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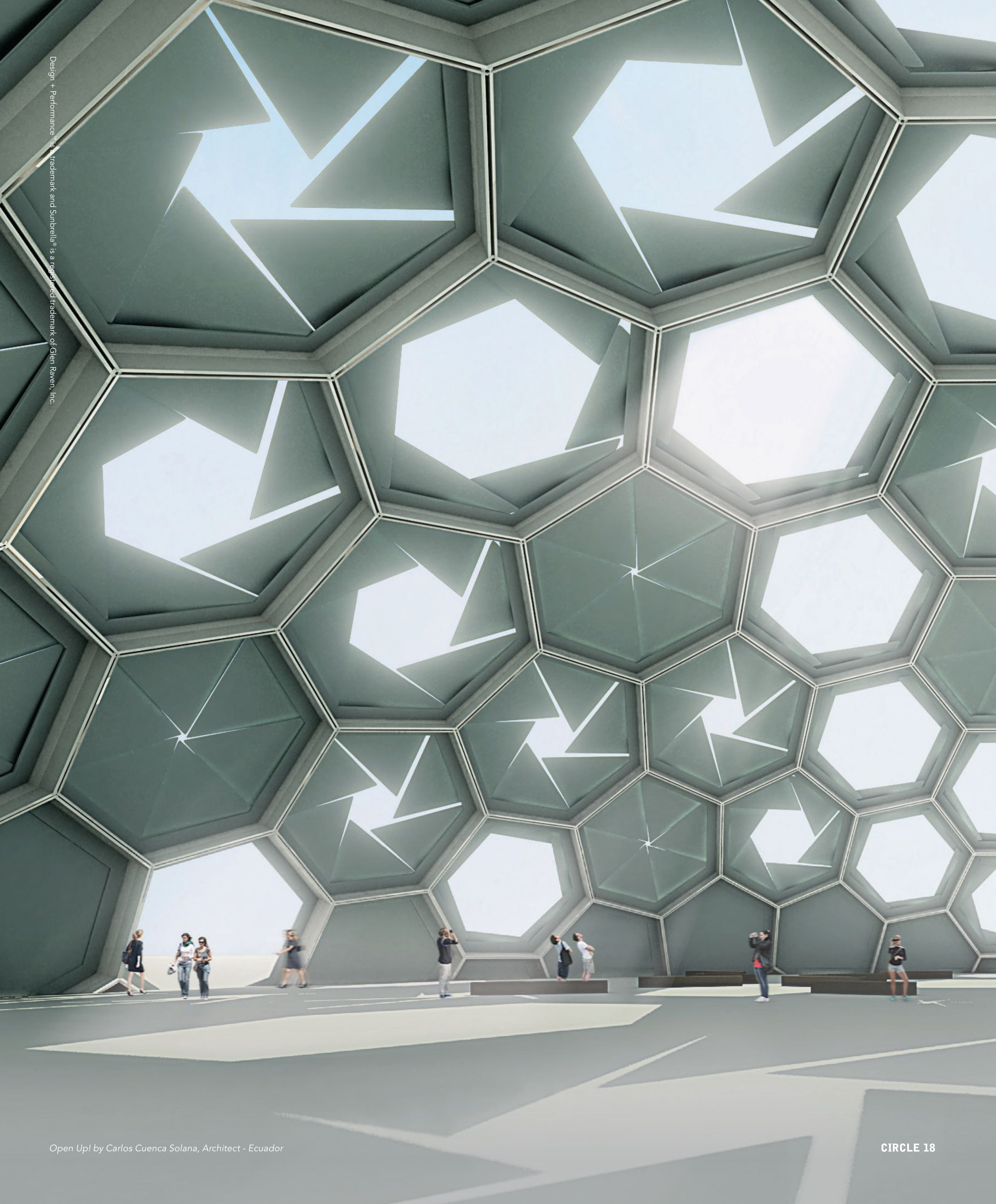

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ARCHITECTURAL RECORD (ISSN: Print 0003-858X Digital 2470-1513) November 2016, Vol. 204 No. 11. Record is published 12 times annually, monthly by BNP Media II, LLC., 2401 W. Big Beaver Rd., Suite 700, Troy, MI 48084-3333. Telephone: (248) 362-3700, Fax: (248) 362-0317.
ANNUAL RATE FOR PRINT, DIGITAL AND COMBO SUBSCRIPTIONS TO INDIVIDUALS IN THE U.S.A.: Print $72.00, Digital $18.00 and Print Digital Combo $81.00. Annual rate for subscriptions to individuals in Canada: Print $129.00, Digital $18.00 and Print Digital Combo $138.00 (includes GST & postage); Annual rate for individuals outside of U.S.A.: Print $199.00, Digital $18.00 and Print & Digital Combo $208.00. Payable in U.S. funds. All rates are in USD. Single Copy sales $9.95; Foreign $11.00.

Periodicals Postage Paid at Troy, MI and at additional mailing offices.
FOR SINGLE COPY SALES OR BACK ISSUES ONLY: contact Ann Kalb at (248) 244-6499 or KalbR@bnpmedia.com.
POSTMASTER: Send address changes to: ARCHITECTURAL RECORD, P.O. Box 16387 North Hollywood, CA 91615.
CANADA POST: Publications Mail Agreement #40612608. GST account: 131263923. Send returns (Canada) to IMEX Global Solutions, P.O. Box 25542, London, ON N6C 6B2.
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THE MAAT IN LISBON OPENED TO THE PUBLIC ON OCTOBER 5.

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GREENBUILD 2016
Some 20,000 people and 600 exhibitors attended this year's international green-building gathering in Los Angeles. Read our dispatches and see photos from the week-long conference and expo.

MAAT OPENS IN LISBON
Read about the opening of the London-based firm AL_A's Museum of Art, Architecture and Technology in Portugal, and click through our slideshow.

INNOVATION EAST
Get the highlights from ARCHITECTURAL RECORD's second Innovation Conference of the year, Architecture and Making in the Post-Digital Age, which takes place in New York on November 3.

INCOMING USGBC CEO MAHESH RAMANUJAM SPOKE WITH ARCHITECT BJARKE INGELS ABOUT THE FUTURE OF SUSTAINABLE DESIGN AT THE CLOSING PLENARY OF GREENBUILD 2016.

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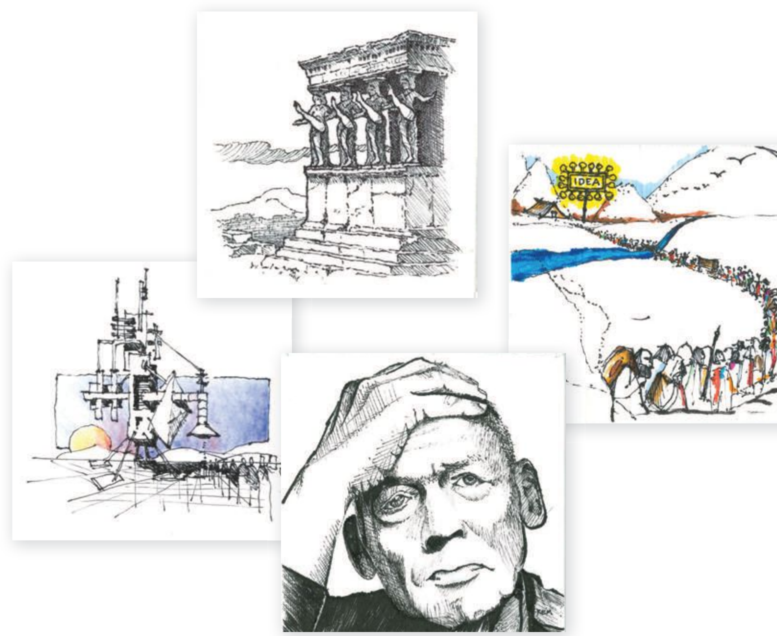
Watch a short movie from Steven Holl Architects about the Visual Arts Building at the University of Iowa.

COCKTAIL NAPKIN SKETCH CONTEST
Scroll through galleries of the winners, runners-up, honorable mentions, and quirky favorites from this year's competition.

FEATURED HOUSES
Find photos, credits, and specifications for new residential projects in this monthly online-only feature.



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Design for Social Animals

Campus architecture of almost any type—labs, dorms, or studios—is designed today with a variety of spaces for interaction, or just hanging out.

WHEN MANY of us went to college, no matter how beautiful the campus, the dining hall was for dining only, with few choices on offer; the snack bars served bad coffee; the gym was generic with old equipment. But if you've visited a college campus recently, you know how luxurious new facilities can be. There are athletic centers that could train Olympians, and wellness facilities that rival those at a luxury spa. Elegant dining halls serve an array of farm-to-table cuisines, to fulfill almost every dietary desire. There are cozy spots scattered around campuses to snack, lounge, study, or just hang out. Gone are the damp gyms and noisy cafeterias of a more spartan era of college life—at least at many private and some public institutions. Like high-powered tech companies today, top colleges and universities compete to attract talent, and the quality of design—not only of laboratories and libraries but of communal spaces—is part of the draw.

In this issue, we look at projects in the college and university sector by some of America's finest architectural firms. And if there is a common thread among the projects here—for science or art programs, or for the general population—it is that the architects sought to include light-filled social spaces that allow students and faculty to interact, or just to get away from their labs or desks to sit quietly with their laptops and enjoy a cup of coffee and a view to the outdoors.

Dormitories always have had some kind of shared spaces, but at the new University of Chicago North Residential Commons, Studio Gang included public plazas, gardens, walkways, and courtyards to try to help bridge the town/gown divide; its large complex comprises three towers that house 800 students (page 104). Inside, the architects created a variety of flexible spaces for studying, cooking, or socializing. At Duke University, the West Campus Union building by Grimshaw was designed to be a dining facility—with a wide variety of both food choices and places to sit—as well as a place where faculty and students can informally meet and mingle (page 116).

Duke's building is also a campus circulation route, which made places for spontaneous interaction even more essential. Indeed, using circulation for social space is a common strategy in the projects on the following pages. At the University of Iowa's Visual Arts building, Steven Holl Architects designed purpose-built art studios, but it is the large light-filled atrium at the core that is the "social condenser," says Holl, that brings students together (page 110). At Vassar College, connecting scientific disciplines—chemistry, earth and environment, and robotics—under one roof was part of the brief for the Bridge for Laboratory Sciences (page 124), but the building, which spans a ravine, also provides a key route from one part of campus to another. So Ennead Architects created an open, double-height, light-filled space along its curving spine for a café and informal seating. For their new tower for Columbia University's Medical School (page 128), Diller Scofidio + Renfro made the most of the stairs and ramps that connect the 14 floors by inserting seating niches, outdoor terraces, and other social spaces on landings along the way.

And at the Andlinger Center for Energy and Environment at Princeton (page 96), Tod Williams Billie Tsien Architects responded to the challenging site and program by weaving a multilevel building of interlocking bars and towers with a series of outdoor courtyards and gardens. Yes, there are modest lounge spaces sprinkled throughout the building, but it is the many instances of large windows open to daylight and nature that gives this surprisingly complex yet serene building its humane rather than institutional quality.

Also this month, RECORD reports on three significant new buildings that are destined to become landmarks in their cities: the National Museum of African American History and Culture in Washington, D.C.; the Port House in Antwerp; and the National Museum of Switzerland in Zurich. All three use bold architectural language for great effect within their surrounding contexts.

So, enjoy this issue of RECORD, packed with writing from the magazine's editors and contributors who have, as always, explored firsthand the impressive works of architecture in the pages ahead.

Cathleen McGuigan

Cathleen McGuigan, Editor in Chief

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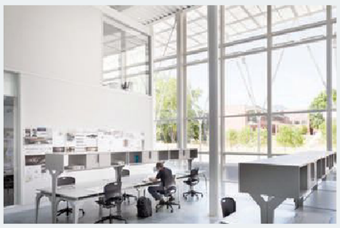

Categorized by Design: Architecturally Exposed Structural Steel

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Photo courtesy of Arup/Kevin Chu

The Core of the Matter

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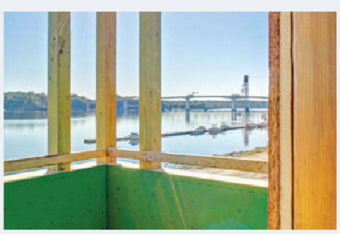

Continuous Insulation in Framed Exterior Walls

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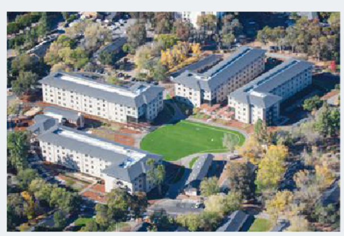

Collaborating Through Design Challenges

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Green Globes Certification Overview

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The Benefits of a Performance-Based Design Process

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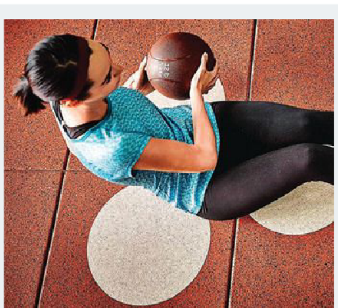

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perspective

I've never felt the need to respond to Patrik because, in part, I agree with him.
—Alejandro Aravena, responding to Patrik Schumacher's criticism of his Pritzker Prize win, in a discussion with Nader Tehrani on September 22.

Francis Kéré has proposed a stepped six-story parliament house for Burkina Faso's capital city, Ouagadougou (top, right; left). The new facility would replace a building that was destroyed during a 2014 revolt (above).

IMAGES: COURTESY KÉRÉ ARCHITECTURE

Francis Kéré Envisions House of Parliament for Burkina Faso

BY JENNA M. MCKNIGHT

IN LATE 2014, citizens of Burkina Faso overthrew the country's dictatorial leader, President Blaise Compaoré, and set fire to the parliament house, leaving it a charred ruin in the capital city of Ouagadougou. Now Berlin-based architect Diébédo Francis Kéré, who grew up in the West African nation, has conceived a master plan for a new parliament complex.

Kéré says he was informally commissioned to design the project by the new head of the parliament last year and has since been meeting with government officials to push his concept forward. "They say it's too visionary. I still have to convince them," Kéré says. "I hope at least some of the ideas will stick." His scheme is on view at the Architecture Biennale in Venice, which closes November 27.

Rather than replicating Western models, Kéré's design reflects the values inherent in Burkinabé society. "We can't keep doing a cheap copy of the West," he told RECORD. "We have to produce buildings that speak to and inspire our people."

Kéré's ambitious design calls for a pyramid-shaped six-story building made of concrete and stone. Members of the public would be invited to climb up the stepped facades, allowing them to take in views of the city. The architect believes such a facility would symbolically engage people in the legislative process in a way that is similar to the forms of governing found in the country's rural communities. "In a village setting, the decision-making process is not a private matter," Kéré explains. "Community members are welcome to sit near the gathering of leaders and observe."

The building also would reflect the agrarian way of life in Burkina Faso. The terraced exterior walls would accommodate public garden plots, which would serve as an educational tool to encourage urban farming.

For the interior of the building, the scheme calls for a grand 127-seat assembly hall bordered by a private garden, where parliamentarians could gather for informal interactions. Kéré's design for the meeting space takes into account local traditions. In Burkinabé villages, elders convene under the shade of a large tree—referred to as *arbre à palabres*, or tree of discussion—to talk about critical issues.

The master plan also calls for a public plaza, new shops and cafés, and a memorial in the footprint of the old building—a sunken area in the earth that would collect rainwater for on-site irrigation and form a reflecting pool.

While Kéré's scheme is intended to facilitate an open and peaceful society, he does recognize that civil unrest and terrorist attacks are an ongoing threat. Last January, Islamic militants ambushed a hotel and café, killing more than two dozen people. Mindful of these concerns, Kéré proposes incorporating guarded subterranean tunnels and parking areas for government officials. "In today's time, we have to deal with security issues. But we also want to provide open access for the public," he says. "The trick is to find a way to put those two things together." ■

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New *Arc* Platform Aims to Streamline and Integrate Green Certification for Existing Buildings

BY MIRIAM SITZ

Scot Horst, who spoke at Greenbuild 2016 about the new platform, will transition out of his role as the USGBC's chief product officer to become *arc* CEO at the end of this year.

AT GREENBUILD 2016, the U.S. Green Building Council (USGBC) and the Green Business Certification Inc. (GBCI) announced a new platform to measure the performance of existing structures and track incremental improvements. *Arc*, as it's called, is intended both for buildings that are actively working toward LEED certification under its existing building rating system and those that are not.

Using this new tool, architects and designers will be able to record data about any building, at any point on the sustainability spectrum, and *arc* will calculate the performance score. "Previously, you had to be earning LEED credits to be part of the system," said Gretchen Sweeney, vice president of LEED Implementation at the USGBC, speaking at Greenbuild. Scot Horst, USGBC's chief product officer, who will become *arc* CEO at the end of this year, told RECORD by phone, "We want to allow everyone to be a part of this ecosystem."

Horst, who has long been focused on transforming LEED from a design tool into a performance metric, compares the rating system to the gym. "The way we had it set up is, you've got to lose a certain amount of weight before you get a gym membership. You can only get in and get healthy if you've already lost weight," he said. "What we're saying now is that we want everyone in the gym—it's just that, once you lose a certain amount of weight, we're going to recognize you in a different way."

Additionally, *arc* will eventually allow project teams to see how LEED standards overlap with those of other green certification systems, starting with those under GBCI's purview such as WELL, SITES, and PEER. "We came back to the core of LEED," said Melissa Baker, USGBC technical business development director, "—the intent behind the credits that actually drives the behavioral change and drives the actions that you take."

By showing architects and designers how close LEED credits have taken them to achieving other certifications, Baker said, "I think it will drive that desire to really push and do a little bit more."

Arc will officially launch by the end of 2016, with full integration slated for the middle of 2017. ■

PHOTOGRAPHY: © ARCHITECTURAL RECORD

FXFOWLE Museum Breaks Ground on Liberty Island

BY ANNA FIXSEN

FOR THE 12 million immigrants who passed through Ellis Island between 1892 and 1954, the sight of the Statue of Liberty presiding over New York Harbor signified their hard-won arrival in the land of the free. Today, 120 years after the French presented this gift to the United States, the statue's symbolism still endures, though it attracts pilgrims of a different kind—some 4 million tourists each year.

For present-day sightseers, access to Lady Liberty is highly restricted. Climbs to her crown—designed by Frédéric Auguste Bartholdi, and built by Gustave Eiffel—must be reserved as much as six months in advance; for the museum, housed within the Richard Morris Hunt–designed pedestal, only 20 percent of all visitors are even allowed access, due to post-9/11 security concerns. Everyone else is left to wander the 12-acre island's uninspired grounds ("free audio tours add to their experience," the website assures), snap a selfie, and catch a boat back to Manhattan.

A new initiative, spearheaded by the Statue of Liberty-Ellis Island Foundation and the National Park Service (NPS), is looking to change that. On October 6, officials broke ground on a new museum, a 26,000-square-foot facility at the island's northwest edge, designed by FXFOWLE.

"Only a small number of people get to experience the whole thing when they're here," said firm partner Nicholas Garrison at the event. "We wanted to add to this island a joyous new place that could be experienced by everyone, regardless of age, language spoken, or type of admission ticket."

The FXFOWLE design, which features an exterior stair leading to a landscaped roof, seems to grow out of the island itself, as if a corner of the lawn has been peeled away. Its materials are also an extension of the island, a fusion of stony creek granite (the same used by Hunt for Lady Liberty's base), precast concrete, copper-zinc alloy, and bronze.

One of the primary drivers of this scheme, according to Garrison, was storm resiliency. During Hurricane Sandy, more than 75 percent of the island was flooded. The roof stairway in the FXFOWLE plan means the base level of the museum will be "over the 500-year storm surge, with some belts and suspenders," Garrison said.

The generous interior spaces, meanwhile, were designed to accommodate Lady Liberty's original 18-foot-tall torch (currently housed in the statue's base), and the throngs of visitors expected when the museum is finished—nearly 450 every half hour at peak times, according to Garrison. The firm ESI Design worked with FXFOWLE to devise a series of flowing interior exhibition spaces, which will include an immersive theater and interactive exhibits detailing the Statue's history and construction, and current perceptions of the meaning of liberty. The exhibition will culminate with a glazed gallery containing the torch, set against scenic views of the statue.

Construction is set to wrap up in 2019, according to the Foundation and NPS.

But freedom isn't free: the new museum will cost an estimated $70 million. To raise such a sum, the Foundation enlisted an unlikely "godmother" for the island's beautification—the fashion designer Diane von Furstenberg. Just as newspaperman Joseph Pulitzer petitioned the public to raise money for the Statue's pedestal in 1885, von Furstenberg is in charge of fundraising efforts. ("Thanks to my husband [Barry Diller] I usually sign the check and get it over with," she said.)

FXFOWLE's museum, to be completed in 2019, features a landscaped roof terrace (top) and a generous glazed gallery housing Lady Liberty's original torch (above). Fashion designer Diane von Furstenberg, FXFOWLE's Nicholas Garrison, and officials participated in the groundbreaking ceremony on October 6 (below).

Von Furstenberg came up with an idea for a donor sculpture, spangled with 50 stars made from the original armatures by Eiffel that supported Liberty's internal structure. Stars were offered to potential donors for $2 million each. The idea worked: individuals and organizations including Jeff Bezos, Michael Bloomberg, Coca-Cola, George Lucas and Mellody Hobson, and even Chanel ("French, made sense," said von Furstenberg) donated.

New York Mayor Bill de Blasio, himself a descendant of Italian immigrants, lauded the museum at the groundbreaking. "My hope for this great museum is that it will be one of those bridges that helps us to finally come to peace with the fullness of who we are, the complexity of who we are, and the beauty of who we are," he said. ■

IMAGES: © DIANE BONDAREFF/AP IMAGES (BOTTOM); COURTESY FXFOWLE (TOP, 2)

Newport Street Art Gallery Wins 2016 RIBA Stirling Prize

BY ALEX KLIMOSKI

Caruso St John converted three historically listed Victorian buildings in London's Vauxhall district into a gallery for Damien Hirst's private collection. The space stretches the entire length of the street and includes six exhibition rooms, a restaurant, and offices.

PHOTOGRAPHY: © HÉLÈNE BINET

ON OCTOBER 6, the Royal Institute of British Architects bestowed its highly coveted award—the RIBA Stirling Prize for best building of the year—to the Newport Street Gallery, designed by Caruso St John Architects. The building is located in London's Vauxhall neighborhood and houses a free public gallery for English artist Damien Hirst's private art collection.

The gallery, completed last year, takes on the entire length of a formerly industrial street, situated across from a railway. The design involved the conversion of three neighboring Victorian buildings—which originally housed carpentry and scenery-painting workshops—and the addition of new structures on either end, making for a total of five interconnected buildings. The ground and upper floors each feature three large exhibition spaces and are connected with a dramatic spiral staircase.

The new additions nod to the original buildings with their use of red brick. An LED panel on its facade is visible to train passengers across the street, encouraging them to visit.

"We see the building as a palace for direct, intimate, and luxurious encounters with contemporary art," said partner Peter St John in a statement.

RIBA president Jane Duncan noted, "Caruso St John has created a stunningly versatile space from a number of linked buildings, with beautifully crafted staircases and superb details including tactile brick facades. The result is a succession of wonderful gallery spaces."

The multidisciplinary group of judges, which included Patrik Schumacher of Zaha Hadid Architects, 2015 Stirling Prize–winner Paul Monaghan, architect Roisin Heneghan, developer Mike Hussey, and artist Rachel Whiteread, called the gallery "a bold and confident contribution to the best of UK architecture."

Caruso St John, founded in 1990, is a first-time winner of the RIBA Stirling Prize; the firm was short-listed for a residential project called Brick House in 2006 and for another gallery, the New Art Gallery Walsall, in 2000.

The other five short-listed entries for the prize were: Herzog & de Meuron's Blavatnik School of Government; the City of Glasgow College's Riverside Campus, designed by Michael Laird Architects; the Weston Library, by WilkinsonEyre; Loyn & Co Architects' Outhouse; and Trafalgar Place, by dRMM. ■

[NEWSMAKER]

Vishaan Chakrabarti

BY SUZANNE STEPHENS

EVER SINCE McKim, Mead & White's stately Penn Station was demolished in 1964 and replaced by Charles Luckman's ultrabanal one, which included a doughnut-shaped Madison Square Garden and dreary office buildings, its users have suffered. The aesthetic pain has not been helped by the functional discomfort caused by excessive numbers (650,000 commuters a day). So cheers resounded with Governor Andrew Cuomo's announcement in late September: the state and developers Related Companies and Vornado Realty Trust would put into place a long-touted plan by the late Senator Daniel Patrick Moynihan to divert Amtrak—and now the Long Island Rail Road—to a new train hall to be located in the nearby James A. Farley Post Office, also designed by McKim, Mead & White.

Soon after, architect and planner Vishaan Chakrabarti and his firm Practice for Architecture and Urbanism (PAU) unveiled a scheme addressing the fact that many tracks and platforms need to remain under the existing Madison Square Garden (MSG). They urge stripping the present Garden to its frame, glazing it, and recycling it as a hall for commuters. (For details on the proposal and *The New York Times* editorial endorsement, see archrecord.com.)

