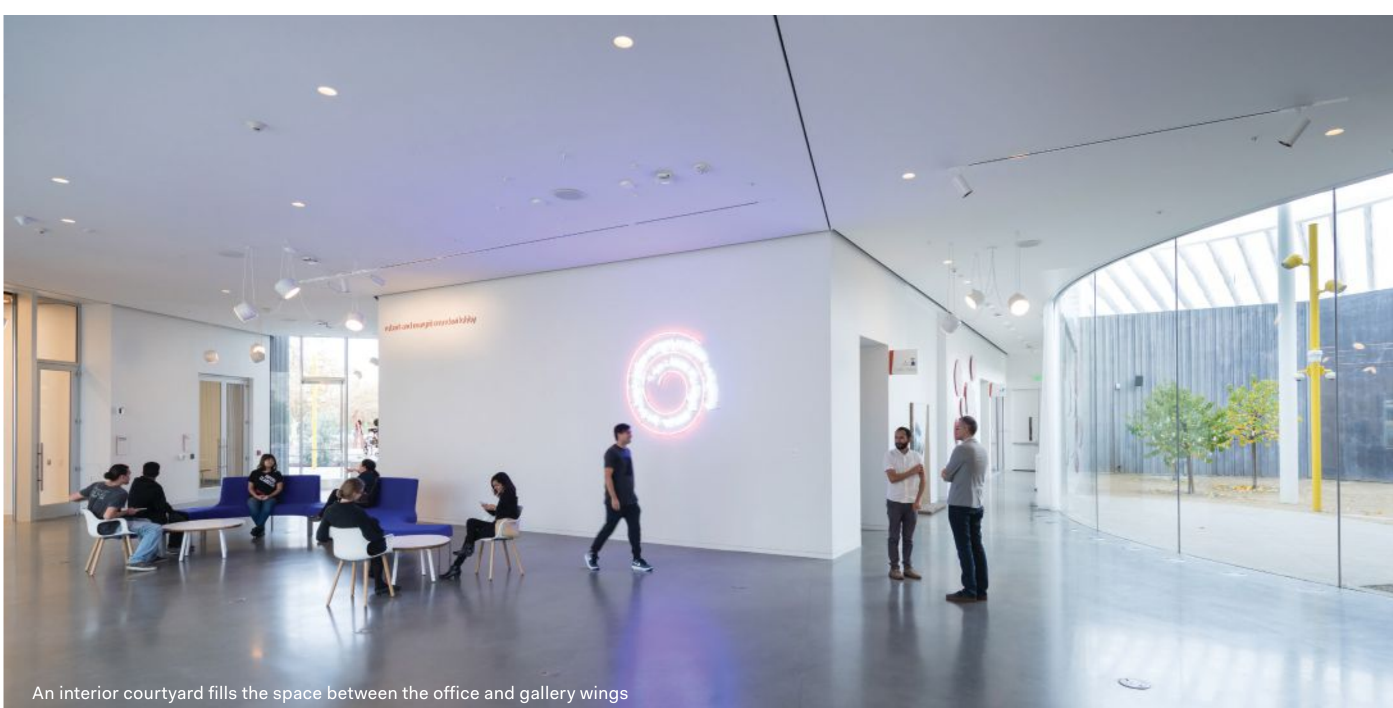
Entrance to the museum



An interior courtyard fills the space between the office and gallery wings

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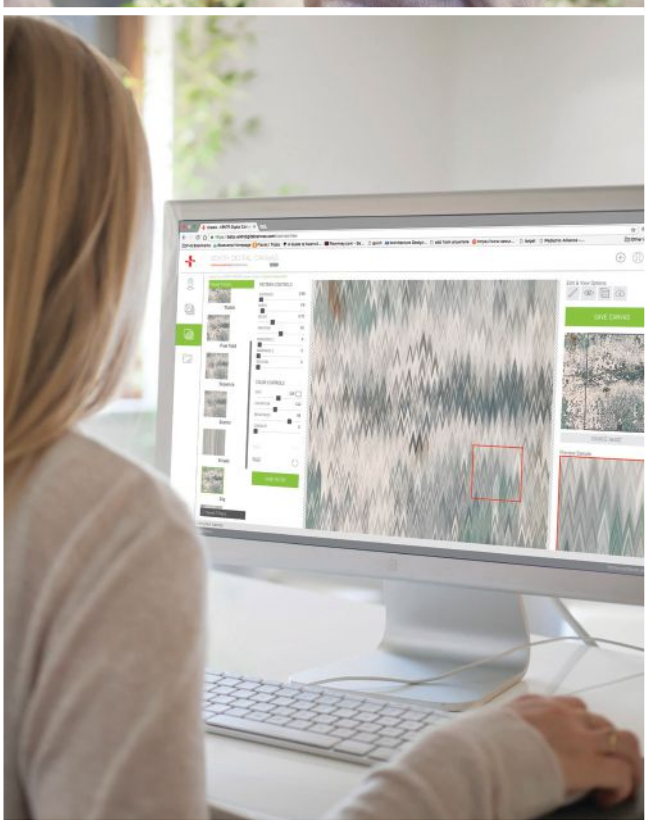

and self-promotion that have grown up around American architecture in recent years. It's a building that is nimble enough to sidestep easy readings. (It is a resolutely horizontal composition, for example, whose spatial surprises nearly all come in how it's organized vertically.) And it's intricate enough, despite its small size, to reward multiple visits. This combination of steadfastness and a quiet (as opposed to neon-lit) dedication to complexity links it in certain terms to what I consider the most encouraging recent work by American architects, including projects by the LA firms Johnston Marklee and Michael Maltzan Architecture, New York City's MOS Architects, and (when he is at his best) Brad Cloepfil, AIA, of Portland, Ore.–based Allied Works.

The Snøhetta Trap

We'll see what happens when SO–IL starts landing bigger, more expensive, and more complicated commissions, of the type that make the most destructive sort of compromises more difficult to avoid. That is precisely the trap that Snøhetta fell into at SFMOMA, where it was asked to defer to an existing 1995 building by Mario Botta but ultimately found the need to disembowel the older building's signature entry hall. For now, SO–IL has thrown down an interesting challenge to its peers and competitors. In the kind of project that can stifle an emerging firm's sense of energy with layers of bureaucracy and cost-cutting, Idenburg and Liu have managed to deliver a museum building that more than anything carries the mark of conviction.

For all of the appeal of recent projects by offices of SO–IL's generation and general outlook, this remains a transitional period in American architecture. The work of moving past the dominance of the celebrities, the bold-faced form-givers who have dominated museum architecture since Frank Gehry, FAIA's Guggenheim in Bilbao opened two decades ago, is very much ongoing. Though impressively porous, the Shrem feels dense with an appreciation for architectural basics—the heaviness of materials versus the play of light, the procession from a wide public plaza to intimate encounters with art and back again—and a certain

IWAN BAAN

Exhibition space

fatigue with old, which is to say flashy, solutions. This is the tone, ambitious but deliberate, that I mentioned earlier. The corrugated exterior walls, with a vertical pattern that is almost delicate enough to read like piping or pinstripes, are a good indication of how this plays out in material terms; they are substantial and finely detailed at the same time, and they give the building—despite its modest volume—a kind of solidity and even a sense of compression that marks a noticeable break from the SANAA school's interest in weightlessness and ethereality.

The Shrem is much less a sign of maturity or mastery than a collection of ideas, nearly all of them pointing more or less away from form-making as a goal in its own right and toward a new dedication to a complex economy of means and compactness of execution. That the building is not entirely self-possessed may say less about the skill of its architects than about the entrenched position of the notions it is fighting against as well as the eternal slowness of the architectural career arc.

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Bates Masi + Architects designed the **Underhill** residence as a place that embodies the Quaker tenets of simplicity, humility, and inner focus for a professional couple and their children. The 6,340-square-foot complex on a 3-acre suburban site in **Matinecock, N.Y.**, is composed of four shingled and gable-roofed pavilions that are reminiscent of early Quaker settlements in the area, but reimagined as a modern and minimalist contemplative retreat. “It is a study of vernacular forms done in a completely novel way,” juror Kevin Kudo-King said. “It is well-detailed and well-crafted, and creates great spaces.”

The north side of the complex presents three primarily opaque pavilions to the street: the entry and guest quarters sit to the east, the main living spaces occupy the center structure, and the garage and utility spaces sit to the west. A fourth, two-story pavilion sits behind the others and houses the bedrooms. The south corners of each of the pavilions feature curtain-lined sliding glass walls that can be opened wide, dematerializing the barrier between the interiors and the backyard. Central courtyards within each pavilion provide every room with at least two exterior exposures. Oak floors and weathered-oak ceiling boards in the interiors are laid concentrically around the courtyards, providing material warmth while accentuating the geometry of the exterior spaces. —E.K.

MICHAEL MORAN/OTTO

Affordable Housing · Award

On the former site of the Cabrini-Green public housing complex in **Chicago**, **Landon Bone Baker Architects** has designed a 21st-century answer to "towers in the park" for Holsten Real Estate Development Corp. **Terrace 459** stands within the larger Parkside at Old Town development and houses residents of different income levels in a mix of public, affordable, and market-rate units. It has 106 units spread over a nine-story apartment building, seven attached townhouses, and a three-story building sited across a landscaped courtyard. "It wouldn't strike me as affordable housing if I happened upon it," juror Dan Maginn said. "It's whimsical, yet serious, and well composed."

A precast concrete floor and wall system helped keep costs down to $194 per square foot, and to ensure that the façades would not appear monolithic, the architects arranged panels in a lively checkered pattern. Market-rate and subsidized units share the same high-quality interior finishes, and residents can access social services inside the building. —A.K.H.

Multifamily Housing · Citation

Near the Eastern Harbor of **Frankfurt, Germany**, an industrial building stood unfinished for a century, its construction halted by the outbreak of World War I. Now **1100 Architect** has renovated the structure and completed it at its intended size. To harmonize the old fabric with the new while still maintaining a distinction between them, the design team picked up the proportions and rhythm of the existing structure in the new wing, but used a modern architectural language and materials palette. The cement fiberboard façade of the addition was inspired by the original mansard roof; its faceted openings reveal brightly colored accents that create a sense of depth.

The finished, 159,300-square-foot **East Side Lofts** has 88 residential lofts and mixed-use spaces on the ground floor. High ceilings and large windows carry over from the historic building into the new wing, creating light, airy living spaces. Outdoor areas were also a priority: Each loft has a balcony, and a central courtyard that is accessible to all residents serves as a refuge from the bustle of the nearby harbor. —A.K.H.

DAVID SCHALLIOL

NIKOLAS KOENIG

Custom House More Than 3,000 Square Feet · Citation

On a 5.6-acre wooded **Upstate New York** site that slopes towards a small pond, **Gluck+** has divided all the programmatic requirements of a 6,080-square-foot **Artist Retreat** and studio into a dynamic compound of eight cubic volumes. The architects intended the simple forms to reference the organization of farms in the region. The façades are clad in weathered horizontal slats of hemlock, whose cool gray contrasts with the warm greenery of the surrounding landscape.

Each volume holds a single room, and they are clustered according to use: living, working, and sleeping. Three pairs of volumes are connected via glazed hallways and arranged around a courtyard; a final pair sits separate and houses a studio and darkroom. The entrance side of the complex is predominantly opaque, with a glimpse of the courtyard framed by a glazed entry corridor, but the bold pops of color evident through picture windows in each volume suggest a liveliness and creativity behind the quiet exterior. —E.K.

On The Boards · Honorable Mention

Designed by **Steven Christensen Architecture**, the **Emigration House** was originally sited on a ridge on its mountain canyon site in **Emigration Township, Utah**. But this being the type of place where people want to look at mountains and not houses, it seemed prudent to change the location to the back side of a knoll. Now the 6,500-square-foot house drops mostly out of sight, while still taking advantage of views of unoccupied sections of the surrounding mountains. The house's angular forms are imposing at times, but its elongated Z-shaped form—in plan and section—follows the site's topography and opens itself to the warmth and sunlight of its southern exposure. —N.B.

ABOVE: PAUL WARCHOL

ROLAND HALBE/JOHNLINDEN

Renovation/Adaptive Reuse · **Honorable Mention**

The **Morgan Phoa Library and Residence** in **Los Feliz, Calif.**, updates a historically designated property designed by Wallace Neff in the late 1920s. **Studio Pali Fekete Architects** renovated an ill-conceived 2004 family room addition to the original garage in a manner complementary to Neff's original interiors. The 3,300-square-foot project also includes the insertion of a new two-story garage and library volume. Its gabled form and tile roof recall the articulation of the original structures, and a perforated bronze anodized-aluminum screen offers both privacy and solar control as well as a boldly modern reinterpretation of the precast concrete window grilles of the original house. —E.K.

Student Housing · Citation

Significant site challenges defined the form of **SL11024**, the new university housing complex designed by **Lorcan O'Herlihy Architects** (LOHA) near the campus of the University of California, **Los Angeles**. It's located on a narrow pizza-slice of a site with a 50-foot elevation change, and it sits across the street from a Richard Neutra–designed apartment building. To address these challenges, and honor its distinguished neighbor, LOHA's design for the 31-unit complex mixes bold forms and colors with volumes that blend into the landscape and other surroundings. Solid, perforated, and ribbed white metal panels make up most of the building's envelope, but green-painted cement board panels add flourish to some exterior walls, walkways, and roof decks, the last of which are accessible from every floor. Split into two volumes to enable cross-ventilation, the building cascades down the hill to the site's low point, where it aligns with the roof of the Neutra apartments, a neighbor with which this newcomer is very much at home. —N.B.