RECORD has asked Chakrabarti for more details about his scheme, its genesis, and its future.

After *The Times*'s extensive coverage of your proposal, have you had any reaction from Governor Cuomo and his cohorts?

Not directly. But we've had tremendously positive response from the public. One thing this has taught me is just the vast number of people who are touched by Penn Station.

You worked on the previous plan for Farley (aka Moynihan Station) between 2005 and 2009 as the president of Moynihan Station Venture, a partnership formed between Related and Vornado. Why didn't you work with those developers on this new proposal?

For me, Penn Station is about much more than the station. What we ultimately do to solve its problems is really a symbol of whether we actually believe in a shared, collective realm. It's also about the role of an architect.

You have suggested that a new Madison Square Garden move to the back (west) end of Farley, where there is plenty of room for an arena. That will need backing.

There's a critical first step: the governor's office and MSG have to make a deal for it to move to Farley. I believe that the Garden would want to move into a new facility: they have severe operational constraints in their existing building. The federal government is a stakeholder as well, since it's the driver behind the Gateway plan to build new tunnels under the Hudson River for tracks that would tie into the station. It's complicated, but creating a brand-new train station with new structure and foundations looks like a $6 or $7 billion enterprise. We're trying to say, "If the Garden were to move and if we recycled the existing arena, you could have a beautiful new station without a grand public price tag." The renovated Garden in Penn Station would cost about $1.5 billion. The new arena in Farley should be $1.5 billion too.

But couldn't Vornado and Related—already landowners in the area—help by putting money into relocating MSG to the back of Farley?

The deal the last time around was that the Garden would get a new arena free in the back of Farley, and Related and Vornado were building it. They would get about 5.5 million square feet of air rights over the Garden in return. The only thing now is where you land the air rights for new development, with the Gateway tunnels' tracks and platforms coming in due south of the Garden.

Are there other incentives besides air-rights transfers for the developers?

You could also give tax-increment financing to basically take advantage of the higher value of the real estate in the future. Such financing mechanisms can pay for this without public money. Creating a truly civic building in the heart of the district, you get incredibly valuable real estate all around it, which is the model of Grand Central.

Where do *you* make money on this?

This is an advocacy project. We make money on the other projects we do. If someone wants to hire us to do the station, we would be thrilled. We're a 10-person office, but we could collaborate with great larger firms where we're the design engine.

What is the next step?

We're going to see if there is a groundswell around the idea. We all have to keep the vision alive. That's the key. ■

noted

Renzo Piano to Redevelop Power Station in Moscow

The V-A-C Foundation, dedicated to contemporary Russian art, has commissioned Renzo Piano Building Workshop to redevelop a defunct power station in Moscow. Built in the early 1900s to supply energy to the city, the complex is expected to reopen in early 2019 as a contemporary arts and culture center.

Designed By Calatrava, World's Tallest Tower Breaks Ground

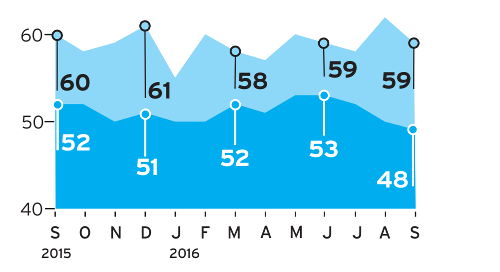
Construction commenced last month on the Santiago Calatrava–designed Dubai Creek Tower. When completed in 2020, the 3,045-foot-high structure, anchored to the ground with cables, will surpass the Burj Khalifa, making it the world's tallest skyscraper.

Record Vanguard Winner Receives Kiesler Prize

Spanish architect Andrés Jaque, a 2014 RECORD Design Vanguard winner, received the 10th Austrian Frederick Kiesler Prize for Architecture and the Arts on October 6. The cash prize of 55,000 euros honors achievements in line with Kiesler's interdisciplinary view of the arts and is granted by the Republic of Austria and the City of Vienna every two years.

Museum of Art, Architecture and Technology Opens in Lisbon

After a construction period of two years and an investment of $22 million, the MAAT—commissioned by the EDP Foundation and designed by London-based studio AL_A—has opened to the public. The curvilinear building's facade features 15,000 three-dimensional crackle-glazed tiles.



ABI Reflects Two-Month Decline

The Architectural Billings Index (ABI) posted a two-month-long decline in September, the first such slump in four years. The month finished with a score of 48.4, down from 49.7 in August (any score above 50 indicates an increase in billings). The new projects inquiry index was also low, scoring 59.4. These scores "should act as a warning signal," said AIA chief economist Kermit Baker.

PHOTO: COURTESY PAU

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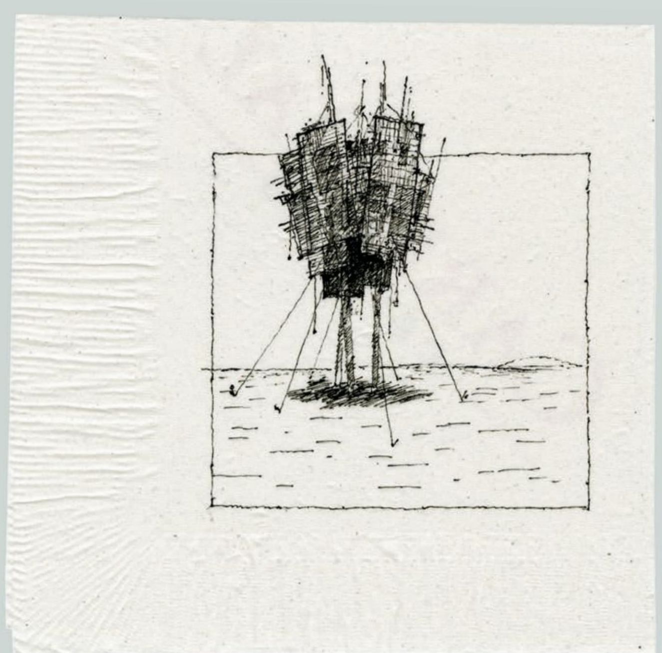
ARCHITECTURAL RECORD Announces the Winners and the Runners-up of the

2016 COCKTAIL NAPKIN SKETCH CONTEST

More than 400 architects, designers, illustrators, and students submitted sketches to this year's Cocktail Napkin Sketch Contest, which, now in its seventh year, showcased the passion and skill of a diverse group of professionals. Record editors sifted through upwards of 2,000 individual napkins to select the two winners, six runners-up, and three individuals representative of the best group to submit entries—this year, a school.

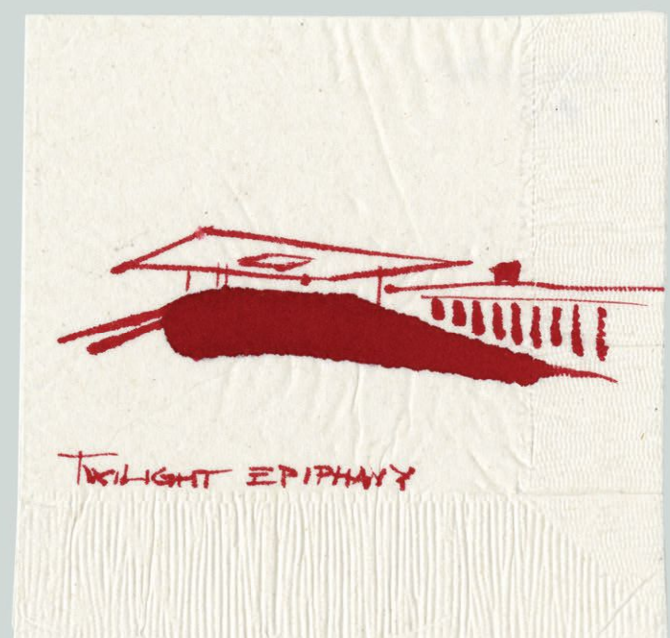
WINNER, REGISTERED ARCHITECT



ERIC J. JENKINS, PROFESSOR, CATHOLIC UNIVERSITY OF AMERICA, WASHINGTON, D.C. **FACULTY MEETING #12**

Architect Eric J. Jenkins challenges students in his course on freehand analytical sketching to increase their understanding of buildings by drawing them. "How do you inform your imagination?" he asks. "How do you learn from the things around you?" Often, Jenkins finds, the answer comes by putting pen to paper. "I compare architecture to studying music or literature," he says. "When musicians listen to a song, or when writers read a book, they are attuned to the rhythm and cadence of the words. You can learn from others' work by deeply observing it." In his winning sketch, he imagines a building overgrown by technological equipment, bursting out of a square frame. Literalizing the cliché, he says, "I like to work outside of the box."

WINNER, NON-REGISTERED ARCHITECT



MAKSIM KOLOSKOV, DESIGNER, ROTTET STUDIO, HOUSTON
TWILIGHT EPIPHANY

In 2014, as Maksim Koloskov recovered from a liver transplant, he would take walks around the campus of Rice University, often ending up at James Turrell's *Twilight Epiphany*. "The idea of the 'skyspace' is so strong," he says. "A thin line hovering over the big hill. And in the fog, it has a really mystic quality." Recently, the designer returned to quickly sketch the structure—a practice that has become part of his daily routine. "I don't care how it looks," he says. "I just sketch for myself. It's so freeing." Working in ink and sometimes with a marker, he finds napkins the ideal canvas for this type of drawing. "They don't let you overwork," he says. "Several strokes and that's it. They force you to think fast and draw fast."

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RUNNERS-UP, REGISTERED

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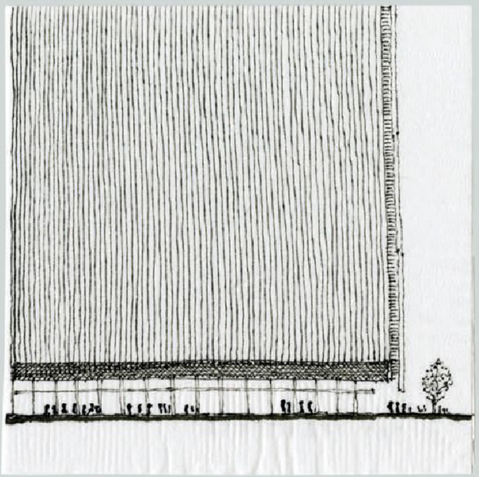
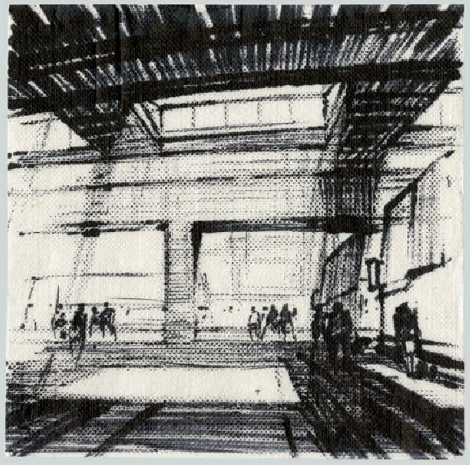
ABRAHAM



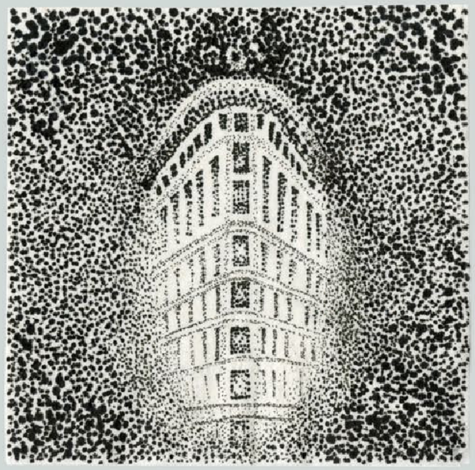
PAT MANDIOLA, ASSOCIATE VICE PRESIDENT, CALLISONRTKL, CORAL GABLES, FL
LEVITATION

CAROLINE LAVOIE, LANDSCAPE ARCHITECT/ ASSOCIATE PROFESSOR, UTAH STATE UNIVERSITY, LOGAN, UT **GRAND CENTRAL ENERGY**

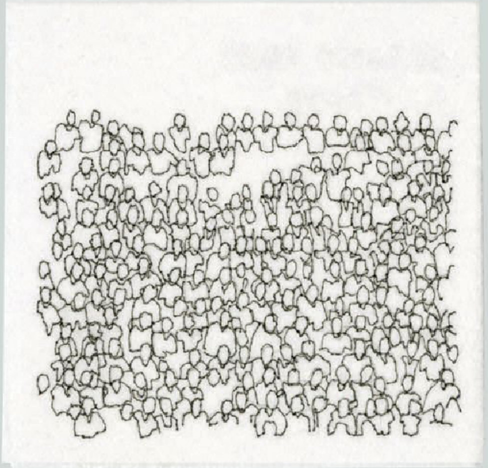
RUNNERS-UP, NON-REGISTERED



PETER GIRAUDEAU, ARCHITECTURAL ILLUSTRATOR, CLARK NEXSEN, ROANOKE, VA **ROANOKE BUS DEPOT**

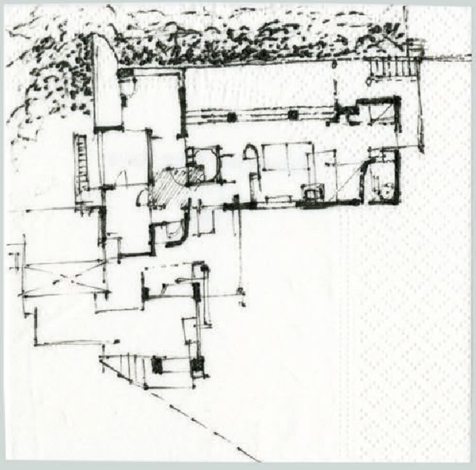


HEEJAE MOON, STUDENT, CALIFORNIA STATE UNIVERSITY, LONG BEACH, CA **FLATIRON BUILDING**



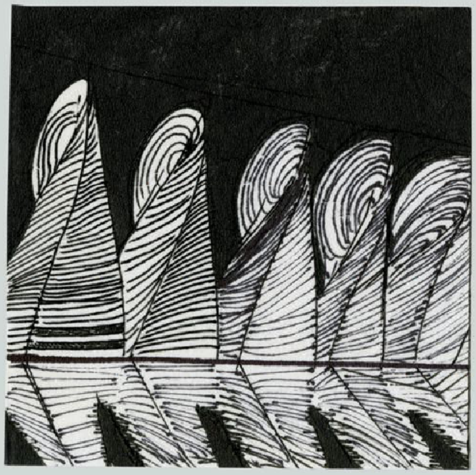
GERARDO GANDY, TECHNICAL DESIGNER, GENSLER, AUSTIN, TX **STADIUM SEATING**

BEST SCHOOL



DANICA DURANT, STUDENT, CALIFORNIA STATE UNIVERSITY, LONG BEACH, CA
EILEEN GRAY OPENS THE FLOOR PLAN. E-1027

LIZBETH RANGEL, STUDENT, CALIFORNIA STATE UNIVERSITY, LONG BEACH, CA
THE BRADBURY BUILDING



DIVINA Y. LEMUS, STUDENT, CALIFORNIA STATE UNIVERSITY, LONG BEACH, CA
METAPHYSICS

perspective house of the month

A DISCREET RURAL RETREAT WEST OF TORONTO NAVIGATES THE CHANGING SEASONS. **BY MIRIAM SITZ**

IN RURAL Ontario, where mild summers give way to cold, snowy winters, a family of six was ready to chart a new course in a sustainable second home. The Compass House, designed by Toronto-based superkül, responds to the dramatic seasonality of its context and the needs of its occupants by reconfiguring shared spaces around a central point as seasons change.

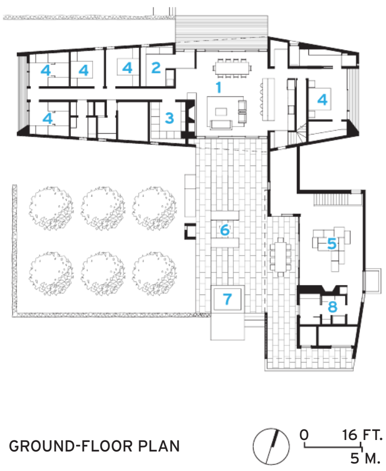
Returning to Toronto after living in London, the clients longed for a pastoral retreat reminiscent of those they had frequented in the English countryside, which could accommodate family and friends. On their 200-acre property in Mulmur, Ontario–part of a UNESCO World Biosphere Reserve–they selected a wooded site that offered privacy, views, and a buffer from winds blowing across the high plateau of the Niagara Escarpment. "We wanted to blend in and not be seen," says the husband.

A detached garage sits just north of the main wing (top). For warmer months, operable glass doors open to a patio with an outdoor fireplace and plunge pool, which becomes a hot tub in the winter (above). Inside, a skylight connects a lofted room above the kitchen to the outdoors (left).

Taking cues from the English vernacular-style long barn, the architects designed a low-lying house with perpendicular volumes, built in two phases, aligned to the cardinal directions. In the winter, the house operates along an east–west axis, with communal spaces concentrated at the center of the main wing. In the summer, when insect screens usually replace operable glass walls running parallel along the open-plan kitchen, living, and dining room, the common areas expand to include a courtyard and the secondary wing, effectively rotating the hub of activity 90 degrees to the north–south line.

"The clients were interested in being as light on the land as possible," says principal in charge Meg Graham–a fact that influenced both the sustainability features and the appearance of the house. Passive cooling and a geothermal system contributed to a LEED Gold certification for the first phase of the project. Clad in white cement-board panels, the wood-frame structure has a low roofline that matches the undulation of the surrounding hills. The house is "a little bit stealthy," says Graham, explaining that "in the summer months, when the fields grow up around it, you don't see it right away. Then, when it snows, it's stealthy in a completely different way."

Inside, oak floors and durable knotty cedar walls tie the house to its forested setting and provide a warm contrast to the white ceilings, punctuated with skylights. "When you look up from inside the house and see the boundless sky, for a nanosecond you don't register the scale of it. You can just breathe and feel this connection to the cosmos," says Graham. "It's kind of spiritual." ■



GROUND-FLOOR PLAN

1 KITCHEN/LIVING/DINING
2 MUDROOM
3 DEN
4 BEDROOM
5 FAMILY ROOM
6 OUTDOOR FIREPLACE
7 HOT TUB/PLUNGE POOL
8 CHANGING ROOM

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Downtown Style

Architect Richard Found creates a cool Saks Fifth Avenue in lower Manhattan.

BY LINDA C. LENTZ

ACROSS THE street from the 9/11 Memorial in New York, Brookfield Place, the former World Financial Center designed by César Pelli in the '80s, is undergoing a transformation along with the reconstruction of the World Trade Center site and the opening of Santiago Calatrava's transit hub (RECORD, April 2016, page 50). The office-building complex is not only luring tenants like Time Inc. but a spate of upscale food and retail businesses too. Among them, a new Saks Fifth Avenue satellite is notable for its elegant yet hip boutique style—a fresh take for the iconic department store.

Designed by London-based Found Associates, Saks Fifth Avenue Downtown is tucked into the first two stories of an octagonal pavilion at the base of a tower in the complex. Departing from the sharp edges of the exterior, principal Richard Found stacked a pair of glazed rotundas behind the faceted facade, wrapping the glass on the inside with fixed, brushed-brass louvers that filter sunlight into the sales areas. "This allows views out to the World Trade Center," says Found. "At the same time, it provides a backdrop for the merchandise."

Throughout the store, color and material choices are subtle, serene, and surprisingly consistent for a multibrand retail establishment. There are no designer shops here. The soft brass is used again on garment racks and low-profile casework; pastel upholstery wraps Fritz Hansen and HAY seating; champagne-hued carpet alternates with terrazzo floors; and hand-finished polished plaster coats the walls.

An open plan maximizes the quirky 65,000-square-foot space with avenues that branch from the rotundas back toward the building core. Whenever possible, Found fused structural, mechanical, and decorative elements. Escalators at the center of the rotundas bisect circular sales hubs, which are, in turn, ringed by clothing and accessories. Tall, modular mirrored displays fade into the scenery and also serve as storage units and full-length mirrors.

PHOTOGRAPHY: © JASON SCHMIDT

Warm LED lighting is equally discreet. Concealed in ceiling coves that follow the lines of the architectural elements, its glow creates halos around columns and above the rotundas. The lighting also delineates a corridor leading to the shoe department, and Found's one touch of bling: a 15-foot-wide, half-spherical chandelier supporting 50 globes. Mounted on a polished-metal ceiling, it is a glittering orb—a dazzling effect, and all the more so in a Saks that offers an understated alternative to the usual luxury experience. ■

A 220-foot-long Barry Reigate mural follows a corridor into the shoe department, where a spectacular light installation hovers above mirrored storage "blocks" and Fritz Hansen Ro chairs by Jaime Hayon.

The Fair's the Thing

The London Design Festival takes over England's capital, offering a bounty of ideas and visual treats.

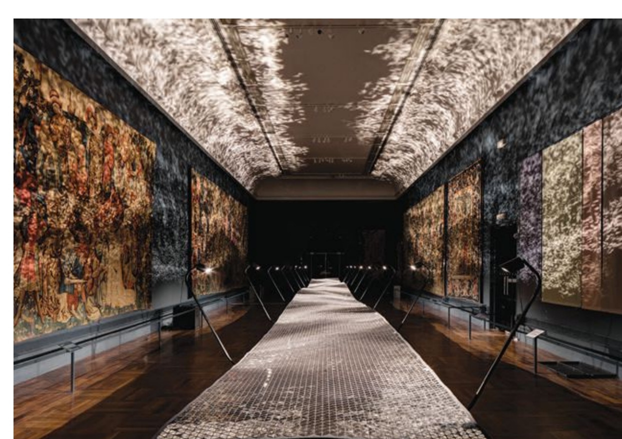
BY CHRIS FOGES

FOR NINE days in September, when the London Design Festival's distinctive red signage appears at scores of event locations, the remarkable breadth of the U.K.'s design industry is made visible. The 14th edition, held September 17 to 25, was a sprawling affair: hundreds of designers and manufacturers hosted events across the city, while five separate trade fairs ran concurrently.

Commissioned projects gave a sense of order to the dizzying array of pop-ups and partnerships, lectures and launches. At the Victoria & Albert Museum, the festival's official hub, temporary large-scale exhibits were installed among the permanent displays. *The Green Room*, by London-based product designers Glithero, featured a cylindrical curtain of 160 brightly hued cords that dropped down through a six-story stairwell; individual strands gently rose and fell over the course of a minute, inviting viewers to reconsider what a clock could be. In the Tapestry Room on an upper floor, Benjamin Hubert's wavelike *Foil*—an animated ribbon of 50,000 stainless-steel mirrors—scattered light across the walls like a giant disco ball.

At the nearby Chelsea College of Arts, another ambitious project occupied the courtyard. Alison Brooks Architects' *The Smile*, a pavilion in the form of a curved box beam, demonstrated the construction capabilities of cross-laminated American tulipwood. While the center of the 112-foot-long arc rested on the ground, both of its ends rose 11 feet into the air, ending in large openings that offered those inside framed views of the college and the sky. (Unlike most of the festival's installations, which ended on the 25th, *The Smile* was on view through October 12.)

Downriver to the east, Somerset House—a neoclassical cultural center and home to the Courtauld Institute of Art—hosted the inaugural London Design Biennale. For that, curatorial teams from design museums in 37 nations produced pavilions that responded to the theme of utopia,



Alison Brooks Architects' *The Smile* served as a study in the material possibilities of cross-laminated American tulipwood (top). Bompas & Parr's garden, *L'Eden*, used sensors and mechanics to physically respond to visitors' movements (middle), while *Foil* (above), by Benjamin Hubert, cast flecks of light around the Tapestry Room at the Victoria & Albert Museum.

PHOTOGRAPHY: COURTESY ALISON BROOKS ARCHITECTS (TOP); © NATHAN CEDDIA (MIDDLE); BENJAMIN HUBERT/BRAUN (BOTTOM)

Eley Kishimoto applied its Flash pattern to several crosswalks in the duo's Brixton neighborhood, aiming for the change to reawaken traffic awareness and improve safety.

selected to mark the 500th anniversary of Thomas More's classic work. Occupying a prominent spot in the center of the entrance courtyard was Barber Osgerby's *Forecast*. The super-sized weathervane, anemometer, and wind turbine alluded to Britain's maritime history, turbulent politics, and—of course—fabled obsession with the weather.

In Shoreditch, architect Asif Khan erected three small, enigmatic translucent polycarbonate structures, which he then stocked with furniture and thickets of plants. Called *Forests*, the project, commissioned by MINI Living, explored the potential of "third places" in the city: spaces to gather in the public realm, away from home and work. Khan, who designed a summerhouse for the 2016 Serpentine Pavilion program, explained that he hoped his interventions would raise questions about the relationship between public and private space as well as foster interactions among strangers.

Bompas & Parr also used vegetation as a material in *L'Eden*, a bio-responsive garden installed in a Soho gallery. The fairy-tale indoor landscape used concealed mechanics and motion detectors to animate living plants, having them react as visitors moved through the space. Thus, under a starlit LED curtain, tendrils drew themselves back to make a path, and a dancing tree swayed to mirror spectators' motions.