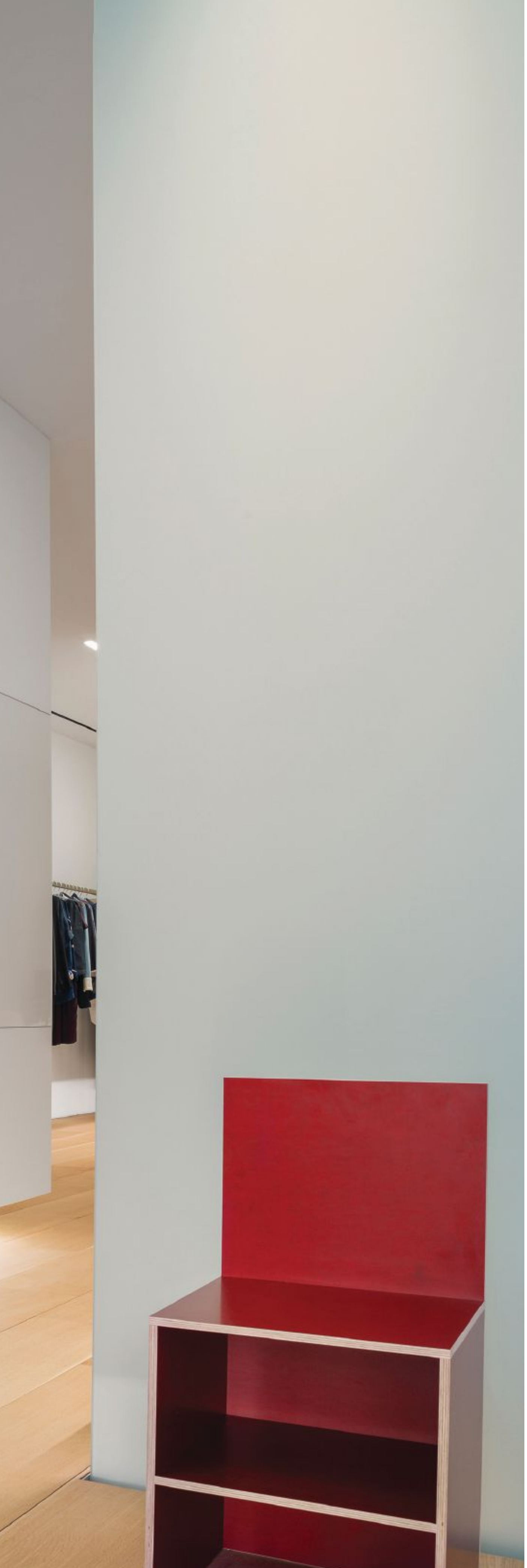
IWAN BAAN

ONNIS LUQUE

Custom House Less Than 3,000 Square Feet · Citation

Located in a historic **Mexico City** neighborhood, the **Cuatro Patios House** by **Andrés Stebelski Arquitecto** is an unexpectedly modern interior stealthily inserted into a traditional masonry structure. The plan is arranged in a grid that alternates landscaped courtyards with spaces enclosed by steel-framed glass walls. The calm and composed interiors, with their wood paneling, contrast with the riot of textures and materials found in the four courtyards: the old plaster and brick of the original structure, pebble-covered ground planes, and flowering vegetation. These terrariums make the house feel both larger than it is, by framing views that extend through the courtyards and into the next room over, and more intimate, with delicate self-contained gardens right at hand. The two floors are connected via floating stairs, and bridges that cut through the double-height interiors to connect the second-floor bedrooms. A glass-enclosed rooftop patio holds a hammock from which residents can look out over a roof garden. —Z.M.

PAUL WARCHOL



Architectural Interiors · Award

This 5,000-square-foot loft in **New York City** is a minimalist composition of white, light-bathed ceilings and walls, with accents of oak, steel, aluminum, and resin. It is the studio and residence of a photographer, divided into public and private zones that come together in a library and reception area off the entry.

Inspired by the work of James Turrell, **Desai Chia Architecture**'s **Photographer's Loft**—which juror Kevin Kudo-King called simply "beautiful"—makes extensive use of LED lighting, cutting and folding ceiling planes to give the light form and bounce it around. The open, flowing layout allows for long axial views. Functional elements like the steel kitchen island and resin work tables in the studio also have a sculptural quality. "I appreciate how the spaces were divided—it shows a sensitivity to detail," juror Anne Decker said. "I also think the handling of light in the space was incredibly well done."

The loft's public zone revolves around a living/dining/kitchen ensemble lit by windows on two sides. In the private zone, the bathrooms are quiet retreats from urban life, with waterproof white-resin walls and custom sinks, shower areas, and niches, complemented by floors of striated stone. —A.K.H.

Renovation/Adaptive Reuse · Award

The **TP-H Residence** is a 1,152-square-foot addition to a 1948 adobe-brick house in **Palo Alto, Calif.**, that provides a fully accessible dining room, two bedroom suites, and a reading room for a couple who expect to spend their retirement years there. **Alexander Jermyn Architecture** reprised the materials and formal language of a 2011 addition, balancing the earlier wing with four new volumes—three white solids with sharply defined fenestration, and a glazed link. "In plan, it relates to the existing house, but still does its own thing," juror Kevin Kudo-King said.

The minimalist palette extends to every detail, including the custom aluminum windows with frameless edges. Mature American elm and plum trees were preserved on the site, and the new addition engages the garden with windows and glass doors that are positioned to control views into the landscape. "It has a great relationship between inside and outside which was executed in a playful and abstract way," Kudo-King said. —E.K.

Custom House Less Than 3,000 Square Feet · Honorable Mention

The design of the **Tower House** in **Portland, Ore.**, starts with a four-story tube, from which sections on each floor are carved to form loggias with expansive views. The hillside site had been deemed unbuildable, but **Waechter Architecture** devised this vertical solution, which features one primary program on each floor—dining room, living room, and two floors of bedrooms—in order to minimize the house's footprint and foundation. A steel pedestrian bridge connects the third-floor entrance to the top of the hill. The house is clad in black corrugated steel and has rounded corners that dispensed with the need for corner trim. In contrast, the interior features white walls and oil-rubbed white oak floors and finishes. —Z.M.

LEFT: LARA SWIMMER; ABOVE: LUCAS FLADZINSKI

Multifamily Housing · Citation

In **New York City**, where space is at a premium, developers have to seize opportunities where they can find them—even in the air. Designed by **FXFowle**, **35XV** was made possible when Alchemy Properties acquired air rights over Xavier High School. The building's six-story granite-clad base is an expansion of the school, and from it rises a 19-story glass-clad icicle that holds 55 one- to four-bedroom apartments, as well as amenities such as a gym, playroom, and shared terrace. The tower's form derives from setbacks and sky exposure planes: It cantilevers 17 feet over the existing school and 36 feet over the rear yard, thanks to a structural system that supports it from the back of its base. —A.K.H.

DAVID SUNDBERG/ESTO

Custom House Less Than 3,000 Square Feet ·
Honorable Mention

The **Enough House** in **Upper Kingsburg, Nova Scotia**, is a monolithic gabled volume clad in Cor-Ten steel; an example of what the team at **MacKay-Lyons Sweetapple Architects** calls a "good generic" housing typology with a "rural industrial" aesthetic. The form recalls the prototypical child's drawing of a house, but it is executed with a hyper-vigilant attention to craft and reverence for materials. The house—one of the newest additions to Brian MacKay-Lyons' Shobac Farm, which is part retreat, part design test-lab—is hoisted up onto concrete plinths that serve as the foundation (tie-downs help withstand lateral wind loads) and extend beyond the perimeter of the house proper to frame an entry procession and courtyard. Inside, the house—which is used by architectural interns much of the year, but is available for summer rental—is a tasteful collection all things rustic and warm: a wood-burning stove, a ladder to a sleeping loft, wide stained-pine floorboards, exposed timber framing, and Douglas fir plywood sheathing. —Z.M.

Custom House Less Than 3,000 Square Feet ·
Honorable Mention

Modeled after the unassuming fish shacks that dot the North Atlantic coastline, **MacKay-Lyons Sweetapple Architects** designed the **Point House** in **Upper Kingsburg, Nova Scotia**, as an intensely regional exploration of one of the most ubiquitous building techniques in North America: the light timber frame. The wood structure is exposed throughout the interiors of the pair of simple gabled volumes; cedar shingles seamlessly clad the roof and exterior walls. Insulation is sandwiched between the framing and cladding, holding at bay an extreme climate characterized by intense wet-and-dry, freeze-and-thaw cycles. A black steel hearth and exposed truss system lend an air of permanence and durability. Concrete fins raise the house off the ground, protecting it from tidal surges, which are not uncommon on this point of land that is surrounded by water on three sides and once served as a small inshore fishing port. Residents can watch the changing tides through floor-to-ceiling wraparound windows, while still keeping warm inside. —Z.M.