Similar levels of ingenuity could be seen in designers' showrooms. To introduce his new lighting range, Lee Broom, for example, transformed his East London store with an Op Art–inspired installation. *Opticality* featured geometric-patterned pendant fixtures endlessly multiplied by mirrored walls to create the illusion of infinite space.

Eley Kishimoto took this energy to the streets—literally. With graphic designer Dolman Bowles, the fashion duo applied its signature Flash pattern to crosswalks at busy intersections in Brixton, improving safety while adding some visual flair to the urban environment.

In all, the London Design Festival's messy diversity is its strength: grand spectacles coexist happily with subtle interventions, and culture nestles with commerce. As the event expands into new territories and widens its international participation, its mix grows ever richer. ■

PHOTOGRAPHY: COURTESY ELEY KISHIMOTO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Guess the Architect Contest

ENTER NOW! A monthly contest from the editors of RECORD asks you to guess the architect for a building of historical importance.

CLUE: THE DESIGNER FOR AN "ACADEMICAL VILLAGE" OF NEOCLASSICAL PAVILIONS PLACED AROUND A GRASSY LAWN WAS NOT AN ARCHITECT BY TRAINING. ALTHOUGH HE DEVOTED HIS ENERGIES TO OTHER PURSUITS, HIS TALENTS FOR THIS PARTICULAR ART WON HIM MUCH RECOGNITION.

The answer to the October issue's Guess the Architect is **SIR JOHN SOANE**. Considered one of the most inventive architects of his day, Soane created a house-museum in Lincoln's Inn Fields, London, as part of a project involving three adjoining properties, carried out between 1792 and 1824. Because of its manipulation of light, space, and taut planes, the Breakfast Room (left) at No. 13 has won great acclaim from modern architects.

By entering, you have a chance to win an iPad mini.
See the complete rules and entry form online at architecturalrecord.com/guessthearchitect.

PHOTOGRAPHY: COURTESY LIBRARY OF CONGRESS (TOP); GARETH GARDNER (BOTTOM)

Rules of Engagement

EVA works with displaced communities in Haiti to design vibrant civic spaces.

BY ALEX KLIMOSKI

EVA (left, the London members) designed and completed Tapis Rouge (above), a spiral-shaped open space with areas for gathering and public art in Port-au-Prince. The young firm incorporates local materials and spirited colors to bring life to its projects in Haiti, including the recently opened Ecole de l'Espoir (below, left), and the Bois Tombé school (below, right).

LAST MONTH, Hurricane Matthew tore through Haiti with 145-mile-per-hour winds, causing complete devastation along the Caribbean country's southwestern coast. Although the capital of Port-au-Prince was spared this time, the storm has hampered ongoing attempts to rebuild the city, still hamstrung from the 2010 earthquake that killed nearly a quarter of a million people. Among the architects who are part of the earthquake recovery efforts, the 2-year-old design and research studio Emergent Vernacular Architecture (EVA) has made an impact with a number of socially attuned civic spaces.

EVA's eight projects in Haiti—an amalgam of community spaces, houses, and educational facilities—are characterized by an energetic aesthetic: vibrant colors, verdant landscaping, and a textured palette of local materials such as adobe and recycled metal. Just as the London- and Port-au-Prince-based firm incorporates patterned details onto surfaces ranging from pavement to window shutters, it seeks social, cultural, and economic patterns within a site to inform a design solution.

EVA began to take shape when cofounder Andrea Panizzo left his job working for Massimiliano Fuksas in 2010. Shortly after resigning, he left Rome for Bolivia, where he worked on numerous design projects—including an arts center—for the nonprofit organization Alalay. "I was asking myself questions about where the profession was going," says Panizzo, 37. "I came to realize how architects could have a positive social impact, and how we could help social needs in the global South."

Panizzo relocated from Bolivia to Haiti shortly after the earthquake, volunteering with the now-defunct nonprofit Architecture for Humanity for about eight months. He then became the lead designer for a local contractor—an opportunity that led to his work on MASS Design Group's GHESKIO cholera treatment center (RECORD, June 2015, page 104), and a competition to rebuild the historic Port-au-Prince Cathedral.

As he forayed into solo work in Port-au-Prince, Panizzo began talking to a friend, Simone Pagani, about founding a private practice there. The pair then recruited Jeannie Lee (who has since left), Pagani's colleague from Rafael Viñoly's London office, and tested the waters together by entering a bold proposal for the 2014 Guggenheim Helsinki design competition. Although their submission did not move forward (the competition had a record-breaking 1,715 entries), the trio decided to establish the now 11-person firm.

The firm's first commission, an American Red Cross–funded 16,000-square-foot public space called Tapis Rouge, was completed this past September, and provides a ring-shaped open-air amphitheater with areas for market kiosks, benches, and landscaping, to serve an informal neighborhood of displaced people in Port-au-Prince. As with all of EVA's projects, community participation was integral to every stage of Tapis Rouge's development. "The project's physical form was created by the community," says Panizzo. "They asked for gathering spaces and different terraces, so we came up with these concentric rings." Additionally, locals made up 75 percent of the project's construction workers. "In the end, they're the ones who are going to own the space," he says.

Despite the magnitude of October's hurricane, Panizzo says that EVA's projects were not badly affected ("We only lost one small tree," he says), a fact he attributes to their locations, and to the drainage strategies designed by the firm's group of engineers. Ecole de l'Espoir, a recently completed school in Port-au-Prince's Delmas 32 neighborhood, stayed closed during the storm, but reopened to students shortly after. Another educational and rehabilitation center for children, located south of Port-au-Prince in the town of Bois Tombé, is scheduled to be completed in 2017.

Panizzo now oversees projects with Pagani from EVA's London office, where about half of the staff is located, focusing on schematic design, while the Port-au-Prince satellite oversees community engagement and construction. Although the firm has been able to sustain itself with its current humanitarian work, Panizzo admits it is difficult, but he manages to travel to Haiti about once a month.

The firm is also looking beyond Haiti. In addition to finding work in London, Panizzo hopes to address the global refugee crisis by researching informal neighborhoods and social housing in Europe and the Middle East. But EVA's work in Haiti will be ongoing: "We want to keep going back to see how people are using the spaces," he says. "Architecture doesn't stop when architects leave." ■

IMAGES: © GIANLUCA STEFANI/EVA STUDIO (BOTTOM, LEFT; TOP); ALEX BORRELL/EVA STUDIO (MIDDLE); COURTESY EVA STUDIO (BOTTOM, RIGHT)


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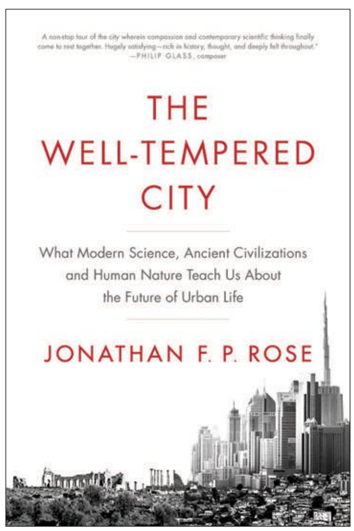
In Harmony

THE WELL-TEMPERED CITY: What Modern Science, Ancient Civilizations and Human Nature Teach Us About the Future of Urban Life, *by Jonathan F. P. Rose. Harper Wave, September 2016, 480 pages, $18.74.*

Reviewed by James Gauer

PLANNER AND developer Jonathan F. P. Rose's title for his new book, *The Well-Tempered City*, alludes to Johann Sebastian Bach's *The Well-Tempered Clavier.* Bach's collection of preludes and fugues in all major and minor keys was composed, says Rose, "to align our highest human aspirations with the sublime harmony of nature. It is a model of the task we have today in designing and reshaping our cities."



This may sound improbably heady coming from the scion of a prominent family of New York City apartment house developers. But Rose is no ordinary real-estate heir. He is also the intellectual heir of Jane Jacobs, and he cites as a seminal influence her belief that what looks like chaos can actually be a highly advanced form of order. Rose is a serious urban thinker and doer who has combined an academic background in planning and public policy with a successful business building green affordable housing. In his ambitious tome of almost 400 pages, he develops a notion, which he first began to explore as an undergraduate at Yale in the early '70s, that "the same principles that increase the well-being of humans and natural systems could also guide the development of happier, healthier cities."

The book's five parts each address a quality Rose believes essential to the future of socially and economically viable municipalities: coherence, circularity, resilience, community, and compassion. In the first four sections, he investigates the interdependent networks, both physical and cultural, that define metropolitan centers.

The chapters in Part 1, "Coherence," exemplify both the strengths and weaknesses of this approach. In "The Metropolitan Tide," the author attempts a far-ranging history lesson that is literally all over the map and seems somewhat unfocused. But in "Sprawl and Its Discontents," he succinctly analyzes sprawl's causes (federal housing and transportation policies, suburban zoning codes, and subprime lending) and this scourge's effects (environmental crises and suburban poverty, to name just two) and suggests that the solution lies in an alliterative paradigm of "concentration, complexity, and connection."

The breadth of Rose's interests ranges from climate change, cognitive neuroscience, ecology, economics, gardens, green building technology, history, and infrastructure to musicology, parks, planning, psychology, public health, sociology, and transportation. And more. He makes the case that, in cities, these are interconnected, but tying all that together in a coherent narrative is a tall order, and so the book tends to ramble a bit.

The most focused chapters include "Water Is a Terrible Thing to Waste," in which the author observes that one reason for the decline of cities and civilizations was expansion beyond the limits of their food and water sources. He tracks efforts to address this problem from the third century CE, when the emperor Diocletian installed an extensive water-supply system in Split, to the present day, when the Gates Foundation is funding experiments in water-saving toilets and small local sewage-treatment systems. The chapter "Green Buildings, Green Urbanism" is lively and informative, which is not surprising, given Rose's considerable experience with sustainable development. Also excellent is "Prosperity, Equality and Happiness," a thoughtful essay on the not-always-predictable relationship between economics and human well-being.

In Part 5, "Compassion," Rose circles back to Bach and espouses an optimistic vision of cities rescued by "science integrated with harmony" and by "altruism arising from trust." His writing takes a lyrical, almost mystical turn here, which comes as a surprise after all the dense scholarly exposition that precedes it. But his idealism seems authentic, and his hopefulness is welcome. ■

CIRCLE 222

WHY DRI-DESIGN?

Dri-Design Tapered Series panels have the ability to create a unique effect of rich texture, giving buildings their own individual identity. Although painted a single color for the Mill Woods Library project, the multifaceted wall panels allow nature to create its own color palette as natural light reflects differently off each individual piece. Even with this unique look, Dri-Design's signature ease of installation and water management system are maintained, and only a single plane of substrate is needed.

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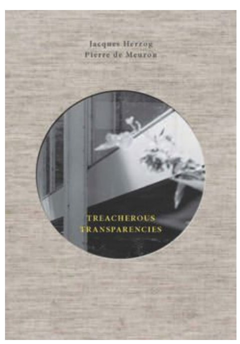
A Surprising Critique of a Modernist Landmark

Treacherous Transparencies: Thoughts and Observations Triggered by a Visit to Farnsworth House, *by Jacques Herzog and Pierre de Meuron. Actar, June 2016, 96 pages, $24.95.*

Reviewed by Fred A. Bernstein

IN 2014, after accepting the inaugural Mies Crown Hall Americas Prize from the Illinois Institute of Technology, Jacques Herzog and Pierre de Meuron drove from Chicago to Plano, Illinois, to visit Mies van der Rohe's Farnsworth House, completed in 1951. "I was ready to admire it for its beauty, but I discovered so many things that made no sense," Herzog later reported. Those discoveries are recounted in a compact volume, with text by Herzog and photographs by de Meuron.



The book, *Treacherous Transparencies*, argues that the house leaves much to be desired and, perhaps worse, that "Mies's statements on architecture are not coherent." It is a rare attack on one of the profession's deities, but Herzog supports his arguments with careful analysis and with de Meuron's incisive, unflattering photos (taken during the 2014 visit and on a return trip in the spring of 2016).

Herzog dislikes the house's use of glass—which is, of course, its defining feature. "The glass is not treated as a material," he writes. "It doesn't count and it has no identity; it would probably be better not to have any glass at all." (Really?) As he also points out, the single layer of floor-to-ceiling glass works terribly in both hot and cold weather.

The building seems to Herzog to be a kind of torture chamber. He quotes Mies's client, Dr. Edith Farnsworth, who said, "Do I feel implacable calm? The truth is that in this house I feel like a prowling animal, always on the alert." And he compares it to a work by the artist Dan Graham, *Alteration to a Suburban House*, in which the front of an ordinary tract house is replaced by a sheer glass wall. "Exposing the interior makes viewers suffer an almost physical panic attack," Herzog writes.

Herzog also examines glass surfaces in the work of other artists he admires, including Gerhard Richter, whose *Eight Gray* (2001) consists of eight large sheets of mirrored gray glass hung in configurations that vary depending on location. As he writes, "One cannot escape the way in which these gray, reflecting pieces of glass reach out and take possession of an architectural space, in full awareness of the psychological impact on viewers." By contrast, according to the author, "Mies had no awareness of his house's psychological impact."

Herzog takes one point too far: he writes that Mies was "utterly blind to the disproportionate distance between house and ground." But Mies—according to some scholars—chose the height carefully, ensuring that the view from the house would be equally divided among lawn, river, and sky. Is Herzog unaware of that explanation, or is he simply dismissing it? Moreover, Herzog focuses on the space below the house, calling it "extremely inelegant and uncontrolled" and noting that you can enter it "only by bending down and crawling in." It's not clear that anyone was meant to enter that space. Still, it's great that Herzog and de Meuron inspected the house from every angle—and that their large body of work contains so many triumphs that they can critique Mies from a position of strength. ■

Photo courtesy of AGS Stainless, Inc.

Image courtesy of KTGY, Inc.

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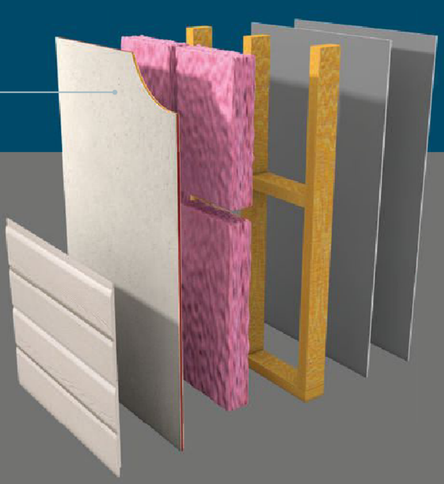

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Total Immersion

Virtual reality is on the cusp of becoming an almost indispensible part of architectural practice.

BY MICHAEL LEIGHTON BEAMAN

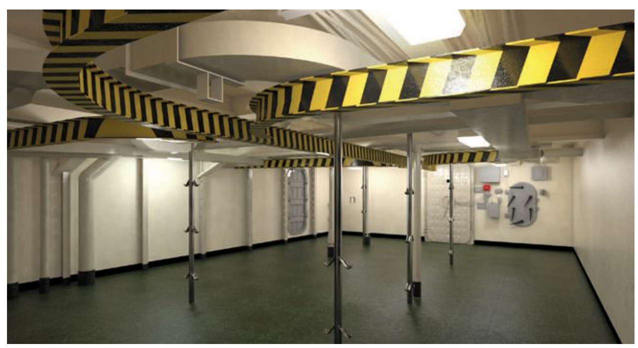
VIRTUAL REALITY, or VR, has had many lives. Expensive and clunky, VR, whose goal is creating an immersive spatial experience from data, never gained a foothold outside of academia, the military, or specialized industries. However, in the past few years, VR has reemerged as a way of developing and exploring proposed environments by architects, builders, and clients.

Today's VR is comprised of three fundamental elements that can be traced back to flight-simulator research from the late 1960s: a virtual environment, a prop to affect that environment, and a digital display to view it, says Jeff Jacobson, CEO of ConstructionVR. He adds that, in its current incarnation, VR combines hardware advances spurred by smartphones with the software developments of the gaming industry, making it an accessible and surprisingly practical platform for design practice.

Increasingly, architects are playing a significant role in shaping VR. SHoP has been working closely with software developers, including New York–based IrisVR. The architecture firm has used Iris applications on a number of projects, including its expansion of the Site Santa Fe Contemporary Arts Center, slated to be completed in late 2017, employing it both as a design tool and a way to introduce the scheme to museum visitors through an immersive exhibition.

For the Santa Fe project, SHoP used Iris's two offerings, which span the dominant modes of consumer-oriented VR. Scope is a mobile app that works with a smartphone in conjunction with an inexpensive stereoscopic viewer, such as Google Cardboard; it produces mainly static yet portable experiences. The more immersive and interactive Prospect relies on dedicated VR headsets; those have motion-enabled controllers such as Oculus Rift or HTC Vive.

Both modes of VR allow an immediate spatial understanding of environments. This is an advantage for architects when working with consultants and clients with different levels of experience reading two-dimensional drawings. But it can also enhance designers' comprehen-



SHoP is using virtualization and augmented-reality tools at the Intrepid Sea, Air & Space Museum to document existing conditions (top), test proposals for renovating spaces (middle), as well as for exhibitions (above).

IMAGES: COURTESY SHOP

sion of the spaces they create. "It reveals, even to experts, things they did not realize about their project," says Joel Pennington, Autodesk product manager. Autodesk's LIVE 360, released in July, is geared to quick production directly from Revit models in only a few steps. It also allows individuals to move through virtual models as they choose.

Rather than developing stand-alone applications, other software companies, such as Vectorworks, are embedding VR capabilities in their core platforms. Its 2017 release includes a one-step 3-D-model-to-VR feature that includes an option to navigate through a space by moving the smartphone, and a "mono" mode which can be used with a tablet.

Some architects are authoring their own VR applications, including Gensler. While the firm uses a number of commercially available design technologies, it developed its own app, which runs on a smartphone and uses Google Cardboard goggles, to offer a custom VR experience to its clients and designers.

VR, however, is just one aspect of virtualization, a term used to describe the spatial presentation of digitized information. Augmented reality (AR), created by layering virtual images on top of real-world views, combines hypothetical spaces with physically existing ones. ShoP is using AR on New York's Intrepid Sea, Air & Space Museum to record existing conditions, test design proposals, and create new experiences for visitors. A number of AR platforms are on the horizon, including Microsoft's HoloLens, and Google's Tango.

Virtualization can also include nonvisual information, says Matthew Krissel, a partner at KieranTimberlake. The Philadelphia-based practice has developed its own sensor network, Pointelist, which allows designers to import data such as humidity, temperature, and light levels into a virtual environment and visually display it. The firm is experimenting with Pointelist on several projects, including its own office, where it is assessing environmental conditions and rethinking the way it operates in that space.

NBBJ, meanwhile, is involved with VR startup Visual Vocal. Its Web and mobile app combines optical virtual reality with voice recording, providing clients and designers a way to communicate notes, thoughts, or technical information in a virtual environment. The Visual Vocal team is working out of NBBJ's Seattle offices and beta-testing software with the firm's client base.

Virtualization is seen by many as essential to the practice of architecture. But as the technology moves forward and brings together different types of information from a variety of sources into a common spatial experience, it won't be hardware and software designers setting the path of development. Instead, it will be users such as industrial designers, filmmakers, and of course architects. As ConstructionVR's Jacobson notes, "It's the artists who are going to change VR." ■

Michael Leighton Beaman, a visiting design and technology critic at the Rhode Island School of Design, is principal of the firms Beta-field and GA Collaborative.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CIRCLE 248

Cersaie 2016

For the annual ceramic tile trade fair in Bologna, Italy, manufacturers revealed smart and sophisticated twists on classic formats.

By Anna Fixsen

Blu Ponti

While many manufacturers looked to the future, others took inspiration from the past. Ceramica Francesco de Maio unveiled Blu Ponti, an exuberant collection that reproduces 12 boldly patterned blue-and-white tiles that Italian designer Giò Ponti created from 1960 to 1962 for his Parco dei Principi Hotel. Meanwhile, Gigacer obtained the right to use one dozen of the 63 colors Le Corbusier deemed appropriate for architecture in the company's LCS Ceramics products.

francescodemaio.it

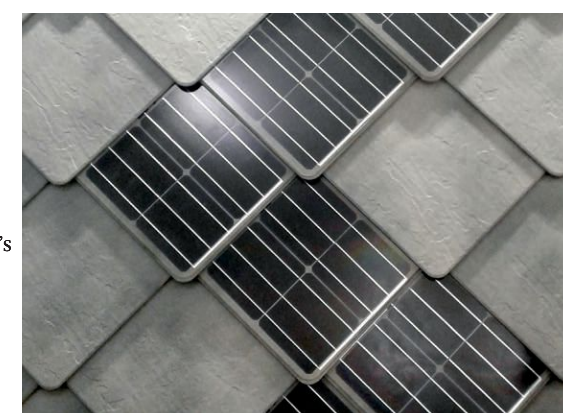
CIRCLE 106

3D Wall Design

Part of Atlas Concorde's 3D Wall Design collection, Angle demonstrates a trend toward fractal patterns. The tile's white crystalline surface—available in 15¾" x 31½" and a larger, 19⅝" x 43¼" format—allows for a dynamic interplay of light and shadow. Manufacturer Del Conca, meanwhile, offered an organic interpretation of this trend with Gran Paradiso, a line of wood-grain-printed geometric porcelain tiles.

atlasconcorde.com

CIRCLE 105

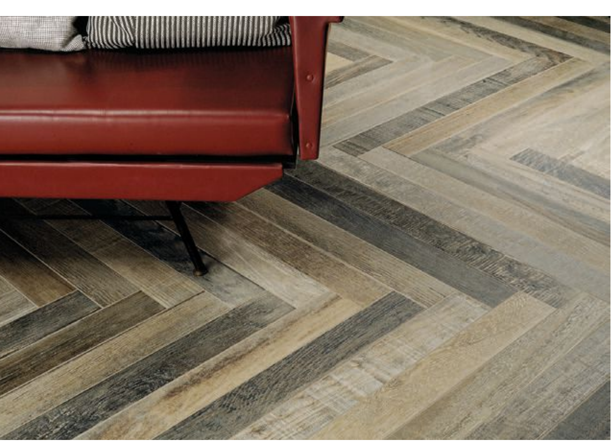


Ardosolar

Advances in high-resolution printing weren't the only new technologies on display at Cersaie this year: Ardogres presented Ardosolar, a roof-tile system equipped with thin photovoltaic panels. The 18W, 15¾"-square module is easily fastened into Ardogres's ceramic roof tiles, which are available in hues including slate black, stone gray, and garnet red.

ardogres.com

CIRCLE 107

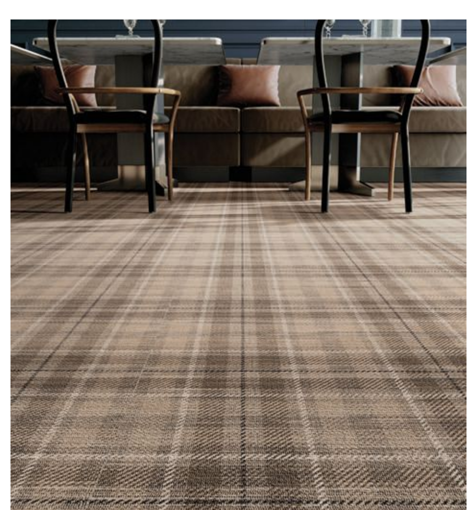


Wood_Mood

Wood-inspired ceramic tiles made a strong showing at Cersaie, but this year they appeared in chic herringbone configurations. Take Fioranese's new Wood_Mood collection, evoking weathered reclaimed timber. The tiles are available in a variety of shapes and colors; the 3½" x 35½" format in "rovere," shown.

fioranese.it

CIRCLE 108



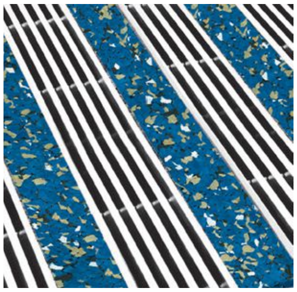
Tailorart

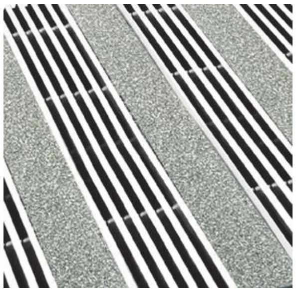
Many manufacturers this year unveiled sartorially inspired collections that took on the look and texture of woven fabrics like tweed and madras. Ceramica Sant'Agostino, for instance, introduced porcelain tiles printed in a neutral tartan pattern as part of its Tailorart collection. The tiles, suitable for both wall and floor applications, are available in sizes ranging from 6" x 23½" to 35" x 35".

ceramicasantagostino.it

CIRCLE 109


The Ultimate
Welcome





Get Schooled

Flexible, eco-friendly furnishings make their way from the office to the classroom.

By Julie Taraska

Exclave

Herman Miller's Greenguard-certified suite of tables, whiteboards, movable carts, and rail-hung storage aims to foster concentration and collaboration. The pieces may be specified in a range of sizes and finishes, including colorful textiles and solid and patterned laminates.
hermanmiller.com
CIRCLE 100

Turf Tile

These 24-inch-square cushioning tiles may be used inside and out on concrete, asphalt, and loose base surfaces covered with protective fabric. The grasslike wear layer—molded from 100% post-consumer recycled rubber—comes in 36 standard EDPM colors.
playguardsurfacing.com
CIRCLE 101

Align Lockers

With one to eight compartments, these steel-framed lockers—which coordinate with the Align desking and storage system—come in 11 colors and four base types; drawer and finish choices include metal, core laminate, and wood-grain laminate options. The Align pieces also contain over 30% recycled material, which can contribute to LEED points.
allsteeloffice.com
CIRCLE 102

Nik Desk

Designed to be used alone or grouped, Nik offers a concealed drawer and glass privacy panel; the desk also features two adjustable dock plates for charging and two movable shelves that can double as bookends. The desk, which has a frame and legs made of steel, is available in 48" and 64" widths.
peterpepper.com
CIRCLE 104

Trua

Though lightweight, this stacking chair—made with a wood or polypropylene shell—is durable enough for everyday use. It is offered in arm and armless versions as well as a barstool; two bases and five finishes may be specified.
keilhauer.com
CIRCLE 103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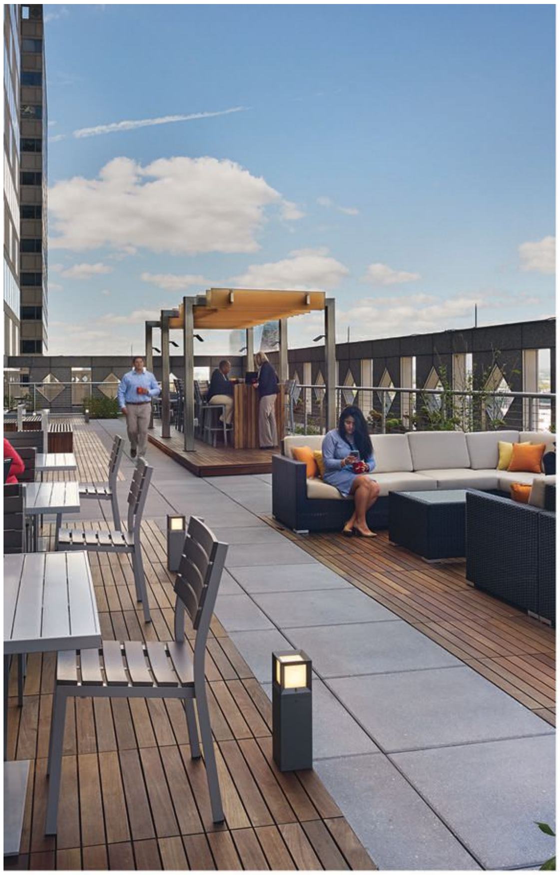

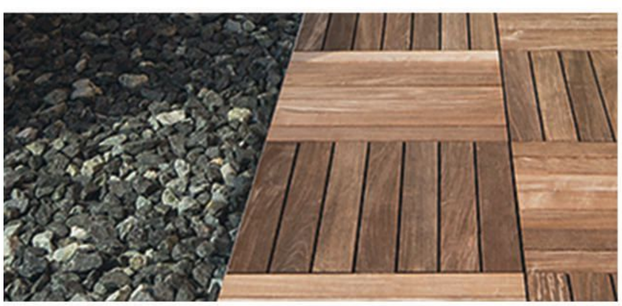


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CIRCLE 234
Odyssey Elementary School by VCBO Architecture • Photographer: Scot Zimmerman

LANDMARKS

Some buildings are instant icons. In this issue, RECORD visits three such projects—each highly anticipated. The first, the National Museum of African American History and Culture, opened on September 24 in a moving ceremony led by President Barack Obama. Over a hundred years in the making, the handsome tiered structure, by a design team including David Adjaye and Phil Freelon, is a standout on the National Mall in Washington, D.C. In Antwerp, it is the brazen form of the new Port House (this page) that now dominates the city's harbor. The crystalline addition lands atop a century-old building through sheer willfulness, a lasting legacy of the late architect Zaha Hadid. Up-and-coming Swiss firm Christ & Gantenbein similarly use bold and unexpected geometry to link old and new with a zigzagging extension of the Swiss National Museum in Zurich.

PHOTOGRAPHY: © HÉLÈNE BINET

ANTWERP'S PORT HOUSE, BY ZAHA HADID ARCHITECTS

National Museum of African American History and Culture | Washington, D.C. | Freelon Adjaye Bond/Smith GroupJJR

Crowning Achievement

A museum dedicated to the African-American story fills the last spot on the National Mall.

BY JOSEPHINE MINUTILLO

PHOTOGRAPHY BY ALAN KARCHMER

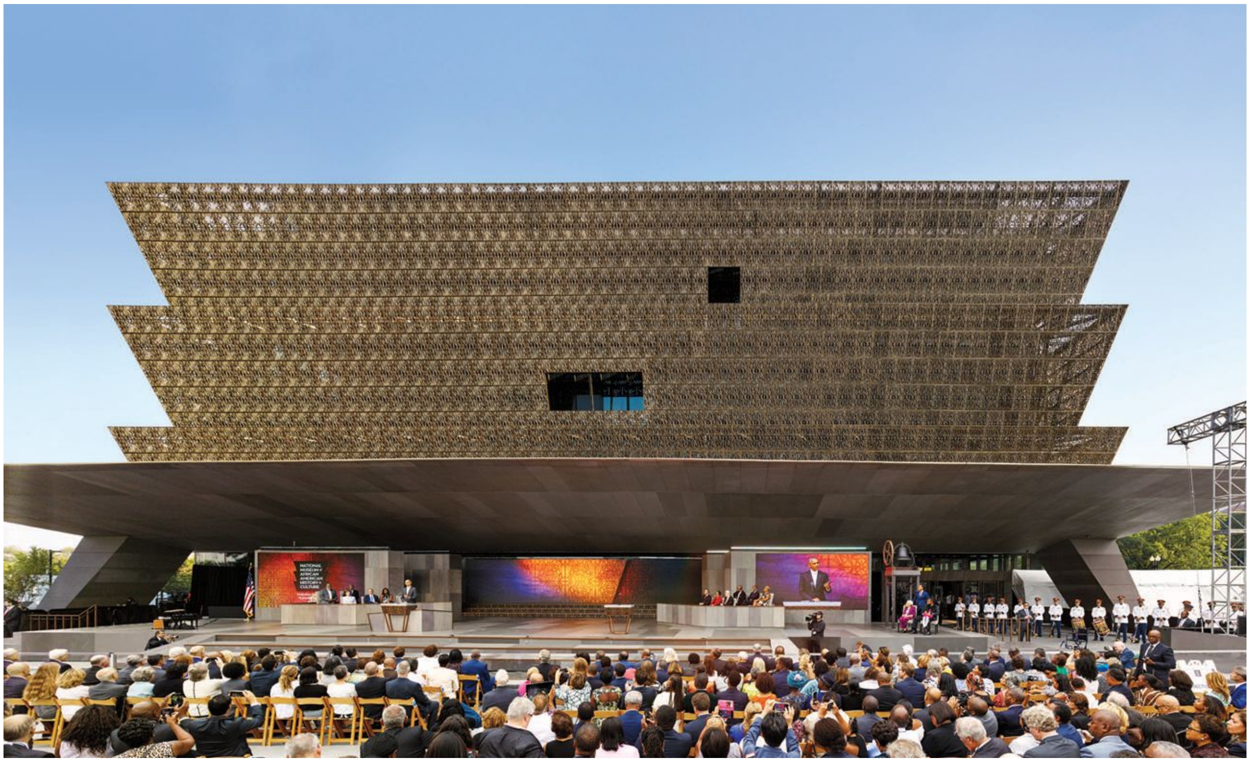
STANDING PROUD The 19th museum of the Smithsonian Institution, NMAAHC sits on five acres (left). It occupies the last available spot on the National Mall, in the shadow of the Washington Monument (below).

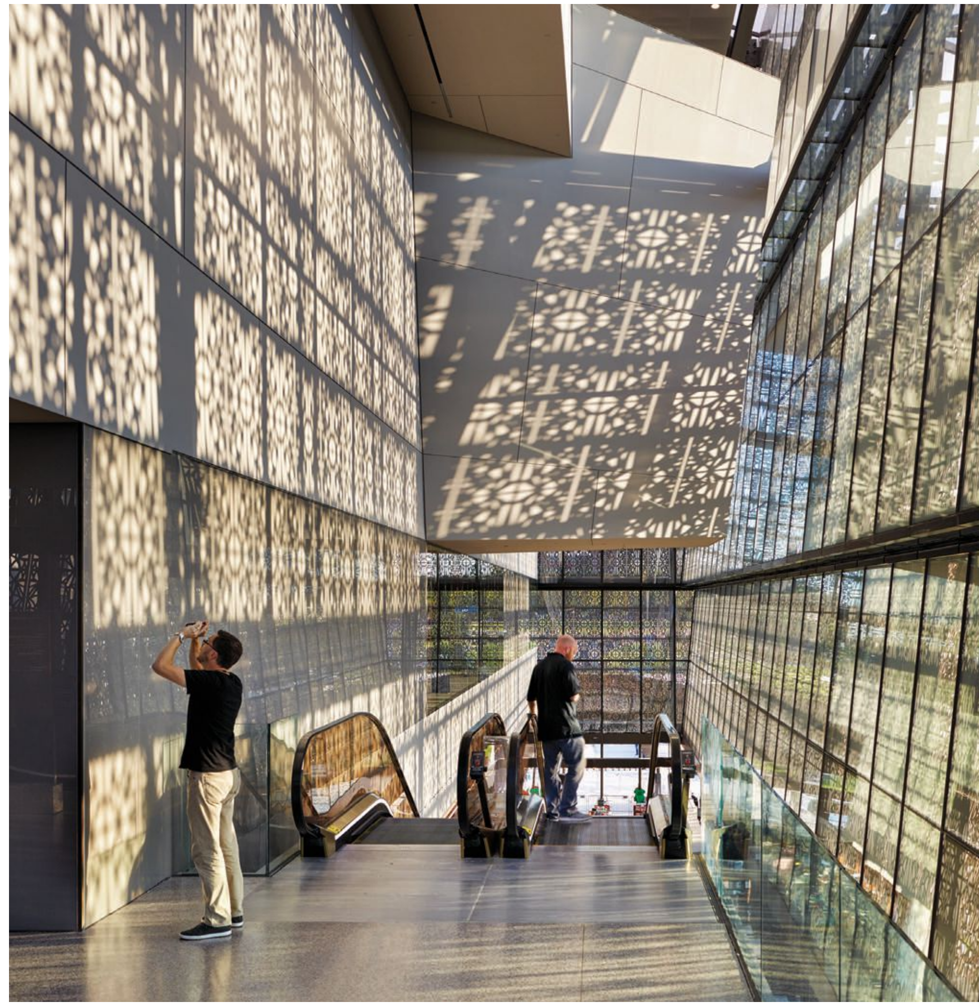
The opening of the National Museum of African American History and Culture (NMAAHC) on September 24 was a long time coming. It has been over a hundred years since such a monument was first proposed by black Civil War veterans and 13 years since President George W. Bush signed legislation to build it, following decades of lobbying. The highly anticipated museum finally came to fruition just in time for President Barack Obama—who features prominently in one of its exhibits—to preside over the opening before leaving office.

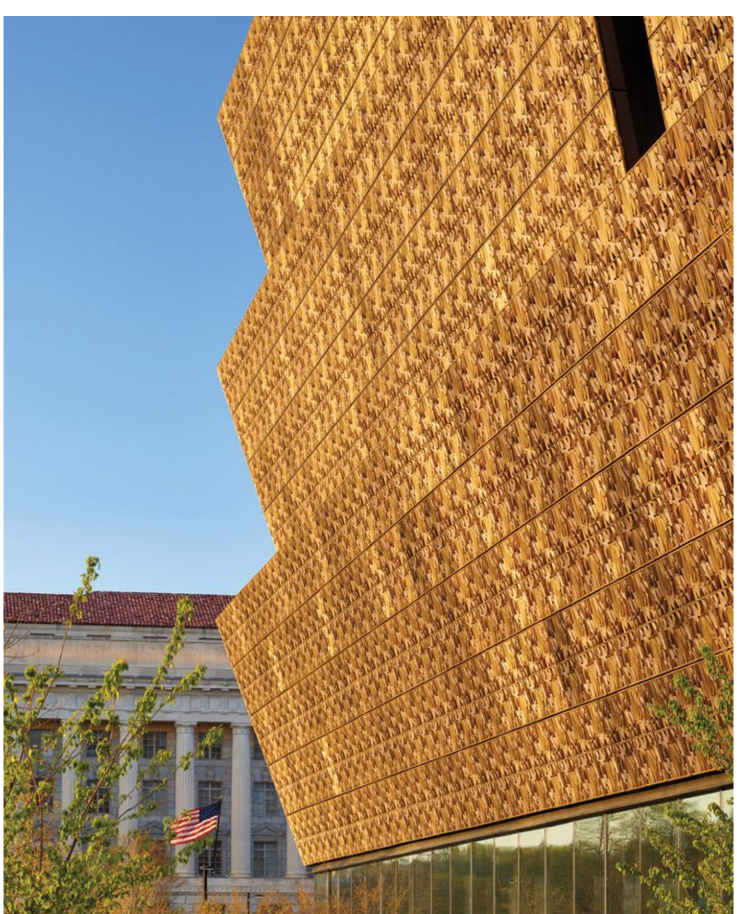
The freestanding building, occupying five acres on the last available spot on the National Mall in Washington, D.C., is both monument and museum—and memorial, according to its designer, David Adjaye, who, with Phil Freelon, led the four-firm architectural team of Freelon Adjaye Bond/SmithGroupJJR. “This story has embedded in it so much complexity that it’s not just about telling that story,” says Adjaye. “This is more than a functional building to hold content but also a representative building—I felt compelled to find symbolism that would start to make a connection, but symbolism that wasn’t too dogmatic. One that was definitely not familiar immediately but would make you ask questions.”

The museum’s story starts in Africa, and Adjaye’s symbol is the corona, a three-tiered crown used in Yoruban art from West Africa. (The actual sculpture that served as inspiration for Adjaye is on five-year loan to NMAAHC from the Haus der Kunst in Munich and is displayed in the uppermost gallery.) The 250,000 square feet of facade that take on that shape are covered in a latticework of bronze-colored cast-aluminum panels that recall celebrated historical patterns by black ironworkers in the South.

FINE FILIGREE
The heritage hall at the ground level is a vast lobby for welcoming visitors (above). Escalators move visitors through the upper-level galleries (opposite, top). At the south entrance, a massive canopy referred to as the Porch spans 175 feet. President Obama presided over the museum's opening here (right). In stark contrast to its Neoclassical neighbors, NMAAHC's 250,000 square feet of facade are covered in a latticework of bronze-colored cast aluminum panels (opposite, bottom).





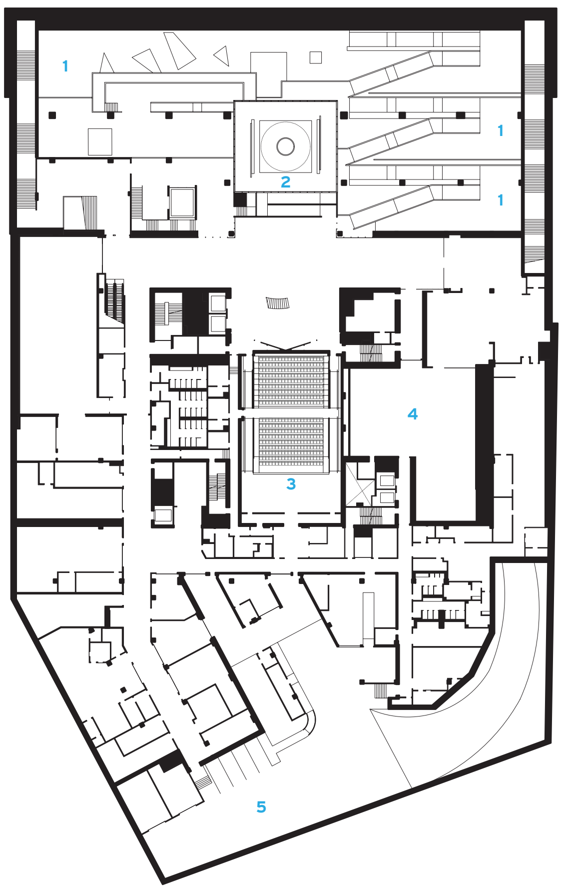


The building's compact exterior belies the sprawling galleries contained within. The structure extends as deep below grade as it rises above—just over 60 feet. In fact, visitors are encouraged to begin their tour at the very bottom. There, the history galleries begin in dark rooms with the story of slavery.

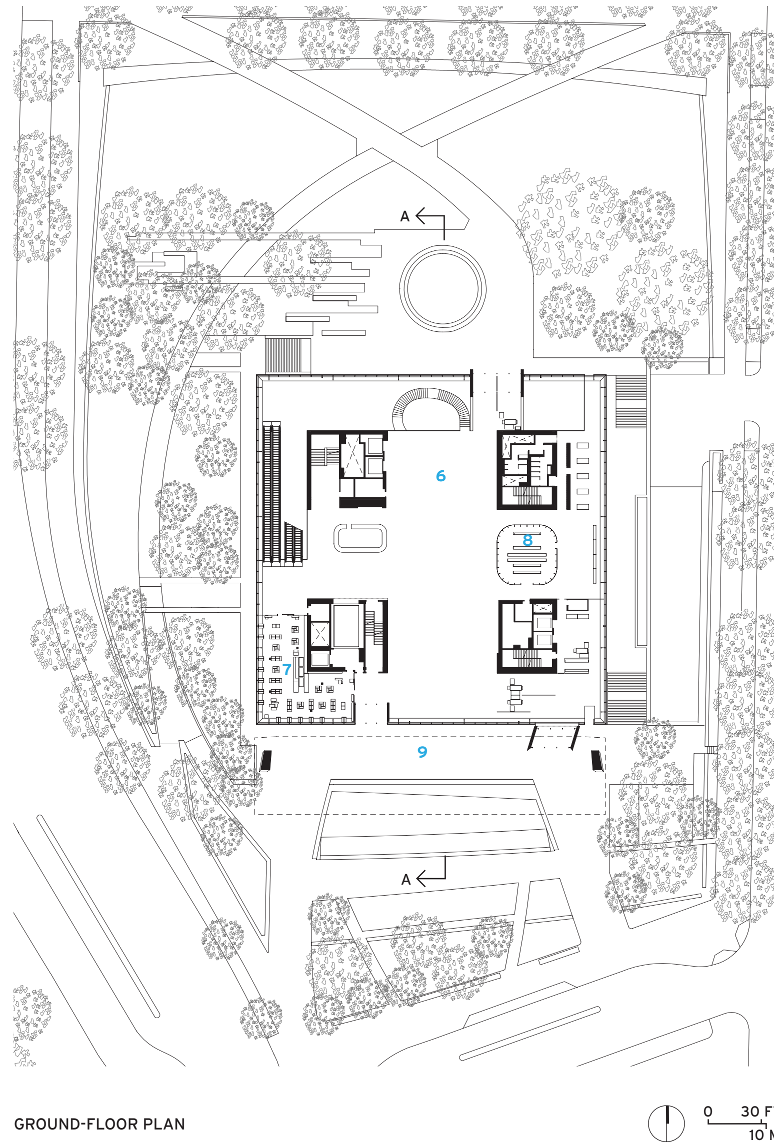
The building's location is not far from the site where slaves arrived by boat in the nation's capital, a center for the domestic slave trade. Built on swampy land where the Tiber Creek once flowed, the entire foundation had to be reengineered when the support for the excavation wall failed. "We encountered similar issues at the Museum of the American Indian on the opposite end of the Mall, but this area of the Washington Monument grounds was much more susceptible to the high water table," says Hal Davis of Smith GroupJJR. "The excavated area contained too much degradable material and large boulders that interrupted the integrity of the wall, creating opportunities for water to get through." The new foundation comprises a bathtub-like waterproofing system, with additional piles to tie down the slabs.

The exhibition opens up into a cavernous space as you ascend the ramping history galleries, passing large installations like a Jim Crow–era railroad passenger car and a plane, soaring overhead, used by the Tuskegee Airmen. NMAAHC is, in fact, a vertical museum, spanning multiple levels. As you approach grade, the contemplative court, with its circular cascade of water, offers a moment of reflection, and rest. The adjacent cafeteria offers up soul food.

Aboveground, the structure of the museum is more like that of a bridge than a building. The floors and facade—both the metal panels and the



CONCOURSE-LEVEL PLAN



GROUND-FLOOR PLAN

1 HISTORY GALLERY
2 CONTEMPLATIVE COURT
3 OPRAH WINFREY THEATER
4 CAFETERIA
5 LOADING DOCK
6 HERITAGE HALL
7 GIFT SHOP
8 ORIENTATION THEATER
9 PORCH
10 EDUCATION CENTER
11 CULTURE GALLERY
12 OFFICES
13 COMMUNITY GALLERY

credits

ARCHITECT: Freelon Adjaye Bond/Smith GroupJJR – David Adjaye, Phil Freelon, Hal Davis, Max Bond

ENGINEERS: Guy Nordenson and Associates, Robert Silman Associates (structural); WSP F+K (m/e/p); Weidlinger/Thornton Tomasetti (blast); RK&K (civil); Froehling & Robertson (geotechnical)

CONSULTANTS: GGN (landscape); Rocky Mountain Institute (sustainability); Fisher Dachs Associates (theater); Heintges (facade); Jensen Hughes (code/fp); Lerch Bates (vertical transportation and facade maintenance); Poulin + Morris (signage); Arup (security); FMS (lighting); Hopkins (food service)

GENERAL CONTRACTOR: Clark Smoot Russell

CLIENT: NMAAHC/Smithsonian Institution

SIZE: 420,000 square feet

COST: $540 million

COMPLETION DATE: September 2016

SOURCES

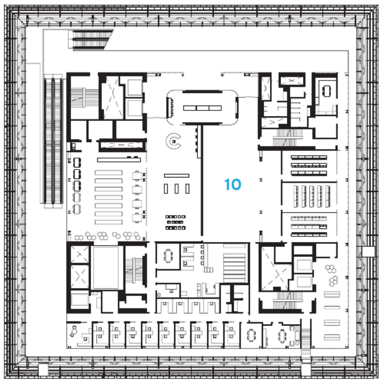
METAL FACADE PANELS: Enclos

ESCALATORS: Otis

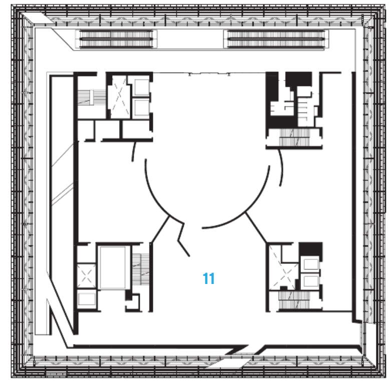
ELEVATORS: Thyssenkrupp, Emco

FURNITURE: Knoll

DISPLAY CASES: Goppion



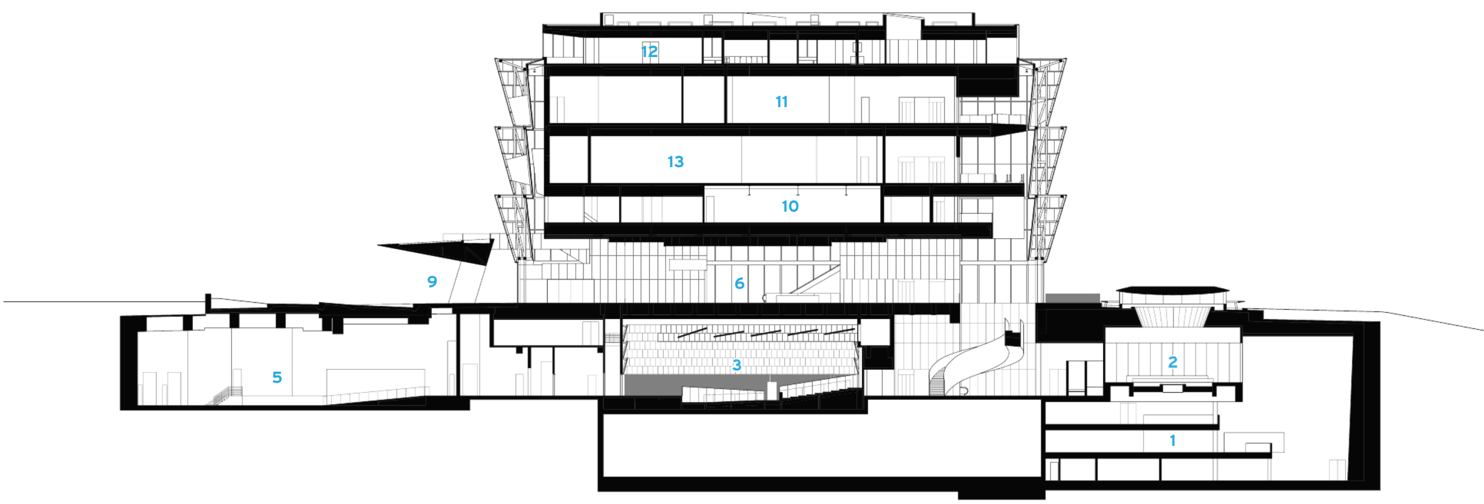
SECOND-FLOOR PLAN



FOURTH-FLOOR PLAN

0 30 FT.
10 M.