ABOVE: WILLIAM GREEN;
OPPOSITE: MATTHEW MACKAY-LYONS/WILLIAM GREEN

Multifamily Housing · Award

Conceived as a hybrid between a courtyard apartment building and a tower, **VIA 57 West** in **New York City** combines the density and intimacy of the former with the height and visual drama of the latter. One corner of the structure is pulled up to a peak of 467 feet, forming a broad slope down to the Hudson River, an arrangement which allowed the **Bjarke Ingels Group** to maintain views for a neighboring building, also owned by the Durst Organization.

Apartments in the 831,000-square-foot building are arranged in a herringbone pattern to capture daylight and views, and the central courtyard, which is lined with amenities such as a children's room and game room, offers ample green space. The Scandinavian-inspired interiors are simple, with white walls and oak floors; a staggered-brick wall in the lobby adds texture. "This project is innovative and commendable," juror Kevin Kudo-King said. "I like the common spaces, but was disappointed in the units, which seem staid compared to the rest of the building." —A.K.H.

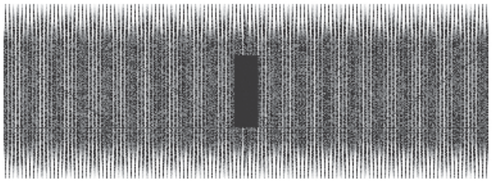
Custom House More Than 3,000 Square Feet · Honorable Mention

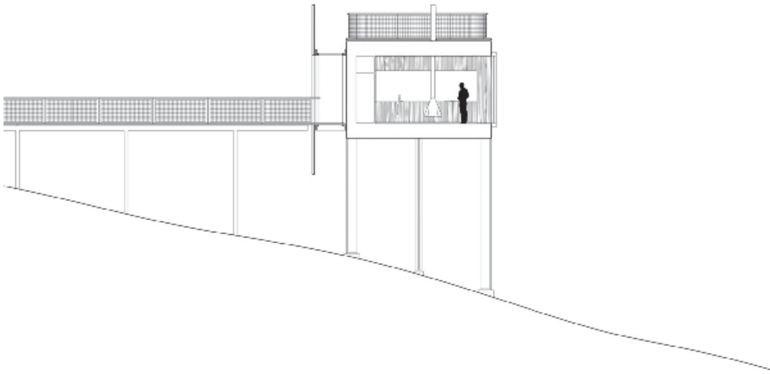
The 4,300-square-foot **Compass House**, designed by **Superkül**, is a weekend home for a family of six that sits on a predominantly flat 200-acre site in **Mulmur, Ontario**. Two volumes in an L-shaped plan create a courtyard from which the family can view the site's three principal landscapes—forest to the west, hills to the south, and fields to the north and east—over low retaining walls built of site-found fieldstone that mark the complex's perimeter. White cement-board cladding wraps the low-slung exteriors, and the warm interiors feature white oak and knotty white cedar floors and walls which glow with the abundant light that reflects off of white ceilings. —E.K.

LEFT: A-FRAME STUDIO; ABOVE: IWAN BAAN

On The Boards · **Citation**

The **Mask House** in **Ithaca, N.Y.**, designed by **WOJR**, envisions a secluded sanctuary that serves as a place of separation. Hidden behind a screen of vertical slats and perched on stilts over a lakeside slope, the house is just 587 square feet and includes a large open room with a small kitchen to one side, an economical bathroom, and a small bed tucked into a skylit cubby. The main room is spare, with wood panels on nearly all surfaces, save a sliding glass door that makes up the entire lake-facing wall and leads to a balcony. Intentionally dark and detached from the outside, the house is nonetheless an artful space ideal for monastic reflection. —N.B.





Custom House Less Than 3,000 Square Feet · Award

Casa IV's little bit of magic is the way it breaks down the hierarchy and division of inside and outside spaces with elements no more transparent than plaster and brick. Designed by **Mesura**, the house comprises a series of four roof sections: long, domestic-scaled vaults right out of Le Corbusier's Maisons Jaoul in suburban Paris. The curved clerestory windows at the ends of each vault pull in natural light despite the rich opacity of the walls, which are made from long, flat custom brick.

Through floor-to-ceiling glass walls, the house, located in **Elche, Spain**, looks out onto a landscaped pool and a series of courtyards, bathing each room in its sunny Mediterranean climate from above and beyond. The textured brick—which is spaced and bonded in some areas to create screen-like gaps that glow from within at night—contrasts with the smooth white vaulted ceilings and roof, and the entire house appears far more ancient than its pedigree suggests. "It's like an adaptation of the Villa de Madame Manorama Sarabhai by Le Corbusier with the vaulted interiors," juror Lisa Iwamoto said, "but it is so much lighter in its materials. If the Sarabhai house is about creating shade, this is about creating light. I think it's just stunning." —Z.M.

JESSE KUROIWA

Custom House Less Than 3,000 Square Feet · Citation

The **Colorado Outward Bound School** commissioned the **Colorado Building Workshop at the University of Colorado-Denver** to work with 28 students to design and build year-round micro-cabins in **Leadville, Colo.**, that would serve as hospitable waypoints for weary hikers. The seven structures are wonderfully simple: just a porch, a mudroom, and a bedroom with custom-built plywood furnishings. These cube-shaped volumes sit 10,000 feet above sea level in a frigid pine forest. The designs were inspired by the quinzee, a shelter Native Americans make by hollowing out piles of compacted snow—though for the cabins, the students opted to use structurally insulated panels. Each is perched on pilotis grounded in concrete piers or existing boulders. Hot-rolled steel cladding serves as a low-maintenance rainscreen and contrasts with the cedar-clad porches and birch plywood finishes that glow orange when the cabins light up at dusk. These warm beacons call to campers to drop their packs and settle in for the night. —Z.M.

Architectural Design Detail · Award

From the street, the row of four new luxury houses designed by **Moto Designshop** in **Philadelphia**'s Society Hill neighborhood is hard to even notice. Your eye is drawn instead to the bold but delicate brick-screen walls that stand in front of all but a thin slot of the masonry-and-glass façade. Towering straight up to the roof level of the **Walnut Estates**, the white bricks are articulated into a halftone pattern reminiscent of a newspaper photograph, providing both privacy and shade. "This is beautifully detailed," juror Anne Decker said. "The rhythm and the animation are nice—it's a very sophisticated use of the material."

Inside, the three 5,500-square-foot and single 6,000-square-foot units are just as intricately detailed. Walnut hardwood and travertine limestone tile cover most floors beneath walnut-paneled ceilings. All of this indoor elegance, however, remains discretely hidden behind the veil of the homes' deceptively simple brick screen, which juror Lisa Iwamoto called "an incredible use of brick." —N.B.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NOAH KALINA

Outbuilding · Award

Jacobschang Architecture's structure for a couple in **Barryville, N.Y.**, literally sits in the trees: Cantilevered over a hillside, its single-room interior floats among the tree trunks to which it's anchored for support. In fact, the **Half-Tree House**'s only direct connection to the ground is a set of footings at the back end of the building. The simple living space is flooded with sunlight through the insulated glass of three oversized steel-tube pivot doors. Its wood boards were milled from Eastern pine trees felled on the property, and the exterior was sealed with traditional Scandinavian pine tar. Juror Kevin Kudo-King appreciated the use of materials and "the way that the inside and outside relate." Juror Anne Decker said, "The forms, in section and elevation, are just stunning." The remote site lacks vehicular access, piped water, and electricity, so the building was designed so that it could be constructed mostly by hand by its amateur builder-owners. At just 360 square feet, it's a compact, rustic getaway, built for only $20,000. —N.B.