FIFTH-FLOOR PLAN



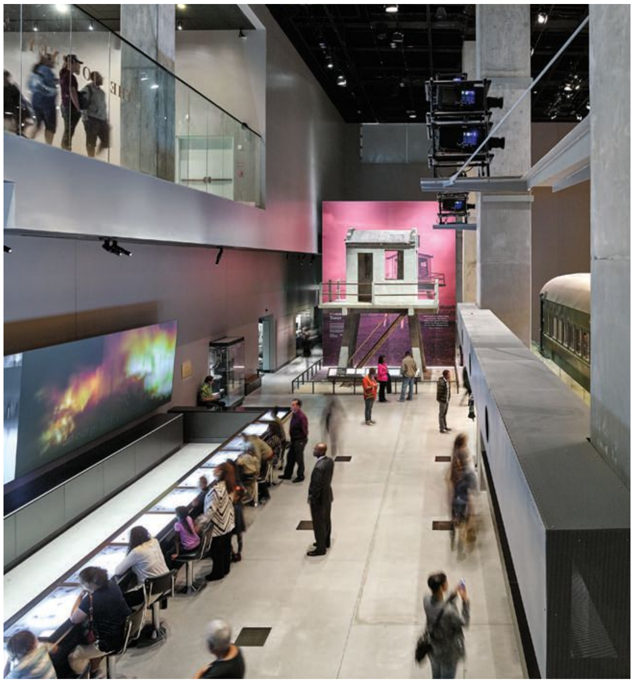
SECTION A - A

0 30 FT.
10 M.

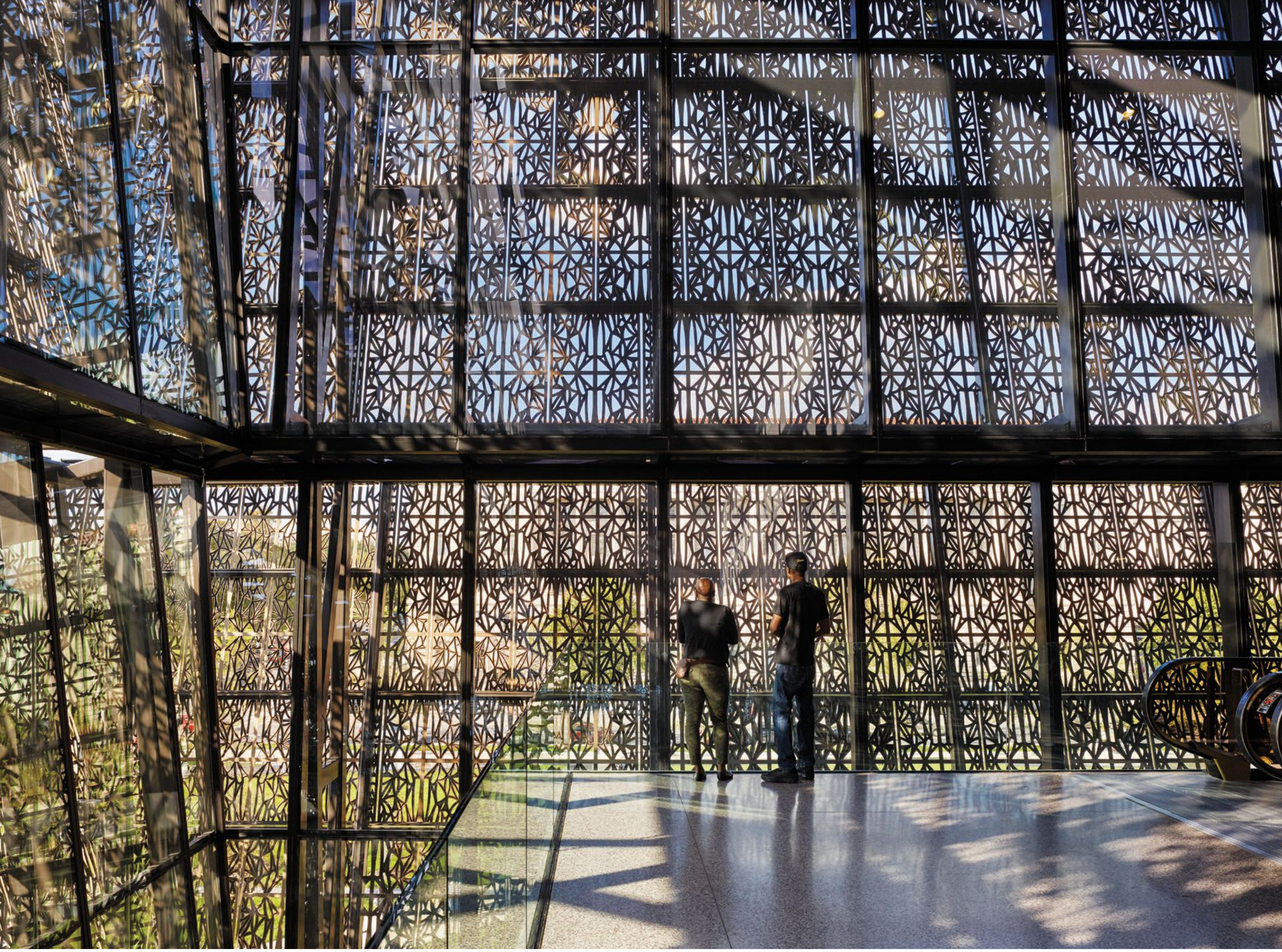
glass behind them—hang off four rectangular concrete-and-steel cores (which contain vertical transportation, restrooms, and mechanical space) toward the corners of the building, which have varying dimensions but are roughly 40 feet long. The entire building is supported by a steel superstructure that spans between those four cores —a convenient reference as well to the four "pillars" upon which NMAAHC metaphorically stands, which include the celebration and sharing of the museum's content.

As a place, the museum is not to be missed. The notion that a *place* like this—a national commemoration of black history—did not exist before is astounding. As architecture, it is not beyond reproach. While on the outside it handsomely—and proudly—stands out against its white neoclassical neighbors, its interiors, with escalators and terrazzo flooring, leave you feeling as if you are at a mall, not on the Mall. Ralph Appelbaum's exhibition design, so moving inside the history galleries below grade, at times

TRAINING GROUND A Jim Crow–era passenger car from the Southern Railway Company is exhibited within the below-grade history galleries. The 154,000-pound car was installed in the museum with two coordinated cranes before construction was complete. The slab supporting it is specifically designed for the load.



SPANNING HISTORY
A concrete guard tower from Louisiana State Penitentiary was cut from its original foundations and transported to the museum (top, left). A self-supporting spiraling steel staircase links the lobby to the concourse level below (top, right). A Tuskegee aircraft hangs in the History galleries (left). Views through the facade's latticework over the capital are possible from the upper-level galleries (above). The underground Contemplative Court, with cascading water and daylight streaming in from above, offers a moment of reflection (opposite).



IMAGES: © ALAN KARCHMER, COURTESY NMAAHC

borders on kitsch within the busy installations of upper-level galleries that celebrate African-American achievements in music, sports, literature, and pop culture. The vast 22-foot-high heritage hall, which serves as the lobby on the ground floor, feels too empty, too corporate. One wonders if the idea for a forest of columns hanging from the ceiling—part of Adjaye's original concept for that space but eliminated partly to save costs, and partly to display art instead—would have alleviated that sense.

Where the interiors excel are in the space between the facade and the enclosed galleries on the upper levels that allows dappled light to filter in from the metal screens. According to Adjaye, "Going out into that corridor, into that light-filled space, and then going back into this sort of dark box is an important part of keeping you engaged as you go up the building." Indeed, as one completes the journey and reaches the lookout at the uppermost gallery, with its views over the capital city, there is a sense of triumph for this ongoing story and how it is told through the architecture of this building. ■

SOFT LANDING
In transforming a century-old fire station into the offices for Antwerp's Port Authority, Zaha Hadid Architects created a faceted, glazed cloudlike structure atop the older building (opposite). While the old and new sections are stylistically disparate, the size of the upper portion's glass panes retains the scale and proportion of the lower fenestration (right).

PHOTOGRAPHY: © HUFTON + CROW

The Port House | Antwerp, Belgium | Zaha Hadid Architects

Star Ship

A picturesque fire station on the city's docks is transformed into a striking office building by a multifaceted glass top.

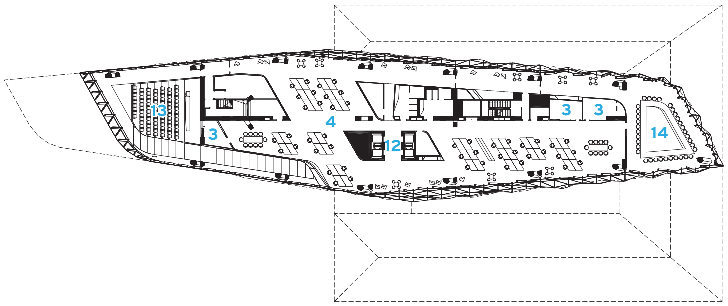
BY HUGH PEARMAN

One of the first completed projects from Zaha Hadid's office since her untimely death, at 65 in March this year, the new Port House on the sprawling docks of Antwerp, Belgium, is a bravura, if distinctly eccentric work. This nine-story headquarters building for the Antwerp Port Authority is not just by Hadid, of course: her long-term codirector, Patrik Schumacher, is equally credited, along with a large team at Zaha Hadid Architects (ZHA). But Zaha was closely involved in this creation, according to Schumacher, which displays her wit, sense of mischief, and knowledge of the history of heroic modernism from Futurism and Russian Constructivism onward. Many of her later buildings, such as her gigantic Heydar Aliyev Center in Baku, Azerbaijan (RECORD, November 2013, page 82) became softer, more organic in form. Not this one: this comes from the earlier Zaha mindset, the time of glittering, jagged edges.

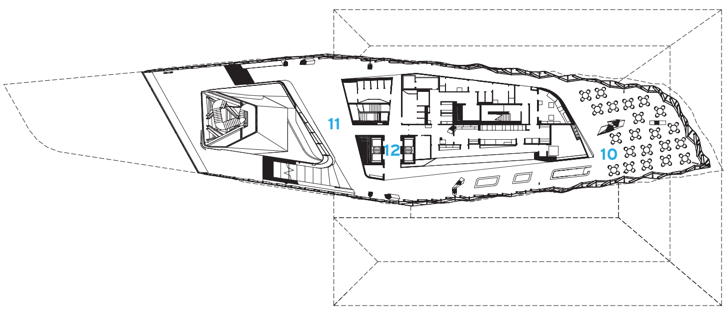
It is architecture as giant jewelry, a 66,700-square-foot, four-story extension above a large 71,000-square-foot, existing municipal fire station dating from 1911. Constructed by the city architect, the fire station replicated a long-vanished Hanseatic League merchant's palace of the 16th century. The stoutly built steel-framed masonry structure fell vacant just as the Port Authority was looking for a new base for its scattered staff. Since the city's busy docklands area is the second-largest in Europe and fifth-largest in the world, the authority wanted a headquarters that was a symbol of modernity for visiting trade delegations.

The resulting hybrid is a building of extreme visual dynamism, its upper portion floating above the roof of the restored old building. Pointing due south toward the city's historic riverside and center, it seems both frozen in motion and surging forward. The top's triangulated glazed cladding starts off flush at the prow but erupts into irregular projections, becoming increasingly crystalline along its length–a reference to Antwerp's famous diamond trade. According to ZHA's Belgian-born project director, Joris Pauwels, Zaha did not overemphasize visual metaphor during the design process. "The layering of the city was what she talked about," he says, "and how that should have a clear dynamic."

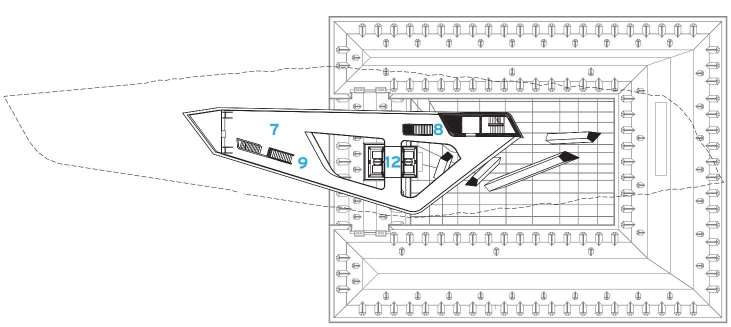
This diamond vessel assumes an abstract rhomboidal form that is freestanding, touching the old building only via one of two elevator shafts housed in a concrete core in the now glazed-over courtyard. A concrete angled prow rising from the cobbled piazza in front contains a fire stair. These two supports are connected above and below ground to form a vertical ring beam, and the whole structure is then braced by four angled black-painted steel columns rising in V formation from two



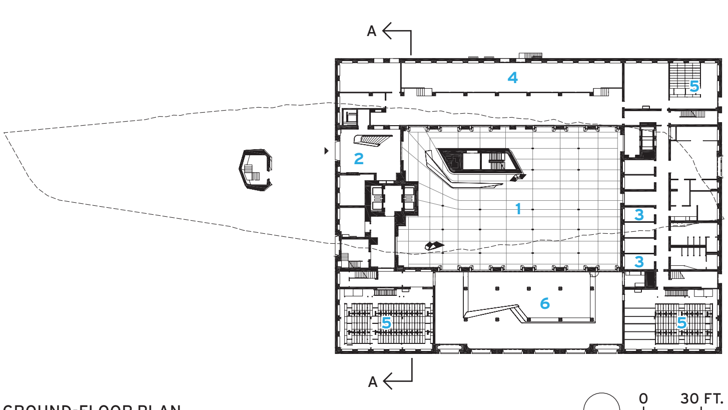
SEVENTH-FLOOR PLAN



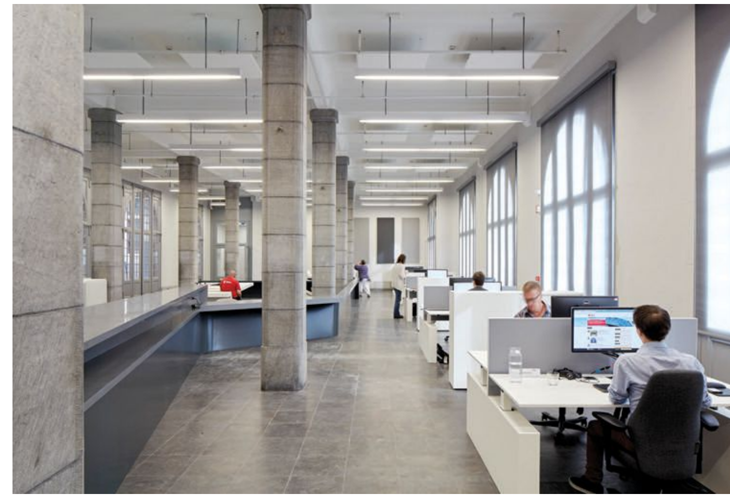
SIXTH-FLOOR PLAN

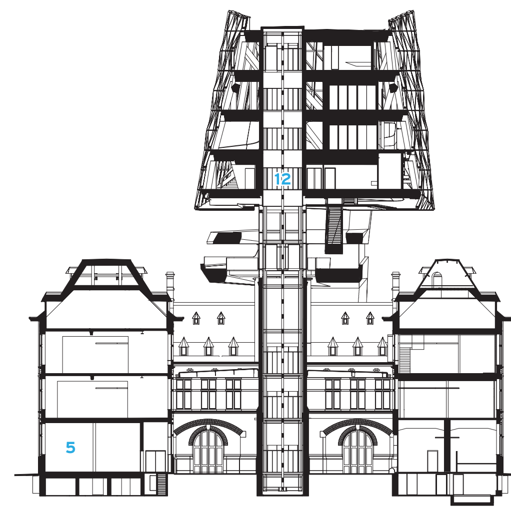


BRIDGE-FLOOR PLAN



GROUND-FLOOR PLAN





SECTION A - A

0 30 FT. 10 M.

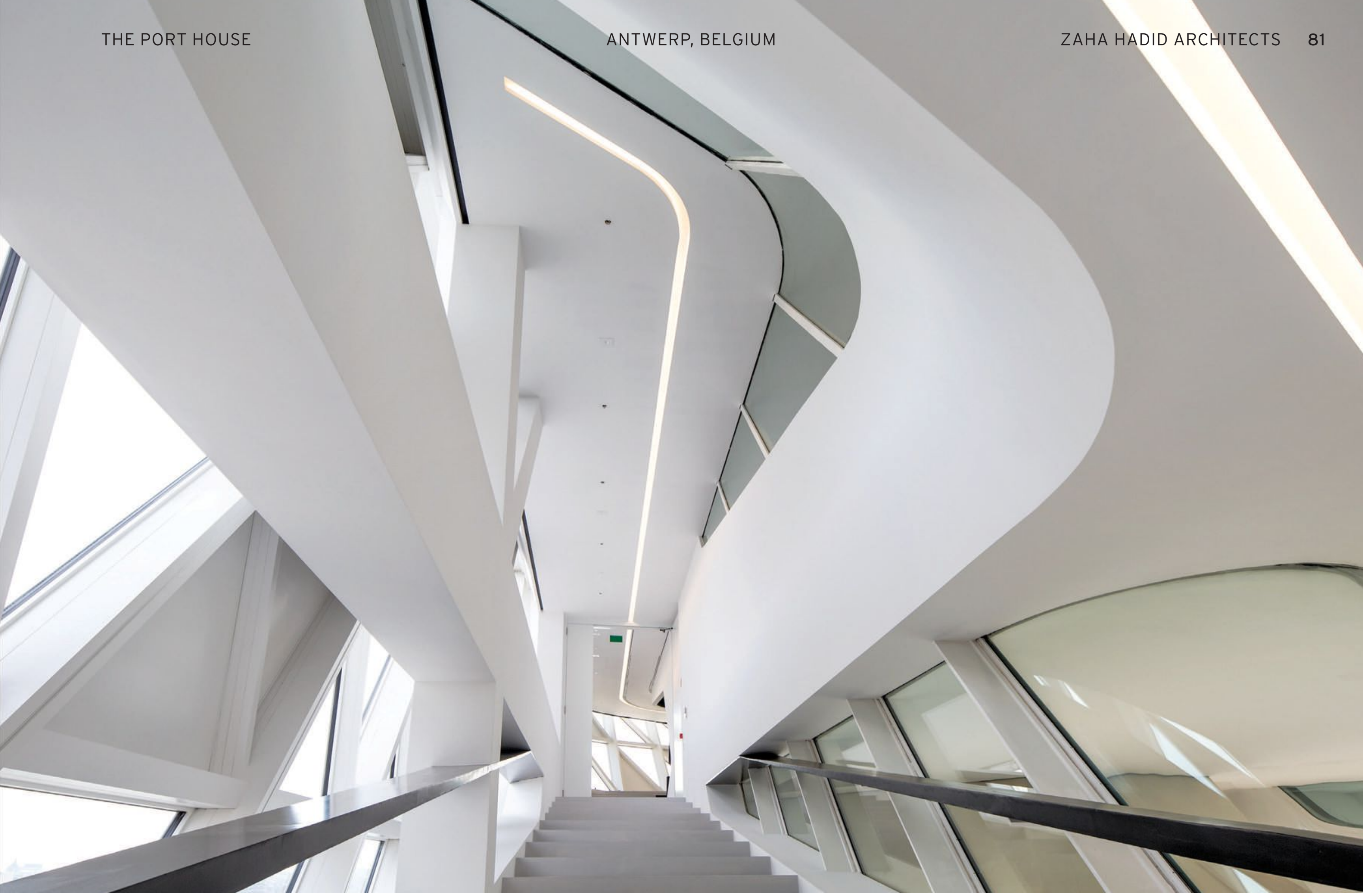
1 COURTYARD
2 ENTRANCE HALL
3 MEETING ROOM
4 OFFICES
5 ARCHIVE
6 LIBRARY
7 VIEWING DECK
8 STAIRS TO SIXTH FLOOR
9 STAIRS TO SEVENTH FLOOR
10 RESTAURANT
11 FOYER
12 ELEVATOR LOBBY
13 AUDITORIUM
14 BOARDROOM

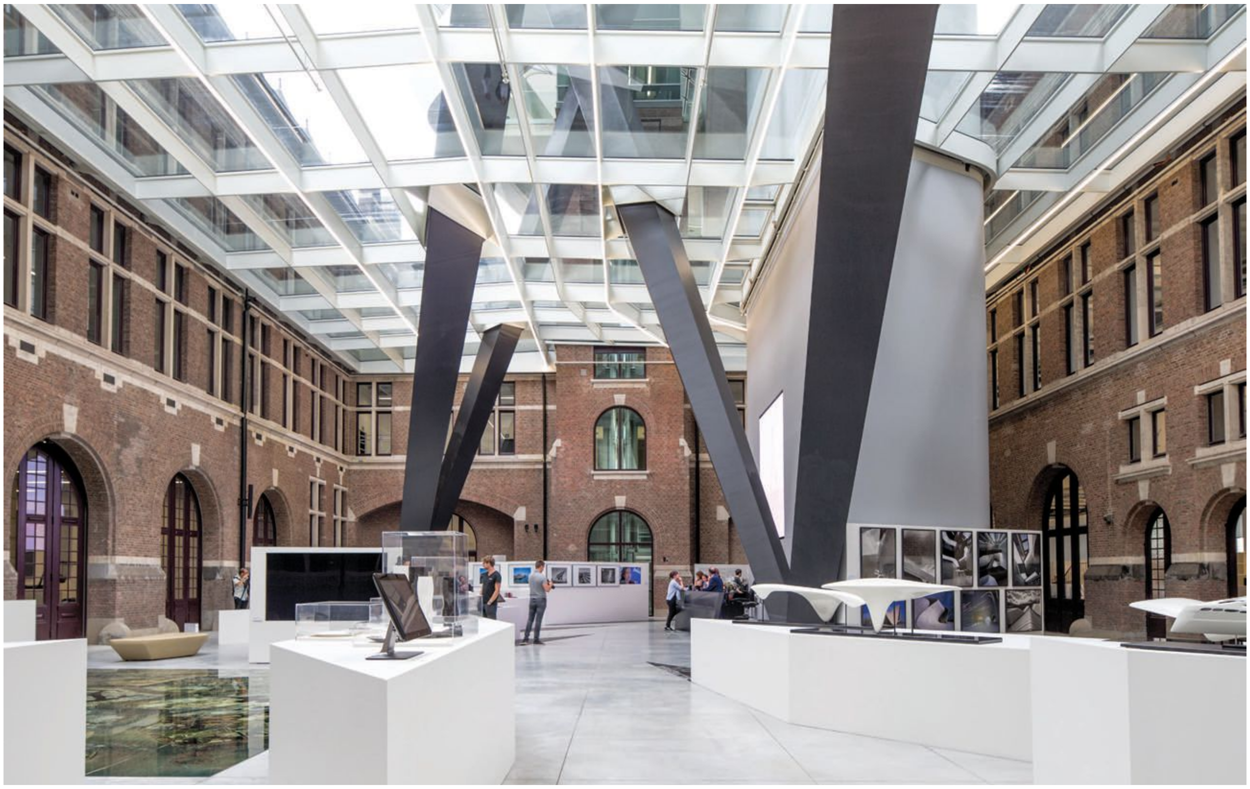
points in the courtyard. They shoot through the courtyard's glass roof, interlocking in the new superstructure to keep it rigid.

Three floors of the shimmering airship are actually a steel-truss bridgelike structure, while another floor is slung beneath it on hangers. Large steel subsections were preassembled off-site, floated in by barge, and hoisted into position by crane. The whole was then wrapped in an aluminum-framed glazed cladding system, which conceals the fact that around a third of the panels are solid, to reduce solar gain.

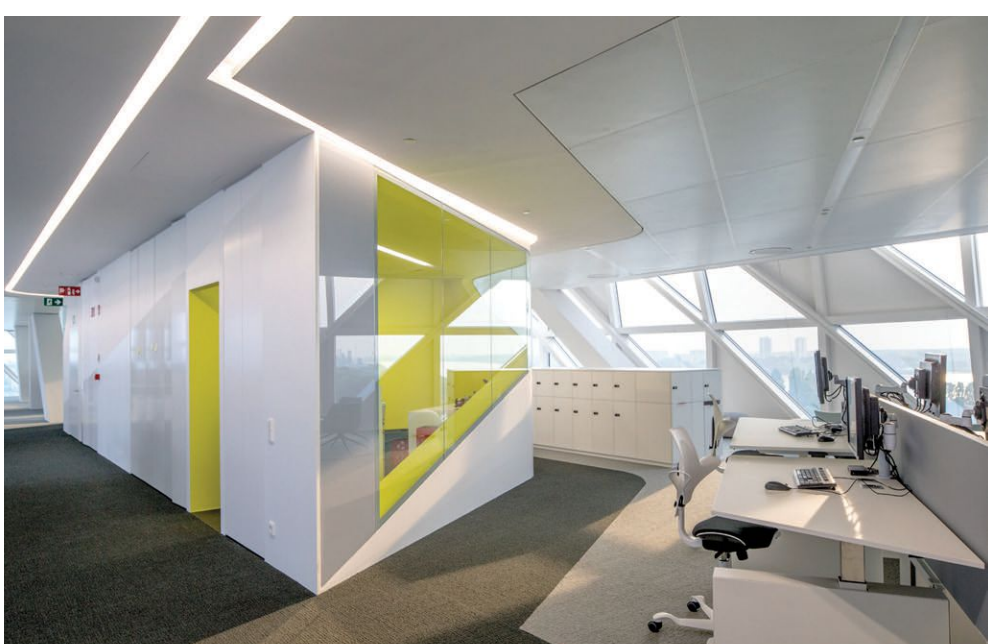
The two halves of the building work as one programmatically in that there are open-plan "hot desking" office floors throughout, housing 450 workers now but with capacity for growth, to 600. However, the larger spaces–a 90-seat auditorium, boardroom, and restaurants–are all in the upper section. A cluster of four panoramic elevators uses the stumpy firemen's tower of the original building, where hoses were hung to dry.