Affordable Housing · Citation

More than 60 percent of **New York City**'s households have one or two people, but the supply of studio and one-bedroom apartments is limited. Enter **Carmel Place**, designed by **nArchitects**—the city's first all micro-unit apartment building. Fifty-five loft-style units, ranging from 260 to 360 square feet, sit in four slim "mini-towers" of unequal height, which were built using modular construction. Forty percent of the units are earmarked as affordable, while the rest are market rate. Units are designed to feel spacious despite their small dimensions, with 9-foot-8-inch ceilings and clever features like a fold-down kitchen table/counter and linear storage loft. —A.K.H.

Custom House More Than 3,000 Square Feet · Honorable Mention

The 3,300-square-foot **Troll Hus** in **Norden, Calif.**, draws inspiration from alpine chalets and local predilections toward indoor-outdoor living. **Mork Ulnes Architects** raised the two-floor, pine-tarred wood-clad house a story above ground on concrete piers to account for extreme snowfall, which has exceeded 800 inches in a single season. Generous decks provide all the living spaces with adjacent outdoor areas; overhangs harness winter light while shading the interiors from summer sun. The top level's open plan encompasses the kitchen, living, and dining areas under vaulted ceilings capped by skylights that harvest as much scarce winter sun as possible to light the clean-lined interior. —E.K.

TOP: FIELD CONDITION; BOTTOM: BRUCE DAMONTE

IWAN BAAN

Restoration/Preservation · Award

The chief documentarian of midcentury modern architecture, photographer Julius Shulman, was also one of its patrons: He commissioned modernist architect Raphael Soriano to design an elegant, geometric home for his family in the Hollywood Hills. Completed in 1950, the **Schulman Home and Studio** in **Los Angeles** is now home to a new young family after a restoration by **Lorcan O'Herlihy Architects**. Through extensive research, the firm upgraded features and amenities while maintaining the original materiality and design intentions. Juror Dan Maginn called the restoration "very respectful, but also fearless. The architects went for it in a couple of areas, but the changes are definitely within the original DNA of the Schulman house."

The cork-lined entryway has been restored, and new adjustable screens have been added to the home's plentiful glass walls and sliding doors. New cabinetry and shelves were added in a way that respects Soriano's original design intent while also creating space to integrate modern HVAC equipment—avoiding its intrusion on the house's flat roofline. The most significant change to the building was an alteration of the floor plan to accommodate a guest bedroom, which was achieved without altering the structure's steel frame. It all combines into a restoration that preserves the past while enabling its use by a new generation. "I love seeing when architects know not to change things to create good architecture," juror Kevin Kudo-King said. "It's a great refresh, and still very respectful of the bones that are there. I think it's a great project." —N.B.

EXECUTIVE VIEWPOINT

FERRY MARCELLIS, LUMION

Revelation or Revolution?

A Look at the 3D Visualization Tool Everyone Is Talking About

Ferry Marcellis
CEO of Lumion

Ferry Marcellis is one of the two founders of Act-3D B.V., which was established in 1998 and has since been at the cutting edge of real-time 3D technology. After years of experience creating 3D simulations, training tools, 3D movie technology and architecture, Ferry steered the company specifically towards architectural visualization. To this day, he remains passionately involved in the Lumion development process.

For Ferry Marcellis, the eureka moment came when the architect he was observing hesitantly moved their mouse over the button, clicked, watched in awe, and exclaimed, "It can't be that easy!" He had just witnessed an act of discovery that would be repeated again and again by tens of thousands of architects worldwide.

Meet Ferry Marcellis, co-founder and CEO of Act-3D, the parent company of Lumion, the fast-emerging standard for rapid, hyper-realistic 3D videos, images, and 360-degree panoramas. Today Lumion's under-the-radar growth throughout design firms of all sizes—from sole proprietorships to the world's top 100—has revolutionized workflows and client presentations.

Why the shift to Lumion? What differentiates it from other rendering tools? How does it transform the art of what's possible for designers? Marcellis offers his views:

Today 61 of the top 100 architect companies in the world are Lumion customers. How do you explain this broad global acceptance?

Software is not something architects necessarily love to work with. So our goal from day one was to offer a design tool that doesn't fight you. Rather, it works with you as an architect to bring your ideas to life quickly and easily with uncompromising style and precision. Lumion is much more than just a rendering tool. This tool includes a huge library with materials, objects, people, presets and effects. Lumion tries to bring a complete package.

Our website is packed with dozens of first-person accounts of the surprise and delight that greets first-time Lumion users. I think anyone who has faced the steep learning curve of other 3D rendering tools will find Lumion is an absolute revelation.

What about architect firms that outsource 3D rendering?

Lumion helps eliminate the workflow disruptions, back-and-forth changes, and expense that outsourcing often represents. What kind of lead time is realistic for outsourcing? A week? Two weeks or more? Lumion compresses the rendering cycle, freeing more time for design.

Even clients that render animations in-house with a competing 3D tool benefit. One client, HKS Inc. of Dallas tracked workflow before and after Lumion. In their weekly cycle they went from two days of design and three days of preparation/rendering to four days designing, with just a single day of preparing and rendering. Everyone benefits.

What about results? How does Lumion help win commissions?

Lumion puts world-class visualization capability in your hands, whether you're a small or large studio. It's gratifying how it levels the playing field, allowing anyone to offer wow-factor presentations once reserved for only the few. I'm often asked what my favorite Lumion-produced animation or image is. It's really anything a new client, small or large, produces from the get-go. You'd be amazed at what I've seen from architects and staff that thought this kind of capability was beyond their skills or budget.

Does Lumion play well with others?

Lumion is compatible with all the mainstream design tools, including SketchUp®, Revit®, Vectorworks®, Allplan®, Rhinoceros®, 3DS Max®, Archicad®, and MicroStation®. You can upload and effortlessly reload from all these and more 3D design tools.

What would you tell an architect looking for a better way to bring their ideas to life?

Give Lumion a serious look. We're not a huge brand name but we've managed to create a truly game-changing product. We add new features and capability all the time. Advanced functionality like high quality lighting for interiors, beautiful new materials, virtual reality outputs and directly sharing your designs online are all recent developments and we keep delivering improvements. Ask around. Visit our website. Word-of-mouth is our best sales asset. ●

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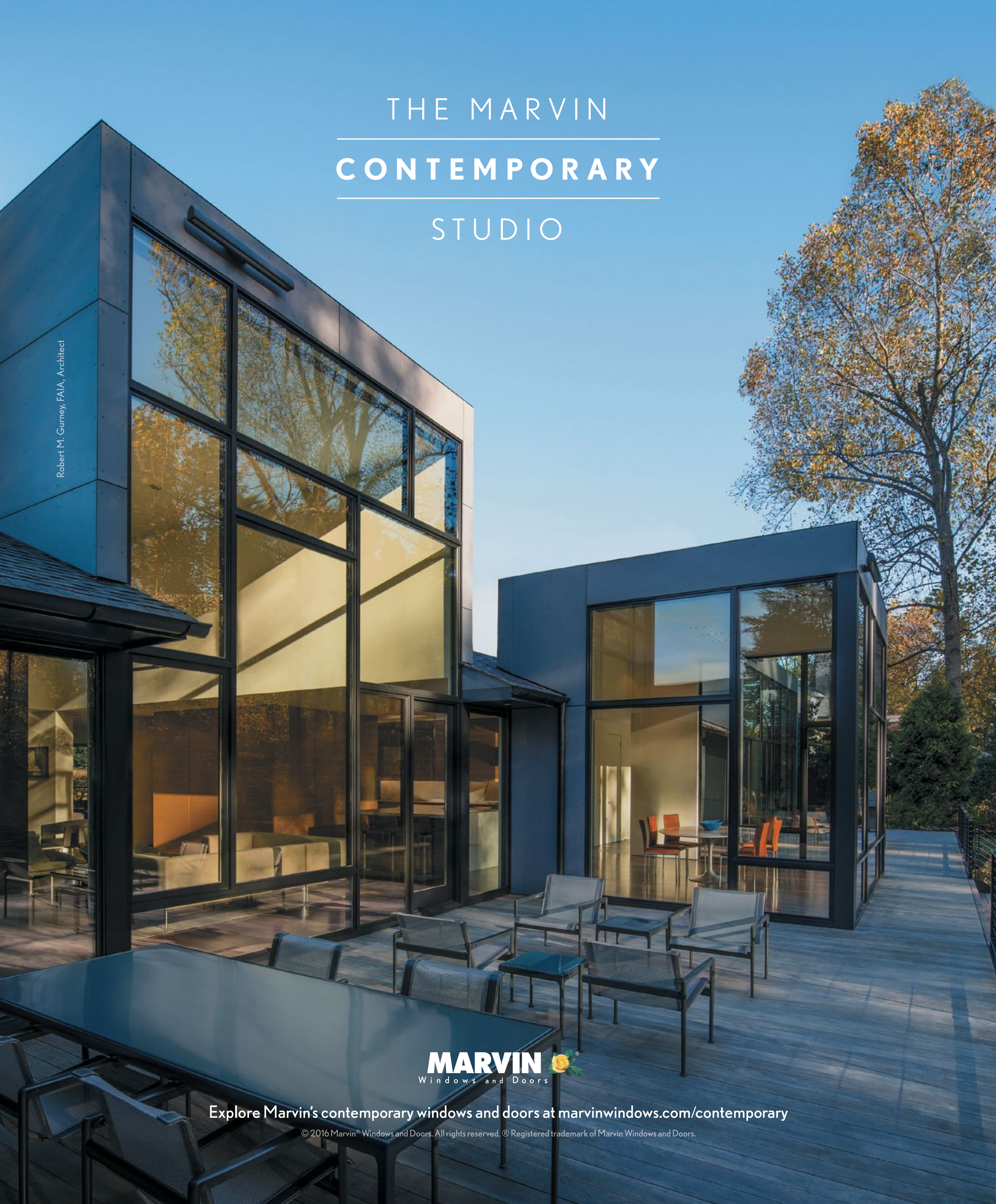
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MICHAEL BODYCOMB

Residential:

The Frick Collection Presents 21 Neoclassical Works by the Oft-Copied French Master Gilder Pierre Gouthière

TEXT BY VICTORIA CARODINE

Admired by King Louis XVI and Marie Antoinette, gilder Pierre Gouthière—the subject of a new exhibition at New York City's Frick Collection—began working for the French court in 1767 as a master *ciseleur-doreur* (chaser-gilder) through the Menus-Plaisirs du Roi, an institution for the king's collection of personal effects and entertainment. Copies and mistaken attributions of Gouthière's work occurred during his career and continue today, but this exhibition showcases 21 objects that have been analyzed for authenticity, including a table he gilded on a commission from the Duchess of Mazarin (shown). "Pierre Gouthière: Virtuoso Gilder at the French Court" runs through Feb. 19, 2017.

> *Read more about the exhibition at bit.ly/GouthiereExhibition.*

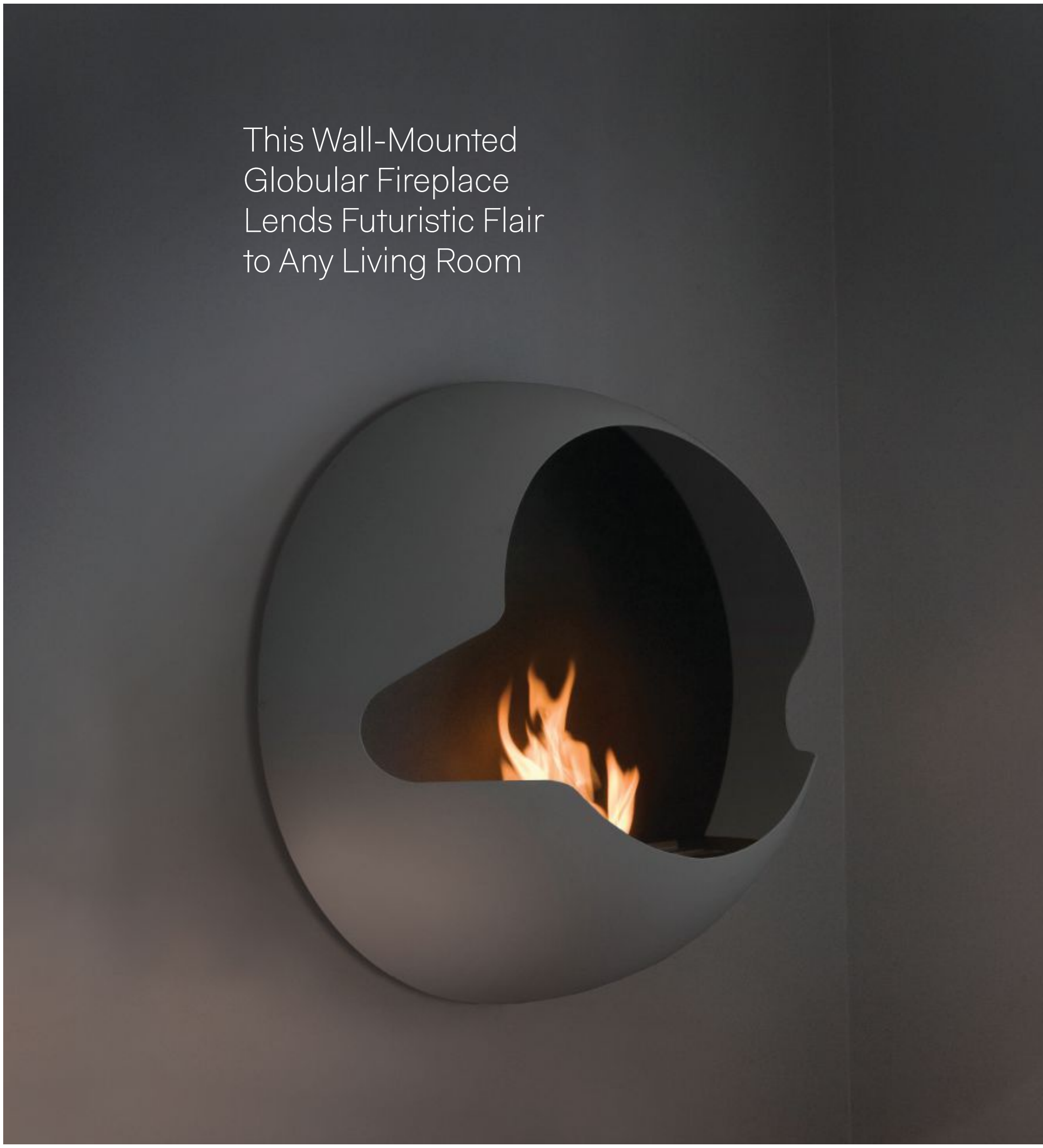
A Methodical Examination of the Houses by an Architect Who Once Wrote “We Should Design our Surroundings as if They Originated by Chance”