PHOTOGRAPHY: © HUFTON + CROW; DANICA KUS (OPPOSITE, 2)





MOVING UPWARD
The original station, a copy of a 16th-century Hanseatic League structure, has been stripped to its basic frame for new offices (opposite). The courtyard (left) functions as a reception and exhibition area. V-shaped black-painted steel columns push through its glazed steel-lattice roof to keep the superstructure rigid. The stairway (above) between the foyer and the auditorium on the sixth floor is enclosed by cloudlike, swerving walls.



ANGULAR ARRAY Two diagonal steel supports meet in the sixth-floor restaurant (top). A narrow, vaulted corridor on the periphery of this floor (opposite) takes visitors along a dramatic route from the foyer to the restaurant. On the seventh floor, offices and meeting rooms echo the lines of the faceted exterior (above).

These elevators shoot through a flash of open daylight between old and new structures: what could have been merely a gap has become something else. It features an open viewing deck in smooth cast-in-place concrete that makes a virtue out of the necessity for the structural beam clamping the two cores together. A staircase, for all the world like the gangplank of a ship, leads down to this terrace from the belly of the floating building above.

The office interiors are as normal as any office could be in such a structure, where angled columns crash through the spaces at intervals, and contractors have struggled to get solar blinds around some of the more awkward, outwardly-leaning corners. In consequence, there is a fair amount of redundant space in the floorplates–though it is a very different matter in the more efficient, if less well daylighted, rectilinear floors of the restored building beneath. Throughout, freestanding pods of ancillary office accommodation, from storage to meeting rooms, are finished in bright yellow, contrasting with the gray floors. Overall, the building has achieved a BREEAM “very good” rating, roughly equivalent

PHOTOGRAPHY: © TIM FISHER (TOP AND OPPOSITE); DANICA KUS (BOTTOM) to LEED Gold, thanks to groundwater cooling via chilled beams, the waterborne delivery of large parts of the building structure, extensive provision for bicycles and electric cars in a two-level parking garage beneath the cobbled piazza, and of course the total conservation and reuse of the existing building.

The courtyard, now enclosed beneath a glazed steel-lattice roof, acts as a very generous reception lobby and exhibition space. To one side of the courtyard, in the area where fire trucks used to park, there is now a public reading room with access to the Port Authority's archives.

As with much of Zaha's output, this is a building that is as easy to criticize as to praise. Many, seeing the images, see only arrogance. It is an undeniably startling, even shocking, juxtaposition of forms. But photographs exaggerate the drama: in actuality, in this wide-open landscape with no nearby buildings, the Port House does not seem so big. And the century-old host building—which is good but not great—holds its own pretty well. No question that, if seen only as a way to achieve extra square footage, the project verges on the perverse. But nobody ever hired Zaha to do ordinary. For me, this is a magnificent work of architectural surrealism that just happens, by force of will, to be a functioning, if in places awkward, workspace. I left shaking my head in admiration. ■

Hugh Pearman is a London-based architecture critic and the editor of RIBA Journal.

credits

ARCHITECT: Zaha Hadid Architects – Zaha Hadid, Patrik Schumacher, design principals; Joris Pauwels, project director; Jinmi Lee, project architect; Florian Goscheff, Monica Noguero, Kristof Crolla, Naomi Fritz, Sandra Riess, Muriel Boselli, Susanne Lettau, project team

EXECUTIVE ARCHITECT AND COST CONSULTANT: Bureau Bouwtechniek

ENGINEERS: Studieburo Mouton (structural); Ingenium (m/e/p); Daidalos Peutz (acoustic)

CONSULTANT: Origin (restoration)

CLIENT: Antwerp Port Authority

SIZE: 224,000 square feet (total): 71,000 square feet, fire station; 66,700 square feet, new extension

COST: $62 million

COMPLETION DATE: September 2016

SOURCES

ALUMINUM UNITIZED FACADE: Schüco

POLYURETHANE LIQUID FLOORING: BASF

OFFICE FLOORING: Lindner

ELEVATORS: Mitsubishi

Extension of the Swiss National Museum | Zurich | Christ & Gantenbein

Linked In

A modern addition to a 19th-century museum uses bold geometry to connect old and new.

BY FRED A. BERNSTEIN

PHOTOGRAPHY BY IWAN BAAN

The longtime home of the Swiss National Museum, or Landesmuseum, in Zurich, is a stolid 19th-century pile. Its central courtyard opens onto a leafy park overlooking the Limmat River. But if the building's C-shape allowed it to embrace the landscape behind it, it also meant that circulation routes from the main lobby—to the east and west—led to dead ends.

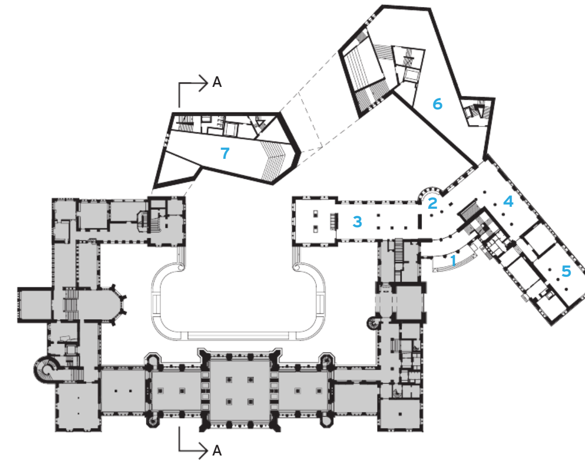
Commissioned to expand the old museum, designed by Gustav Gull, and completed in 1898, Basel-based architecture firm Christ & Gantenbein had to solve one problem, the dead ends, without creating another: cutting off the park. The architects did so by adding a zigzag connector that completes the circuit begun by the C while rising like a giant chevron to provide park access and views. The triangular tunnel created by the chevron is nearly 100 feet across at grade. It is one of several bold moves employed by Emanuel Christ and Christoph Gantenbein—both of whom are teaching at Harvard's Graduate School of Design this fall—in their quest to update what is said to be the most visited cultural-history museum in Switzerland.

The original museum building, directly across from Zurich's main railway station, is a masonry hodgepodge with too many towers and turrets, suggesting a cross between a hunting lodge and Cinderella's castle. Christ and Gantenbein's 80,000-square-foot addition doesn't replicate the turrets, but it does echo their acute angles in its switchbacks. Still, the shape of the addition is no mere homage. It evolved from efforts to preserve as much of the park as possible, and even to protect specific trees, says Christ.

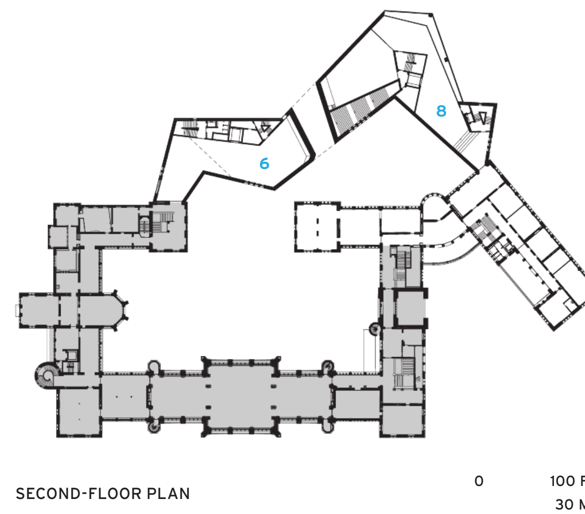
While addressing those constraints, "the building attempts to find a certain autonomy as a sculptural object," continues Christ, who calls the approach "expressive contextualism."

The original building's adorned surfaces were meant as a showcase for Swiss decorative arts. Christ and Gantenbein, on the other hand, clad their addition entirely in board-formed concrete. That includes even emergency exits, which are practically invisible from the outside. Roofs are covered in corrugated fiber cement. So determined were they to keep from breaking the lines of their sharply angled composition that all mechanicals are hidden. The loading dock, inventively, is

RAISE THE BAR The Landesmuseum sits directly across from the main railway station in Zurich, along the Limmat River (left). The addition connects to the old building at the second level, permitting pedestrian access between the museum's courtyard and nearby park (above). The new building's exterior is composed entirely of board-formed concrete (opposite).

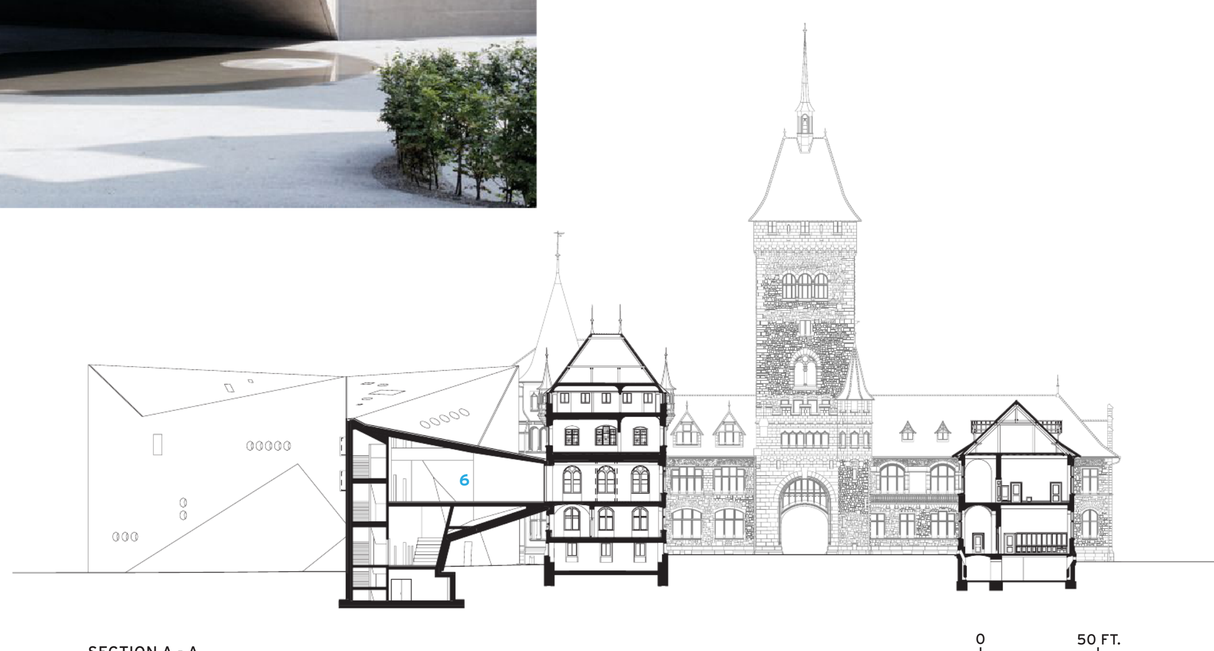


GROUND-FLOOR PLAN



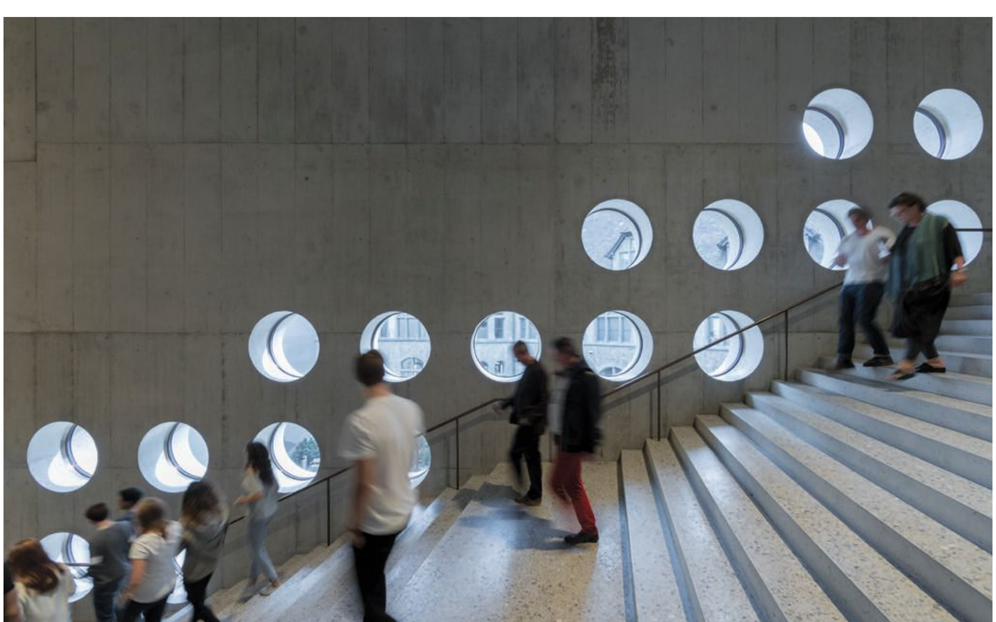
SECOND-FLOOR PLAN

1 NEW ENTRANCE
2 LOBBY
3 SHOP
4 BAR
5 RESTAURANT
6 GALLERY
7 AUDITORIUM
8 STUDY CENTER



SECTION A - A

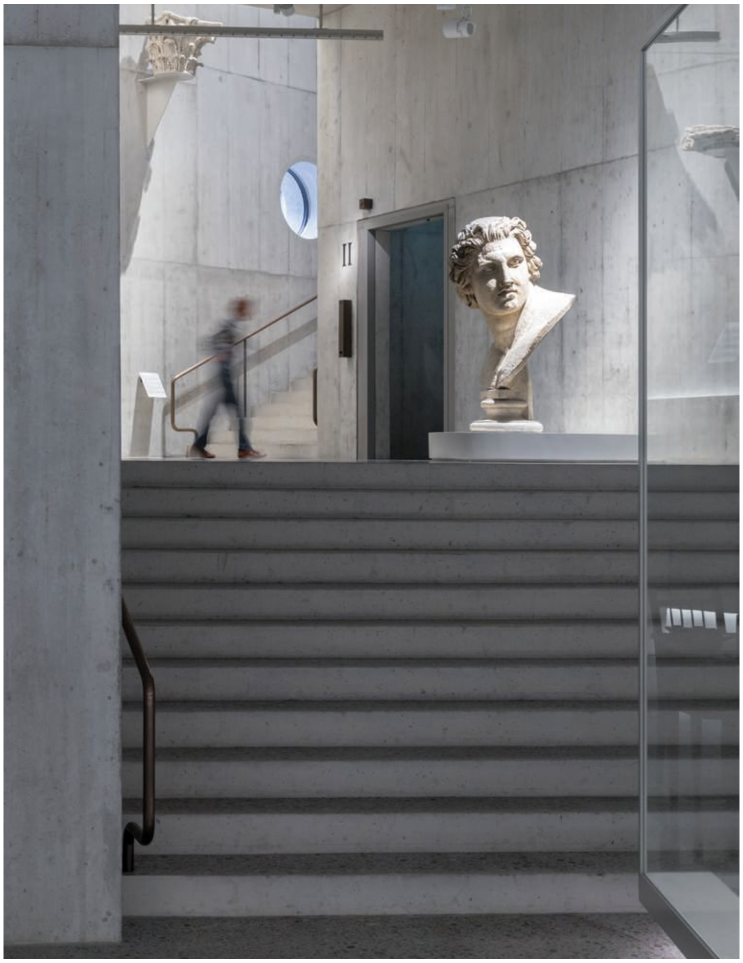
TUNNEL VISION The triangular passage that forms beneath the raised chevron is nearly 100 feet across at grade (opposite). The addition's bold geometry is a stark contrast to the traditional masonry building with its oriels and stepped gables (above). A stairway rises 30 feet along one side of the chevron (bottom).



a contraption that rises up into a parking lot, never touching the aboveground portion of the building. The only openings in the addition are the porthole windows, which echo the rows of arched fenestration in the old building and, in many cases, provide tantalizing glimpses of Gull's confection, as if concentrated bits of it were inset into Christ & Gantenbein's thick concrete walls.

Inside, a dramatic stairway set into one side of the chevron rises 30 feet to the second-floor galleries. Interior walls are the same gray concrete, and floors are a buff-colored terrazzo. That's a tough combination even for lovers of spare architecture. But for visual stimulation, one need only look up at the ceilings, where metal raceways containing lighting and ductwork angle through the spaces, suggesting a vast Louise Nevelson sculpture.

For Christ and Gantenbein, the museum commission came 14 years ago, when, just a few years out of architecture school at the ETH Zurich, they won a competition to renovate and enlarge the museum. The renovation work, which began in 2006, created a brilliant



COLOR CODED
The exhibition areas are cavernous spaces that are not discrete galleries but parts of a continuous circulation route (above). A neutral color scheme pervades the interiors, with walls of gray concrete and floors of buff-toned terrazzo (left). Even so, the exhibition designers have worked to insert color, with lavender walls and magenta partitions backing some displays (right).

mix of old and new. (Controversy over funding caused the addition to be delayed.) Gull's ornament is leavened by Christ & Gantenbein's restrained interventions, including light fixtures that recall the work of minimalist artist Dan Flavin, and new concrete vaults and columns placed alongside Gull's stucco and stone.

The scale of the exhibition halls—cavernous spaces that are not discrete galleries but parts of a continuous circulation route—requires that the exhibition designers create freestanding showcases and "islands" of objects; most items would be lost if simply hung on, or placed against, the walls.

The rooms seem to work best for ancient artifacts such as a large Roman bust or column capital, which are themselves monochromatic. (The museum represents the history of Switzerland from

its origins to the present day.) Artworks with bright hues—like a Renaissance fresco by the Florentine artist Andrea del Castagno that hangs over a porthole—seem practically garish against the all-gray background. The exhibition designers have worked to insert color, with a lavender wall backing one exhibition and a magenta partition cutting through another. The sections of the new building not devoted to showcasing art, which include administrative offices, an auditorium, and a research library, are relatively colorless.

This is a big year for Christ and Gantenbein, who have also unveiled an addition to the Kunstmuseum Basel for contemporary art. There they used heavily veined marble and galvanized metal to variegate the interior and exterior walls. But in Zurich, it is geometry rather than surface treatment that gives their architecture its power. ■

credits

ARCHITECT: Christ & Gantenbein – Emanuel Christ and Christoph Gantenbein, partners; Mona Farag, Daniel Monheim, Anna Flückiger, Michael Bertschmann, Julia Tobler, Thomas Thalhofer, project managers

ENGINEERS: APT Ingenieure, Schnetzer Puskas Ingenieure, Proplaning

CONSULTANT: Vogt Landschafts-architekten (landscape)

CLIENT: Swiss Federal Department of Finance, Federal Office for Buildings and Logistics

SIZE: 80,000 square feet

COST: $113 million

COMPLETION DATE: August 2016

SOURCES

ROOFING: Kämpfer & Co.

FLOORING: Walo Bertschinger

FURNITURE: Inch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COLLEGES & UNIVERSITIES

Increasingly, college and university academic buildings are not just about academics. These days, no matter how specialized or high-tech the facility, it includes areas to promote student interaction. The projects that follow demonstrate this trend, showing that social spaces can take many forms. At Princeton University's Andlinger Center, for example, leafy sunken gardens are interspersed among the state-of-the-art research facilities. Inside Columbia University's new medical school tower, a zigzagging stair expands and contracts to create a variety of collaborative environments. And Vassar's new laboratory sciences building, which is literally a bridge linking two sides of campus, serves as a place where students can connect with each other.

PHOTOGRAPHY: © IWAN BAAN

ROY AND DIANA VAGELOS EDUCATION CENTER, COLUMBIA UNIVERSITY MEDICAL CENTER, NEW YORK, DILLER SCOFIDIO + RENFRO

Andlinger Center | Princeton, New Jersey
Tod Williams Billie Tsien Architects / Partners

Serene Machine

An energy research facility brings nature into its discreet, low-rise precinct.

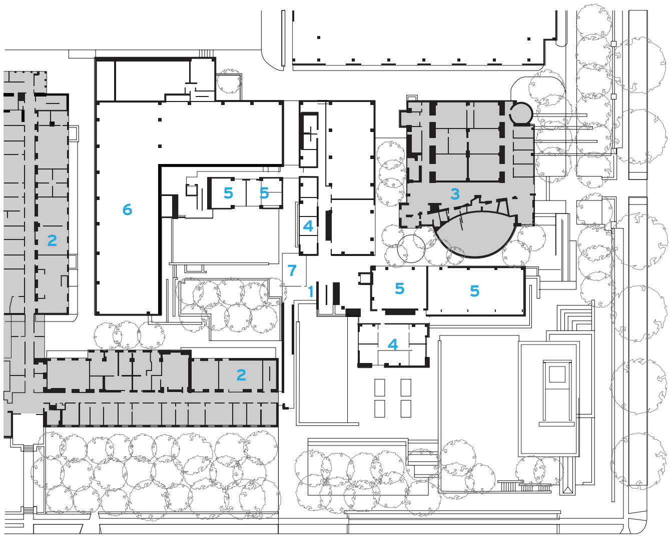
BY SUZANNE STEPHENS

PHOTOGRAPHY BY MICHAEL MORAN

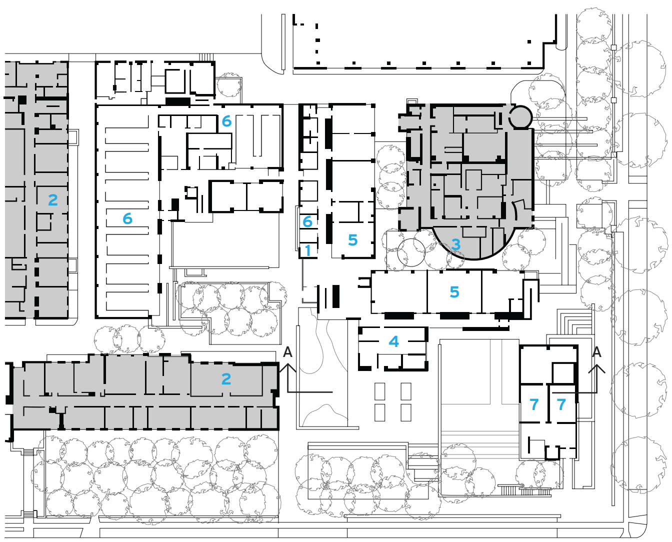
In presenting its design solution for a research and teaching facility devoted to sustainable energy and conservation at Princeton University, Tod Williams Billie Tsien Architects | Partners (TWBTA) surprised the selection committee. As Ronald McCoy, the university architect, recalls, the team showed a sketch of its proposed buildings poking above a photo of an old brick wall, and called their scheme "Enter into the Garden." The rendering referred to the site on the northeastern edge of the leafy campus. Formerly devoted to playing fields and an athletics facility (now demolished), it was bounded on two sides by the masonry wall that McKim, Mead & White designed in 1911. This fragment of history intrigued the architects: "The wall seemed to hold a secret," says Billie Tsien. "We wanted to make it feel as if you were coming into a hidden garden."

While Williams and Tsien had already designed two major science facilities—the Neurosciences Institute in La Jolla, California (1995) and Skirkanich Hall at the University of Pennsylvania in Philadelphia (2007)—"the garden idea was a compelling premise for the selection committee," McCoy says.

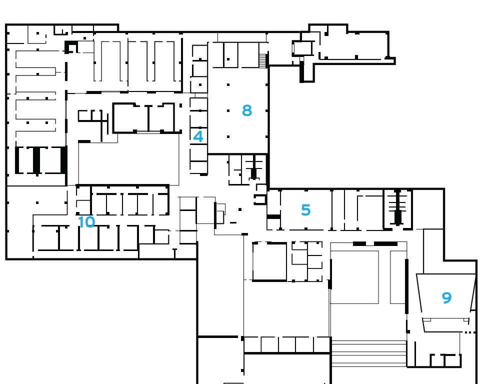
FLOATING ABOVE IT ALL From the north side of the center (this page), visitors have a direct view beyond the gardens to the entrance lobby and the meeting room above. A stair tower, with venting apparatuses on top, looms behind this volume. A path to the entrance lobby on the west (opposite) skims past the end of the historic brick wall designed by McKim, Mead & White in 1911, and a sculpture, *Uroda* (2015), by Ursula von Rydingsvard.