TEXT BY SARA JOHNSON

Inside the playful pink graphic cover of *Josef Frank—Spaces* (Park Books, 2016), authors and Swedish architects Mikael Bergquist and Olof Michélsen, who have published other books about Frank, pack a meaty analysis of six residential projects into just over 100 pages. According to the publisher, this book is the first to hone in on the Austrian architect’s single-family portfolio. In his 1958 essay “Accidentism,” Frank wrote that “we should design our surroundings as if they originated by chance.” Bergquist and Michélsen picked the six houses, half of which were never built, to illustrate Frank’s range and evolution: Claëson House in Falsterbo, Sweden (1924-1927); House for Vienna XIII (1926, unbuilt); House for MS in Los Angeles (1930, unbuilt); Villa Beer in Vienna (1930); Villa Wehtje in Falsterbo (1936); and Accidental House, Fantasy House No. 9 (1947, unbuilt). The book highlights Frank’s use of volumes, scale, and placement of staircases to define public and private spaces, entry sequences, and a house’s circulation path, and liberally illustrates these ideas with floor plans, sections, diagrams, renderings, and photographs. The last quarter of the volume is dedicated to a chronological index of drawings of Frank’s houses, beginning in 1913 with the Scholl House in Vienna and ending with the conceptual D House series in 1957 and 1958.

JEFF ELKINS

This Wall-Mounted Globular Fireplace Lends Futuristic Flair to Any Living Room



TEXT BY SELIN ASHABOGLU

Vauni, a Swedish design studio and manufacturer of ventless ethanol-powered fireplaces, has just launched a range of five limited-edition metallic finishes—including Stellar Black, Frozen Grey (shown), and Nordic Rust—for the aluminum shells of its wall-mounted Cupola collection, which was first released in 2011. The semi-spherical fireplace is fueled by liquid bio-ethanol that does not produce smoke or ashes, and emits only small amounts of carbon dioxide and water vapor, eliminating the need for a flue. Cupola measures 31.8" in diameter by 13.7" deep. Its ethanol burner is fitted into a base at the bottom of the outer shell. The base itself comes in Black Granite, Ice Mineral, and Trillium Tech finishes. *vauni.com*

> *To read about the Cupola fireplace online, visit bit.ly/CupolaVauni.*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Queen's House Restoration
Greenwich, England

TEXT BY CLAY RISEN

PHOTOS COURTESY NATIONAL MARITIME MUSEUM, LONDON

In 1616, fresh from a tour of Italy, the English architect Inigo Jones was hired to design a royal residence in Greenwich for Anne of Denmark, wife of King James I. Drawing on his newfound fascination with Palladian architecture, he built the Queen's House, which, when it was completed 19 years later, became the first consciously Classical building in Britain. But Anne died before it opened, and for the next several centuries it languished, beloved by architectural historians but rarely visited by its royal owners—or, since it was opened to the public in 1937, tourists.

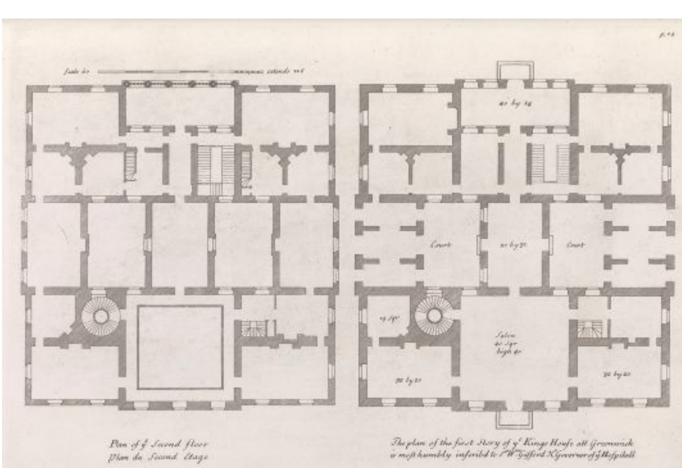
That may be about to change. This fall the Royal Museums Greenwich, which oversees the Queen's House, completed a $3.78 million, 15-month renovation, including its stunningly restored, double-height Great Hall. Around its ceiling and upper walls flit glittering flourishes of 23-karat gold leaf—a new work that the museum commissioned from Turner Prize–winning artist Richard Wright.

In recent decades, the house was used as a gallery, so much so that several fireplaces, windows, and doors were covered over to create more wall space for hanging paintings. "There had been piecemeal changes across the house, so the design got fuddled," says Christine Riding, curator for the Queen's House. In an effort to return some sense of the house's original feel, the renovation team of 100 curators and outside specialists opened those back up, while reprogramming the museum's gallery functions to accommodate not just paintings, but vitrines and free-standing displays. Post-renovation, Queen's House can accommodate three times more objects than it did before.

Other considerations were more mundane. Wiring and plumbing, which were added during one of the previous modernizations, were outdated. "The basic services were about to die," Riding says. Some of the wood floors had deep cracks, so they replaced many of them with new French oak boards. Wi-Fi now runs throughout the building. The cornices in the King's Presence Chamber, which, besides the Great Hall and Queen's Presence Chamber, is perhaps the grandest room in the building, needed complete regilding. The work was carried out by London-based Carvers and Gilders, a Royal Warrant–holding restoration firm, and involved about 21,850 leaves of 23.5-karat gold leaf.

Even with the building closed to visitors, the renovation process was far from easy. The Queen's House is a Grade 1 site on Britain's Statutory List of Buildings of Special Architectural or Historic Interest, placing it in the same category as buildings such as Tower Bridge and Rogers Stirk Harbour + Partners' Lloyd's Building (the youngest ever to be listed). Buildings on the list are heavily protected, and every step in the restoration, down to the most minor detail, had to be approved by preservation authorities. "You can't just knock a wall through," Riding says. "Working in a building like this was a daily challenge."

The result is a building that Anne of Denmark would recognize, but a 21st-century visitor will find inviting and comfortable. "Without being slavish, we wanted to get back to the idea of this being a house, not just a gallery," Riding says, and perhaps most importantly for Jones' legacy, "we wanted the architecture to speak."