SECOND-LEVEL PLAN



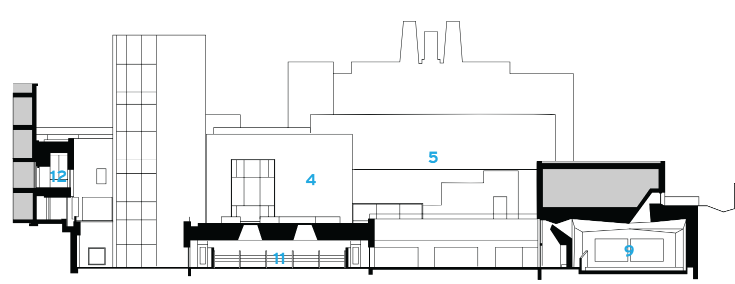
GROUND-LEVEL PLAN



LOWER-LEVEL PLAN

0 30 FT. 9 M.

SPATIAL CONNECTIONS A path links the Andlinger to an existing engineering building and runs past gardens and sunken courtyards (above). The long horizontal bricks of the new building emphasize the dynamic interplay of volumes. Inside, poured-in-place concrete stairs with profiled soffits dramatize a lounge area of the lower level (opposite), where ample daylight is admitted through glazed walls.



SECTION A - A

0 30 FT. 9 M.

1 ENTRANCE
2 ENGINEERING QUAD
3 BOWEN HALL
4 OFFICES
5 INSTRUCTIONAL LAB
6 CLEAN ROOM
7. MEETING ROOM
8 MECHANICAL
9 AUDITORIUM
10 IMAGING CENTER
11 GRADUATE STUDENT AREA
12 CONNECTION TO ENGINEERING QUAD

Williams and Tsien's back-to-nature approach for the Andlinger Center for Energy and the Environment, which opened in May, evidently gave them an edge over short-listed firms Rafael Viñoly Architects and Foster + Partners. They won the commission. TWBTA had jettisoned the idea of an "object" building for one that was ultra-discreet and deferred to Princeton's lush, verdant lawns, trees, and gardens. "We wanted to create a three-dimensional complex of courtyards and landscaping integrated with labs and offices," says Williams, principal of the New York firm, which was recently named the architect for the Obama Presidential Center in Chicago. The university campus's ample gardens, many designed by early 20th-century landscape designer Beatrix Farrand, along with its distinctive courtyard typology, had been ignored by modernist architects, observes McCoy. "Here Williams and Tsien reinvented a tradition."

In pursuing this idea of entering a planted domain and not creating a showy stand-alone building, the architects arrived at an intricate, puzzlelike solution that manages to look effortless and simple: they created an orthogonal weave of low-rise concrete-framed bars and two mid-rise towers, all clad in a pale gray-beige brick. Since the mission of the center is to solve problems of sustainable-energy production, pollution, and climate change, TWBTA wanted trees and plants to subtly signify the center's nature-oriented research. Many of the spaces in the 129,000-square-foot structure have recurrent views of surrounding vegetation. Working with Michael Van Valkenburgh, the designated campus landscape architect, Williams and Tsien filled the outdoor areas with weeping beech trees, English boxwood, witch hazel, and rhododendron.

The architects placed the volumetric low-rise facility, which is part of the School of Engineering and Applied Science, so that it would nestle in and around the Engineering Quad on one side and Bowen Hall for Material Sciences on another. The center pulls in faculty from other departments, such as Physics and Architecture, along with scholars, researchers, and graduate students, as part of its interdisciplinary mission. Indeed, the university's acclaim in the sciences (this year's Nobel Prize for Physics was shared by a Princeton professor and two colleagues at other institutions) is symptomatic of the long history of the school's investment in them, now shifting to such areas as renewable energy, clean fuel combustion, and carbon capture.

The design needed to signal the importance of the new center's academic vision and emphasize the connection to other disciplines through the interlocking blocks of classrooms, labs, and lecture halls, organized around three sunken courtyards. These exterior spaces, 16 to 22 feet deep, bring daylight into belowground areas: one adjoins the imaging labs and clean rooms, a second is next to the graduate student offices and teaching labs, while the third courtyard abuts the 208-seat auditorium. Because the imaging labs rely on such equipment as electron microscopes, which are sensitive to seismic vibrations, they needed to be placed on bedrock. The clean rooms, 27,000 square feet in all, also start down in the ground and are stacked on two floors, with mechanical spaces between them that filter out dust. Throughout the upper levels of Andlinger, lobbies and lounges are interspersed with more laboratories, classrooms, offices, and conference rooms.

To counter the roughness of the courtyards' sandblasted concrete retaining walls, Williams and Tsien clad the building in a pale elongated brick made in Denmark, known as Kolumba. It had been developed for the Kolumba art museum in Cologne, Germany, designed by Peter Zumthor in 2007, and its scale, hue, and texture emphasizes the center's long, horizontal masses.

Inside Andlinger, poured-in-place concrete stairs with profiled soffits bring a strong sculptural effect to compressed spaces, heightened by ample daylight admitted through glazed walls. There are frequent, surprising glimpses of greenery from offices, conference rooms, and lounges in this complex, given that 60 percent of the building is actually below grade. To keep the interiors, particularly the long corridors, from looking institutional, the design team created synthetic-felt wall coverings. They are boldly printed with scribbles taken from notebooks of such scientists as Galileo, Marie Curie, and Einstein, who lectured at Princeton while at the nearby Institute for Advanced Study from 1933 to 1955. Panels of vibrantly polychromed tiles in geometric patterns, by Heath Ceramics, punch up the concrete walls and add palpably to the sense of craft. Because of these unexpected elements, Andlinger never feels like an ordinary science building: this is architecture in the manner of Louis Kahn.

To counteract the energy waste endemic to clean rooms and other labs, the team has come up with a number of sustainable features. Natural ventilation and a radiant-panel system that cools the non-lab

ROOMS WITH VIEWS Thanks to sunken courtyards, spaces such as a corridor in the lower level (opposite) receive ample light and glimpses of the landscaping outside. Synthetic-felt murals printed with scribblings by famous scientists add visual interest. Murals of ceramic tiles enliven public areas such as the lower-level lounge (above). A framed view from the second level overlooks a garden and the north wing of the center (left).

COLOR PUNCH
The auditorium (left) is marked by a skylight-pierced, faceted ceiling. The clean rooms (below) employ glazing with a deep gold tint, used for its light-filtering properties. Throughout the building, ceramic tiles of different hues arranged in geometric patterns help orient users (opposite).

areas are significant inclusions, as are low-flow plumbing fixtures, green roofs, and stormwater retention. Forrest Meggers, a professor who teaches at both the center and the architecture school, also points out that the thermal mass of the bricks is particularly efficient.

Considering the complexity and ambitions of the program, it is easy to see why Princeton's president, Christopher Eisgruber, and so many others are proud. "The Center combines muscular laboratories with a gentle and graceful aesthetic," says Eisgruber, "and its towers, gardens, and humane scale remind us of the societal context for the trailblazing scientific and engineering work performed within its walls." This is a world and a century apart from the Princeton campus architecture that the critic Montgomery Schuyler excoriated in ARCHITECTURAL RECORD (February 1910, page 128) as too "individualistic" and "architecturesque." Yet Schuyler today would have to admire a new, almost dematerialized building that fits in superbly with the campus, the history, and the humanistic heritage of this centuries-old institution. Williams and Tsien have elegantly resolved an incredibly complex brief with artful intelligence. ■

credits

ARCHITECT: Tod Williams Billie Tsien Architects | Partners – Tod Williams and Billie Tsien, design principals; Jonathan Reo, project manager; Evan Ripley, project architect; Aaron Fox, Whang Suh, team

EXECUTIVE ARCHITECT: Ballinger

ENGINEERS: Severud Engineering (structural); ARUP (m/e/life safety/lighting); Transsolar (sustainability); Jacobs Engineering Group (clean room and laboratory planning); Frank Hubach Associates (acoustical/vibration); Van Note-Harvey Associates (civil); Nitsch Engineering (stormwater)

CONSULTANTS: Michael Van Valkenburgh Associates (landscape); Liora Manne (artisan, synthetic felt murals); Propp and Guerin (graphics); Fisher Marantz Stone (lighting); Shen Milsom & Wilke (audiovisual design)

CONSTRUCTION MANAGER: Sciame Construction

CLIENT: Princeton University

SIZE: 129,000 square feet

COST: withheld

COMPLETION DATE: May 2016

SOURCES

BRICK: Petersen (Kolumba)

CURTAIN WALL: National Glass & Metal

METAL FRAME WINDOWS: Wausau

GLASS: Viracon

TILE: Heath Ceramics (murals)

FLOORS: Polycor

PHOTOGRAPHY: © STEVE HALL/HEDRICH BLESSING; TOM HARRIS (OPPOSITE)

University of Chicago North Residential Commons | Chicago | Studio Gang

Full House

A cluster of elegant residence halls strikes a high note for the neighborhood.

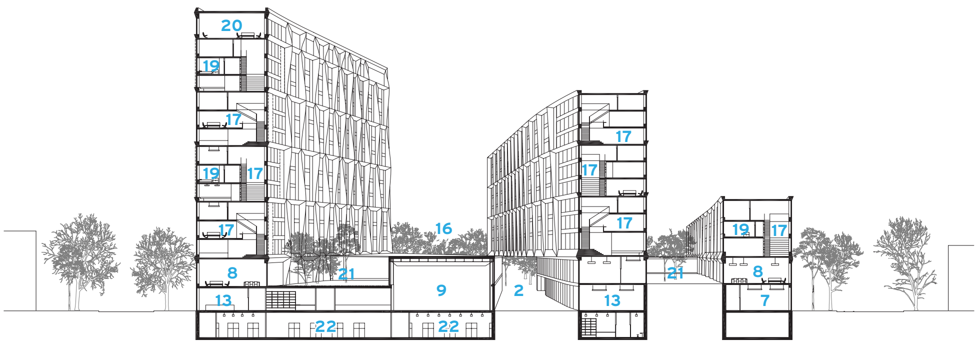
BY JAMES GAUER

THE UNIVERSITY of Chicago, long identified with its venerable Collegiate Gothic campus, has historically cordial relations with Hyde Park, the affluent enclave that surrounds it. But that rapport reached an urban design low in 1960, when Pierce Tower, Harry Weese's 10-story red brick box adorned with bay windows and a mansard roof, and hovering on pilotis, was erected. The dormitory occupied the corner of 55th Street, a major east–west boulevard, and University Avenue, a leafy side street. Often maligned as a "fortress," it blocked access and views, and a loading dock dominated its street presence.

The need for more and better-quality housing and the desire for a more hospitable connection between town and gown led the university to replace Pierce, which had fallen into serious disrepair, with Studio Gang's North Residential Commons, a recently completed 400,000-square-foot set of residence halls. The $148 million complex provides housing and dining facilities for 800 students—compared to 320 at Pierce—in a design that architect Jeanne Gang describes as "four slender bar buildings in an urban fabric of plazas, gardens, walkways, and courtyards." Together, she says, they "form inviting public and semi-private outdoor spaces for students and neighbors."

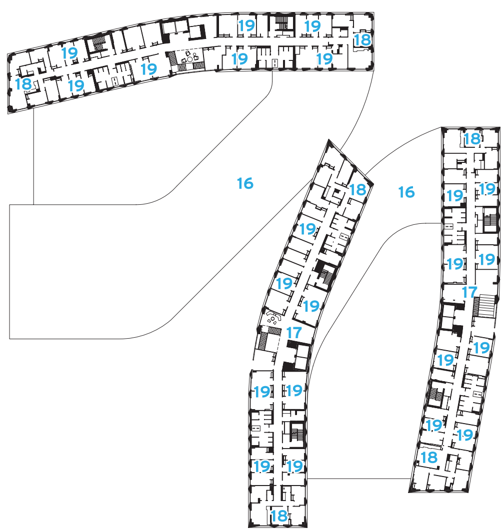
The four bars vary in height. The lowest, at two stories, is a green-roofed, steel-framed, glass-enclosed dining pavilion, positioned to create a diagonal pathway that leads from a plaza at the street corner to a new

LEARNING CURVES The university's Collegiate Gothic limestone architecture inspired the sinuous precast-concrete panels that clad the new buildings (opposite). A raised, curvilinear courtyard sits between the tallest dorm and the dining hall's clerestories.

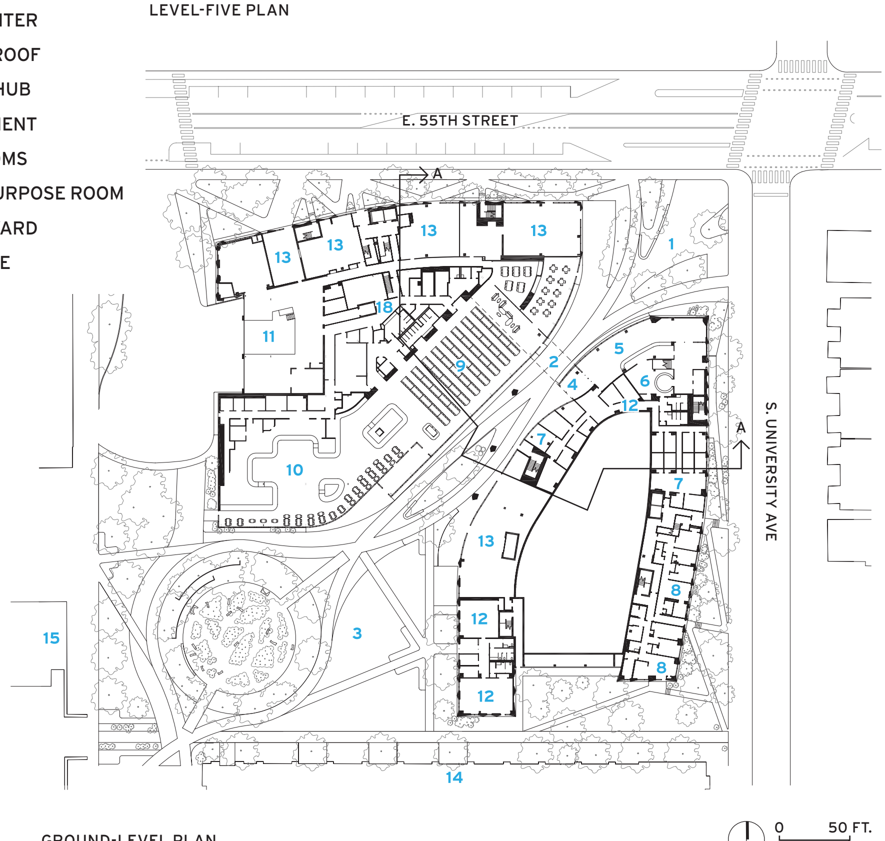


SECTION A - A

1 ENTRY PLAZA
2 PORTAL
3 QUADRANGLE
4 STUDENT ENTRANCE
5 LOBBY
6 MAILROOM
7 OFFICE
8 STAFF APARTMENT
9 DINING COMMONS
10 SERVERY
11 LOADING DOCK
12 CLASSROOM
13 RETAIL
14 FIELD HOUSE
15 ART CENTER
16 GREEN ROOF
17 HOUSE HUB
18 APARTMENT
19 BEDROOMS
20 MULTIPURPOSE ROOM
21 COURTYARD
22 STORAGE



LEVEL-FIVE PLAN



GROUND-LEVEL PLAN

quadrangle. The heights of the other bars, which contain dormitories and are framed primarily in concrete and clad in sculpted precast panels, range from five to 15 stories. The lowest responds to the residential scale of University Avenue. The tallest follows the campus custom of not exceeding the 200-foot height of Bertram Goodhue's 1928 Rockefeller Memorial Chapel and completes the urban edge of busy 55th Street, where shops and a restaurant will activate its ground floor. A single secure entry serves all three dorms, which are connected at the second level by a glass bridge.

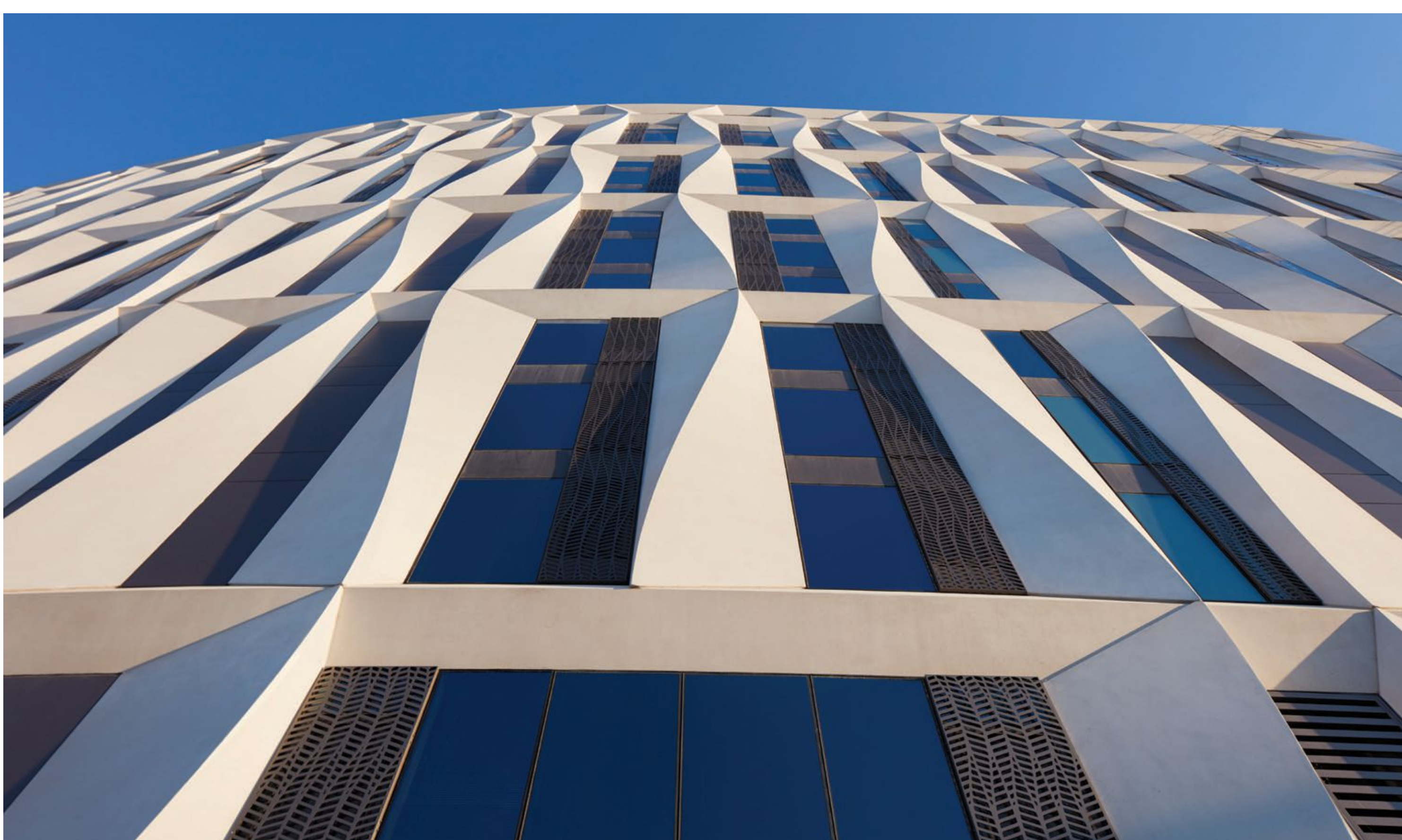
The bars are slightly inflected at their centers to embrace curvilinear and organic outdoor spaces between them. These include two landscaped courtyards at the second level, accessible only to students, and the ground-level quad, which is open to all and arranged around a circular rain garden.

The two tallest bars define the quad's northern and eastern boundaries, while two limestone-clad landmarks—the Gothic Henry Crown Field House (Holabird and Root, 1931) and the modernist Cochrane-Woods Art Center (Edward Larrabee Barnes, 1974)—delineate the other edges. At Gang's suggestion, the university enhanced the quad's western border by closing Greenwood Avenue, which ran directly in front of the Art Center.

The university's "house" system, where 80 to 100 live together, gave the architects a module for distributing and articulating the program. Gang's new dorms contain a total of eight houses organized around three-story-high communal spaces with distinct areas for studying, watching movies, cooking, and socializing. These hubs are located at the center of each bar, but, for the sake of variety in section and elevation, each is offset slightly.

The second tradition informing the design is the university's architectural heritage. "The distinguishing characteristics of the Collegiate

CONCRETE IN CONTEXT
Inflected bar buildings delineate streets, plazas, and walkways (opposite). The interconnected volumes, which vary in height to address the diverse context, define street edges and create a campus portal (left). Undulating concrete panels alternate with metal grilles and glass in a "tuned facade" with a precise ratio of void to solid (bottom).



PHOTOGRAPHY: © TOM HARRIS (THIS PAGE AND OPPOSITE)

Gothic style," explains design principal Todd Zima, "are verticality, rhythm, deep-set windows, limestone, and an organic plasticity that creates a strong play of light and shadow."

This analysis inspired the Commons' signature move: three-story-tall window bays—articulating the house module—surrounded by the boldly scaled sculptural frames of the precast-concrete panels, whose sinuously curved and diagonally warped shapes ripple out from the offset hubs in a subtly syncopated rhythm. The concrete's color and texture, which results from acid washing and sandblasting, resembles limestone but costs much less. And its thermal resistance, augmented by fritted glass and metal grilles to create a 60–40 ratio of solid to glass, in what Zima describes as a "tuned facade," works with a radiant heating and cooling system to meet the university's energy-conservation goals.

Budget constraints kept interior finishes basic in the houses, but punchy colors (each house has its own) and clever details—such as seating platforms and bookshelves integrated with graceful steel stairs—animate the hubs. Major common areas are more luxe. The

PHOTOGRAPHY: © STEVE HALL/HEDRICH BLESSING (TOP); TOM HARRIS (BOTTOM AND OPPOSITE)

UNCOMMON SPACES White concrete floors and plentiful daylight filtered by metal grilles make for a luminous dining hall (opposite, top). The reading room's oak wall and ceiling panels reflect the facade geometry (opposite, bottom). Bright colors animate the three-story house hubs (right).

double-height dining hall—with polished white concrete floors, open stainless-steel kitchens, clerestory windows, and views to the quad through glass walls shaded by the decorative metal grilles—is luminous and elegant. The 15th-floor reading room is sheathed in oak, both for the floor and in wall and ceiling panels that riff on the facade geometry while framing panoramic vistas of the campus, the city, and Lake Michigan.

Creating welcoming links between a university and an adjacent neighborhood is always difficult. But when the site is a prominent corner bound by two streets of differing character at the edge of an historic campus, the challenge is even greater. Studio Gang rose to the occasion with a creative approach to context and a sure hand with forms and surfaces. The result is a stunningly beautiful residential complex, whose scale and siting are sensitive to its neighbors and whose underlying intelligence is well suited to a leading university. ■

James Gauer, an architect and author based in Victoria, BC; Chicago; and San Miguel de Allende, Mexico, contributes regularly to ARCHITECTURAL RECORD.

credits

ARCHITECT: Studio Gang – Jeanne Gang, principal; Mark Schendel, managing principal; Todd Zima, design principal; Aurelien Tsemo, John Castro, Emily Licht, Vincent Calabro, Wei-Ju Lai, Ashley Ozburn, Laura Ettedgui, Chris Vant Hoff, Beth Zacherle, Paige Adams, Ana Flor, Zac Heaps, William Emmick, Roger Molina-Vera, Kara Boyd, Jay Hoffman, Schuyler Smith, Weston Walker, Juan de la Mora, Christopher Ciraulo, Lindsey Moyer, Will Lambeth, Danny Jimenez, Angela Peckham, Michael Leaveck, project team

CONSULTANTS: dbHMS (m/e/p); Magnussen Klemencic Associates (structural); David Mason & Associates (civil); Hood Design Studio, Terry Guen Design Associates (landscape); Lightswitch Architectural (lighting); Transsolar (sustainability)

DESIGN-BUILD CONTRACTOR: Mortenson Construction

CLIENT: University of Chicago

SIZE: 394,000 square feet

CONSTRUCTION COST: $148 million

COMPLETION DATE: September 2016

SOURCES

METAL/GLASS CURTAIN WALL: Schüco

PRECAST CONCRETE: International Concrete Products

GREEN ROOF: Barrett

Visual Arts Building | Iowa City | Steven Holl Architects

Paired Off

Steven Holl revisits the University of Iowa with a second building adjacent to his first.

BY JOSEPHINE MINUTILLO

PHOTOGRAPHY BY IWAN BAAN

Inspired by Picasso's Cubist composition for a 1912 guitar sculpture, Steven Holl's first building for the University of Iowa is a stealth work of architecture whose layered weathering-steel assembly and light structure hugs its site and juts out over a quarry pond. His second one is nothing like that.

Perched atop a hill, Holl's new 126,000-square-foot Visual Arts Building is more cube than Cubist. Originally intended to have only two levels, its boxy form developed—after more than 40 schemes—with the need to squeeze as much program as possible onto a constricted lot at the edge of campus that is bordered by private property.