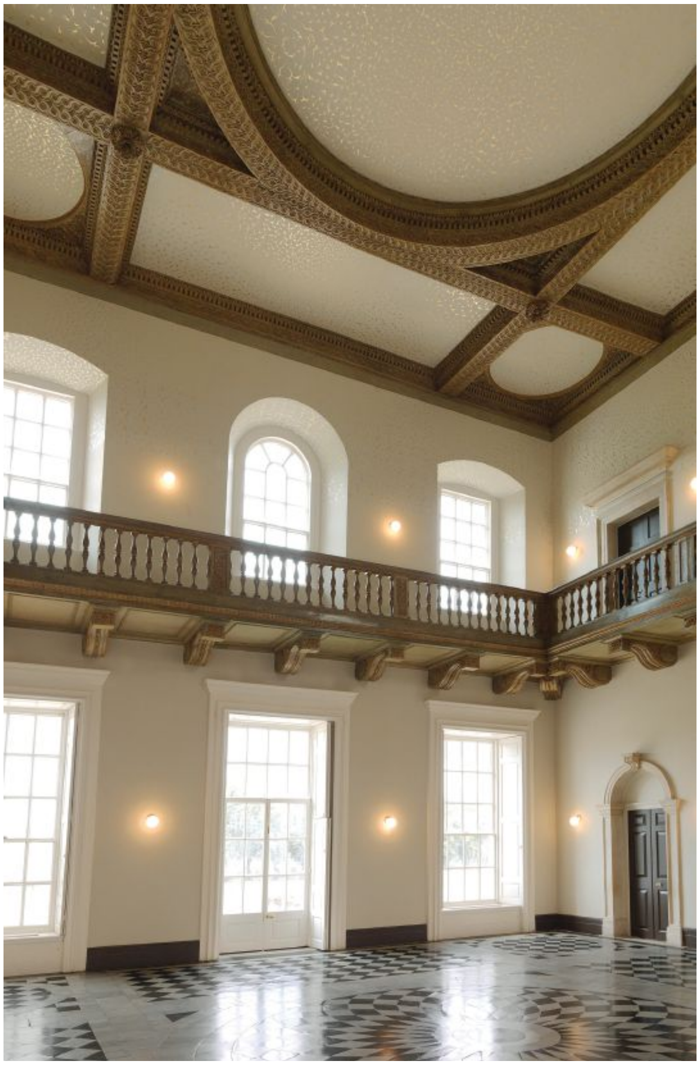


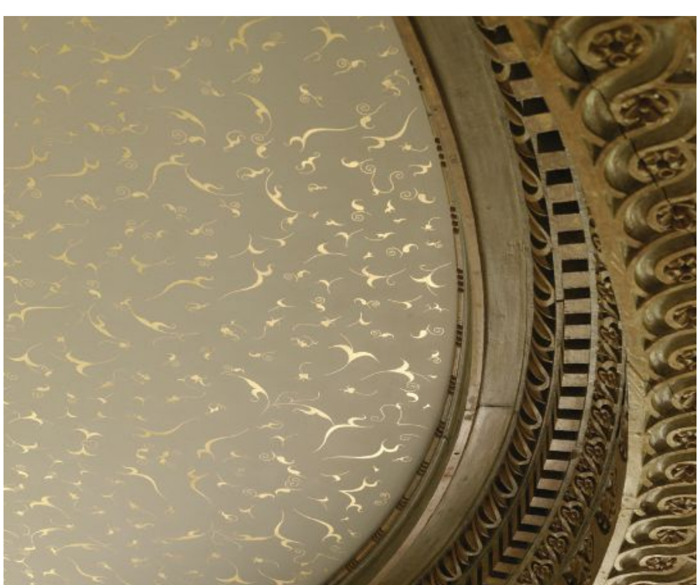
Left: Queen's House plan dating to 1715.

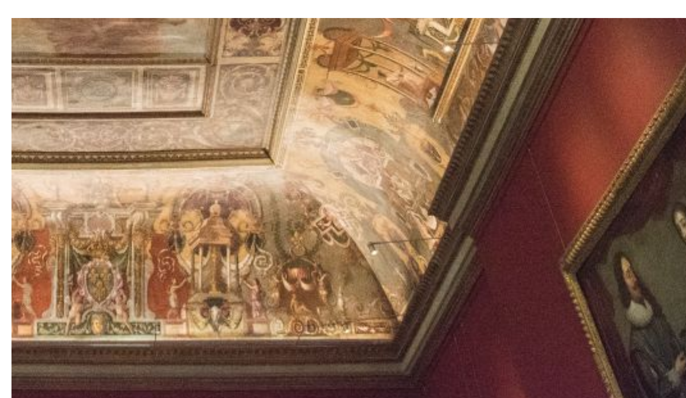
Opposite, Left: The restored Great Hall (top), with a detail of the new artwork by Richard Wright (bottom).

Opposite, Above Right: The King's Presence Chamber (top) was painted blue after research by historic paint consultants, and required complete regilding of its cornicework (bottom).

Opposite, Below Right: The Queen's Presence Chamber was painted a deep red (top). The ceiling, restored in 2013, was relit (bottom).







LEFT: MIKE BRUCE

The metal balustrades of the cantilevered spiral Tulip stairs were repainted to their original cobalt blue as part of the restoration.

Project Credits
Project: Queen's House Restoration, Greenwich
Client: Royal Museums Greenwich
Curatorial Restoration: Royal Museums Greenwich
Historical Paint Consultant: Patrick Baty
Gilding Consultant: Carvers & Gilders
Artist: Richard Wright
Cost: $3.78 million

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Editorial: A Big Responsibility

On the surface, the President-elect's $1 trillion infrastructure plan has all the makings of a glorious, bridge-building, unemployment-busting, bipartisan win-win. Senators and representatives on both sides of the aisle have been making positive noises of support. After all, who doesn't think the United States needs well-paved roads and well-paid jobs? Well, the devil is in the details.

Before shovel hits dirt, Congress has to agree on how to pay. Several financing schemes are in circulation, including straight-up government borrowing (at historically low interest rates); dedicated revenue from a per-barrel tax on oil or from a one-time deal for corporations to repatriate overseas cash at a reduced, 10 percent rate; and an "infrastructure bank" of federal dollars meant to attract private investment.

The Trump team's plan would promote private investment in exchange for tax credits and revenue from tolls and other fees. An op-ed in *The Washington Post* calls it "a tax-cut plan for utility-industry and construction-sector investors, and a massive corporate welfare plan for contractors."

If an infrastructure bill does get passed, the profession will have to mobilize and push for every project to be implemented smartly and equitably. There are signs that they won't, given the track records of some candidates for senior appointments in the new administration. A rumored top pick for Secretary of Housing and Urban Development, Rob Astorino, opposed fair housing practices in his current role as executive of Westchester County, N.Y., and a climate-change denier, Myron Ebell, is overseeing the transition at the Environmental Protection Agency. On the bright side, the most high-profile contender for transportation secretary, outgoing Rep. John Mica (R-Fla.), is reportedly an advocate of high-speed rail.

To grasp how much this matters, think back to the New Deal, and Franklin Roosevelt's publicly funded alphabet soup agencies. The Work Projects Administration alone employed millions and built, expanded, or renovated 39,370 schools, 12,800 playgrounds, 2,550 hospitals, 1,050 airports, 2,700 firehouses, 6,383 office buildings, 15,100 gyms and auditoriums, and 8,000 parks, among other projects.

In addition to creating jobs and buildings, the New Deal demonstrated the government's potential for good at a time when Americans had reason to be doubtful and fostered community at a time when society was deeply fragmented. It wasn't just the power of architecture as finished object in landscape, considerable though that is. A shared enterprise, the primordial act of building, brought people together around a common goal. The optimist in me hopes infrastructure legislation in 2017 could achieve something similar.

To do right by the opportunity, architects may need to subvert the system from within—craft narratives that are honest but avoid ideological flash points, identify loopholes in policies, get creative with budgets, and forge unlikely partnerships. Because if the citizens of the United States are going to spend $1 trillion on infrastructure, it is the profession's responsibility to ensure that they get their money's worth: amenities that are not only beautiful, but sustainable, resilient, inclusive, and truly their own.

STEPHEN VOSS