It was Holl's deft siting for that first project a decade ago for the School of Art and Art History (ARCHITECTURAL RECORD, January 2007, page 92), which maintained an open green, that made it possible to build the new one—nearly twice the size of the former and right across the way from it—even though no one could have predicted the need for another art building.

In 2008, catastrophic floods ravaged the eastern half of Iowa in what was the fifth-worst natural disaster in U.S. history. The university suffered nearly $800 million in damages, particularly to its arts campus. Harrison & Abramovitz's Hancher Auditorium (1972), for instance, was destroyed, replaced this year by a new performing-arts center by Pelli Clark Pelli.

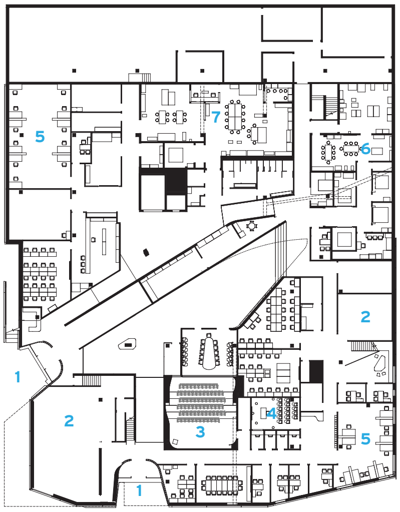
Holl's 2006 building was salvaged. His new one replaces the Art Building, which was built on the west bank of the Iowa River in 1936 after the plan of Palladio's Villa Emo near Venice. It was damaged to the point where it could no longer support its program. With financial assistance from FEMA, Holl's latest campus contribution, designed with partner Chris McVoy, restores the exact square footage lost from the Palladian structure and later additions from the 1960s and '70s. (The additions were razed, though the original red-brick portion remains standing; the university hopes to repurpose it.)

The new Visual Arts Building improves on the obsolete Art Building,

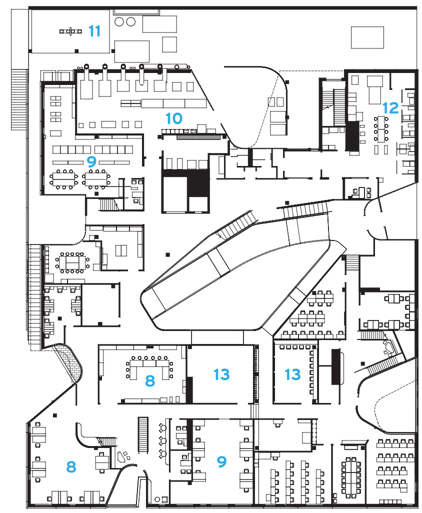
SIDE BY SIDE The first campus building by Steven Holl Architects, a weathering-steel assembly that extends over a pond (opposite), sits immediately adjacent to the firm's latest design for the university. The new building's facade features angled setbacks and ellipitically shaped cutouts surfaced in channel glass (above).

offering purpose-built studios for students in painting, drawing, ceramics, sculpture, metals, photography, printmaking, and multimedia, as well as gallery space, classrooms, and offices. It also presents an architecture that is completely different from—but, according to Holl, complementary to—his first building.

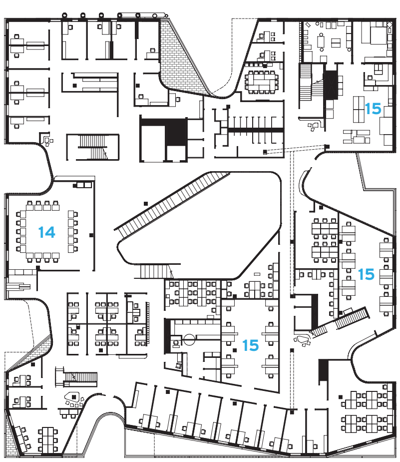
Concrete rather than steel, volumetric rather than planar, the new Visual Arts Building comprises bare-bones interiors within a beautifully crafted envelope of zinc-clad poured-in-place concrete walls. Portions of those perimeter walls throughout the four main levels slip away from the straight planes of the orthogonal container to create angled setbacks. (A small penthouse leads to open-air studios and a green roof.) Six cuts, or scoops, surfaced in channel glass, further ar-



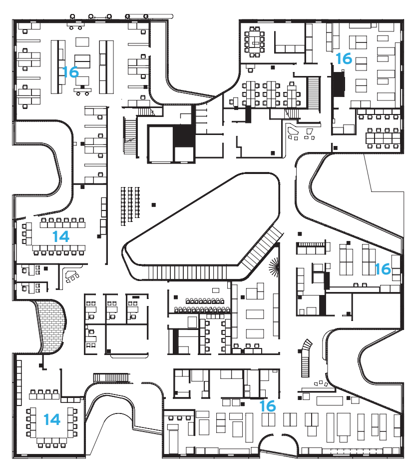
LEVEL-ONE PLAN



LEVEL-TWO PLAN



LEVEL-THREE PLAN



LEVEL-FOUR PLAN

0 30 FT.
9 M.

credits

ARCHITECT: Steven Holl Architects – Steven Holl, principal; Chris McVoy, partner in charge; Rychiee Espinosa, project architect

ASSOCIATE ARCHITECT: BNIM Architects – Rod Kruse, principal; Jonathan Sloan, associate

ENGINEERS: BuroHappold, Structural Engineering Associates (structural); Transsolar (sustainability); Shive-Hattery (civil); Design Engineers (m/e/p)

CONSULTANTS: L'Observatoire International (lighting); WJ Higgins (curtain wall); The Sextant Group (audiovisual)

GENERAL CONTRACTOR: Miron Construction

CLIENT: University of Iowa

SIZE: 126,000 square feet

CONSTRUCTION COST: $57 million

COMPLETION DATE: August 2016

SOURCES

METAL CLADDING: Rheinzinc

VOIDED SLAB SYSTEM: Cobiax

WINDOWS: Wausau

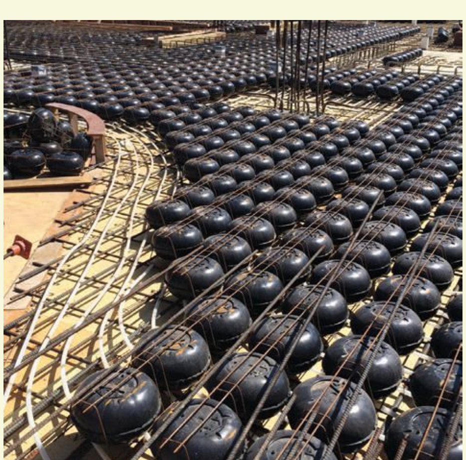
GLASS: Bendheim (channel glass), Cricursa

ROOFING: Johns Manville

FURNITURE: Herman Miller, Steelcase, Allsteel, Vitra, Mott & Grainger

PLUMBING: Filtrine, Koehler, Sloan

1 ENTRANCE
2 GALLERY
3 CLASSROOM
4 SOUND DESIGN
5 3-D DESIGN
6 PROTOTYPING
7 WOODSHOP
8 SCULPTURE
9 CERAMICS
10 KILN
11 OUTDOOR KILN
12 FOUNDRY
13 VIRTUAL REALITY
14 PAINTING & DRAWING
15 METALS/JEWELRY
16 PRINTMAKING



THE VISUAL ARTS BUILDING is one of only a handful of completed buildings in the United States to incorporate voided concrete slabs, and the first to use them in tandem with radiant heating and cooling.

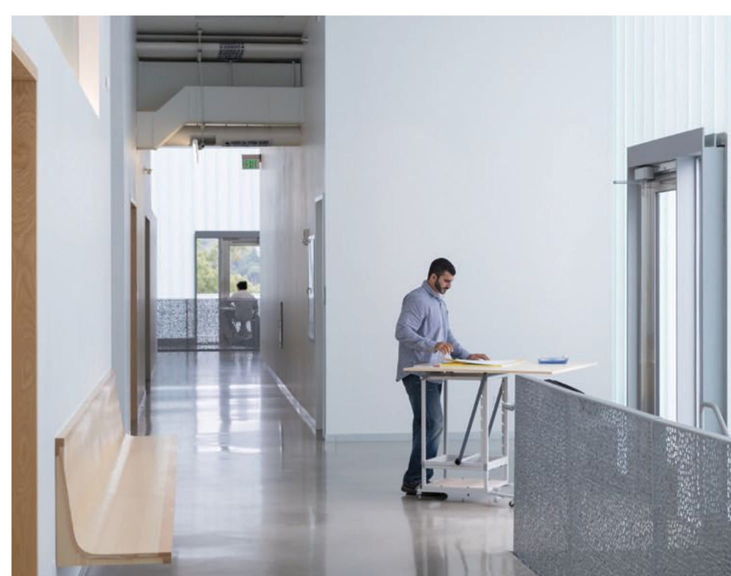
The efficient system places plastic bubble-shaped forms, arranged in a grid, at the center of the slab's depth—where concrete is least effective—to span farther with the same thickness. "In this building, we were able to use 25 percent less concrete," says Kelley Gipple of Structural Engineering Associates. Reduction in concrete could, however, be as high as a third.

In addition to creating larger column-free spaces, the system gives the slab a smoother finish, uninterrupted by beams, a motivation for Steven Holl to use it here and for Diller Scofidio + Renfro at the Columbia University Medical Center (see page 128), completed within weeks of the Iowa project.

"We tried to utilize bubble slabs in several other buildings, including at our Surf Museum in France, where its use is more widespread," says Holl.

But according to Gipple, "It takes a brave client to be among the first to try it." There is a learning curve, though the biggest difference is that, rather than a continuous pour during construction, a small amount of concrete is poured and allowed to set with the bubbles in place. *JM*

SOCIAL CLIMBER
The large central atrium features ramps and stairs that are shaped to encourage meeting and interaction. Its roof features custom 2-foot-by-10-foot aluminum panels with a honeycomb pattern to filter sunlight from the glass above it.



IN THE STUDIO The spare interiors offer light-filled spaces for study and the making of art (top and left). Stair railings are composed of painted steel sheets patterned to reflect the elliptically shaped vertical cutouts of the exterior (above). Similarly perforated steel panels are placed over the zinc cladding and windows on the southern facades of the building to modulate light (opposite).

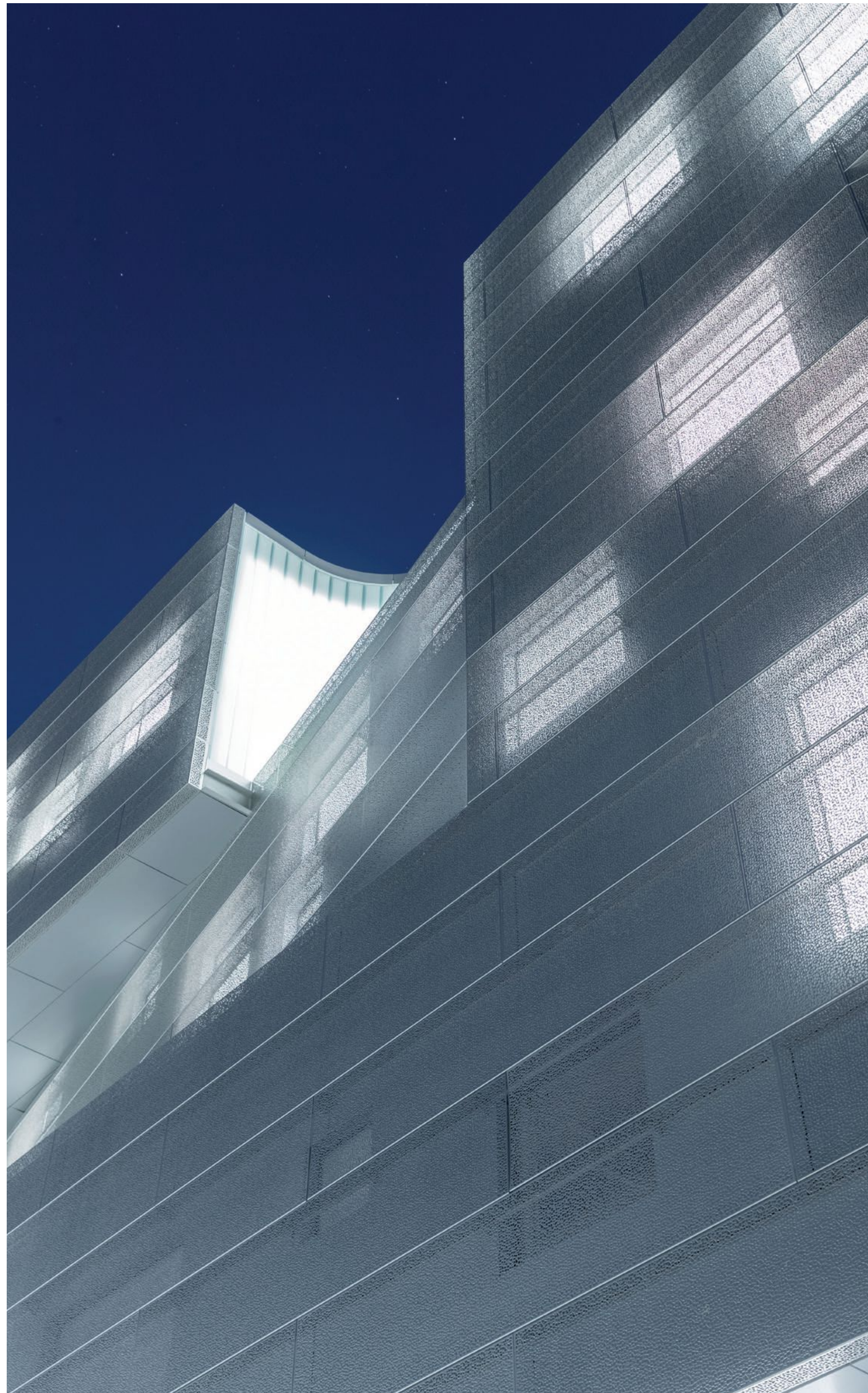
ticulate the facade and bring daylight deep within the building.

At its core, a seventh, and largest, cutout creates an irregularly shaped atrium wrapped by stairs and ramps that stretches from the ground floor to the roof—a much grander version of the social stair he employed at his earlier building. Holl calls it a "social condenser," a place for the 1,600 students and faculty who occupy the space daily to meet and interact.

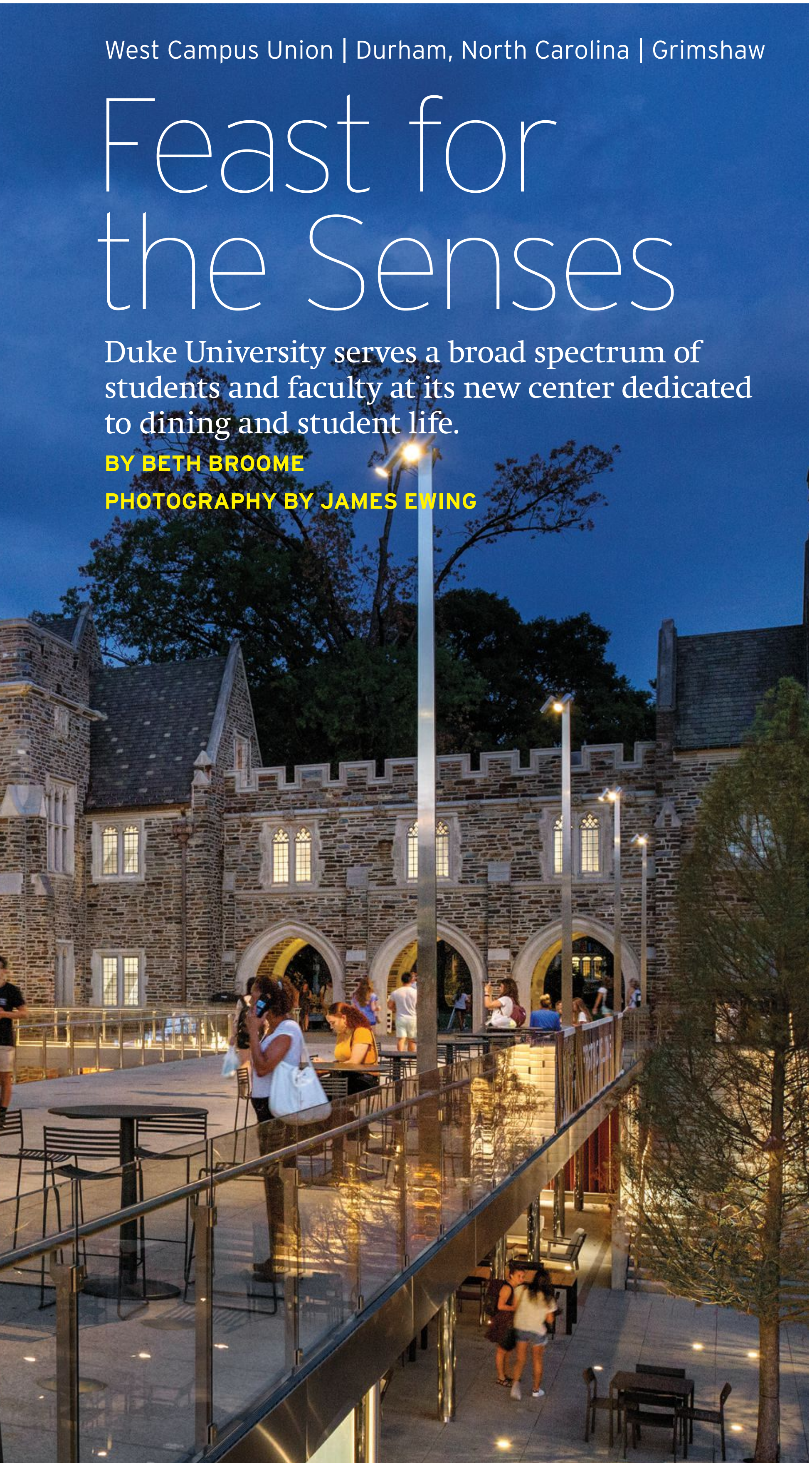
The rest of the interiors are all that they need to be—loftlike spaces with concrete floors, exposed pipes and ducts, and multiple points of daylight (dimensions for the variously sized square window openings follow the Fibonacci series). Maintaining that spare interior environment, however, is deceivingly complex, with energy requirements that rival those of a lab building due to the kilns (both indoor and outdoor), foundry, and fume hoods used in the creation of art that are spread throughout the building.

The exterior offers a different kind of industrial aesthetic. The southwestern and southeastern faces—which overlook Holl's earlier building and where the main entrances are located—are covered in perforated stainless-steel panels that rest 5 inches away from the zinc cladding and windows beneath. The screens, featuring a pattern derived from the elliptical shapes of the building's cutouts, modulate light and reduce solar gain where this is most needed, but also offer abstracted surfaces during the day, as well as an alluring glow at night when the interiors are humming with activity.

The Visual Arts Building at the University of Iowa is one of seven educational buildings devoted to studio art or architecture that Steven Holl Architects has either completed or is in the process of designing. Most famously, Holl designed the Reid Building at Scotland's Glasgow School of Art directly opposite Charles Rennie Mackintosh's touchstone building. There, he deferred to his famous neighbor by creating something that was the complete opposite of it. In Iowa, Holl is in conversation with himself but takes the same approach. Separated by 10 years and wholly different aesthetics, his two buildings are as individual as could be but unmistakably Steven Holl. Maybe the second one is better than the first; together they are two of Holl's best buildings. And at a university that has long been a patron of contemporary architects—with buildings by Gunnar Birkerts, Frank Gehry, Charles Gwathmey, and Norman Foster—they are two of the best buildings on campus. ■



HIGHER EDUCATION The building can be entered at grade or via a new elevated walkway by James Carpenter. This path connects through arched passages to the main historic quad to the east (just renamed for the original campus architect, Julian Abele) and to the Bryan Campus Center to the west (opposite).



West Campus Union | Durham, North Carolina | Grimshaw

Feast for the Senses

Duke University serves a broad spectrum of students and faculty at its new center dedicated to dining and student life.

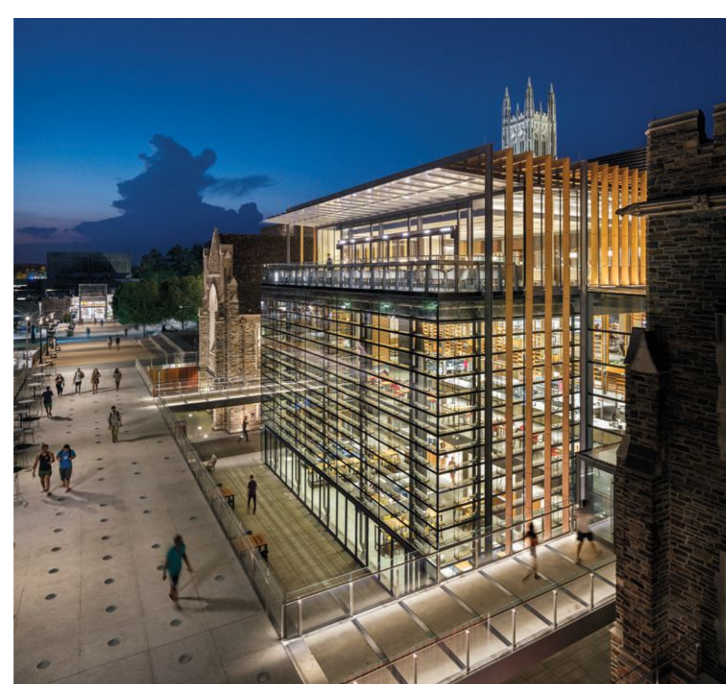
BY BETH BROOME

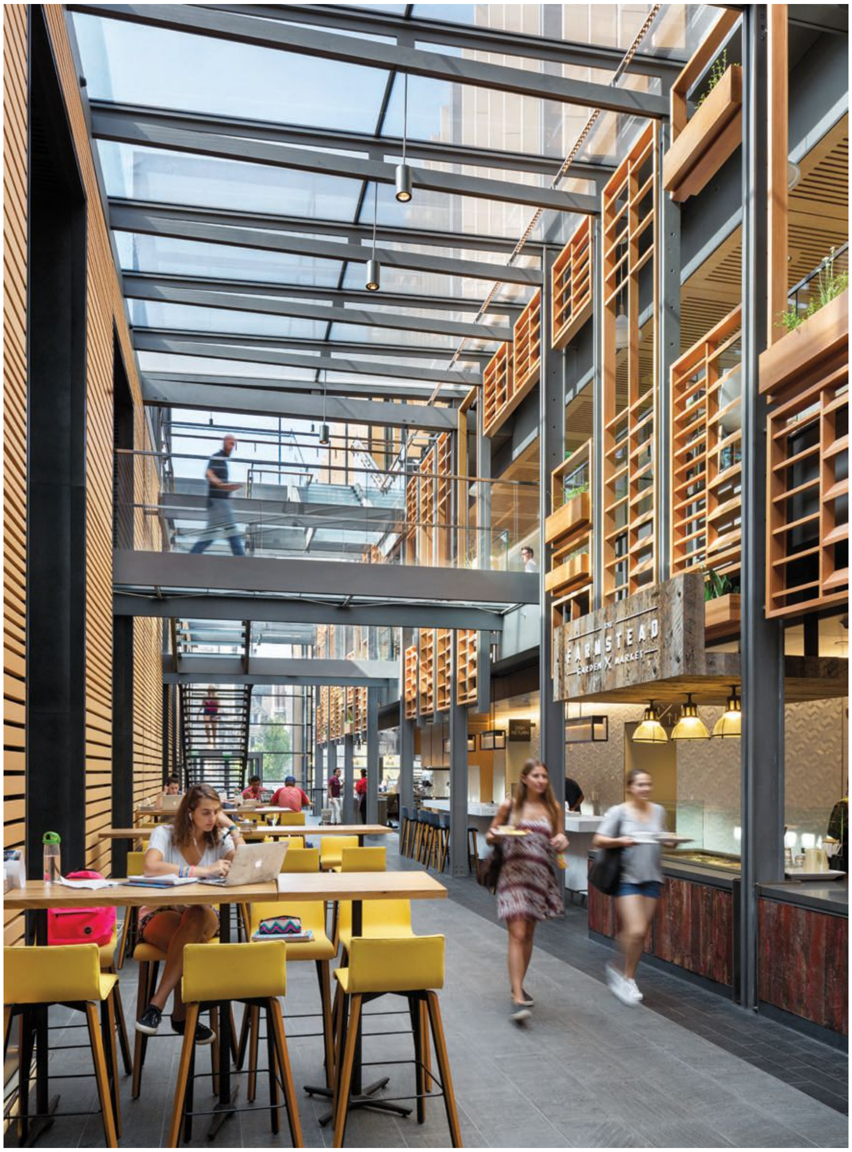
PHOTOGRAPHY BY JAMES EWING

Sometimes called "the Gothic Wonderland," Duke University's West Campus in Durham, North Carolina, is a storybook enclave. Designed by the office of Horace Trumbauer—under the direction of chief designer Julian Abele, one of the first influential African-American architects—and constructed between 1927 and 1932 (with the Olmsted Brothers overseeing the landscape), it is characterized by its bucolic quads and Collegiate Gothic architecture rendered in the local variegated Duke Stone. It is not a place that takes change lightly.

But, as one of the country's most competitive universities, the school also knows the importance of staying current to attract the best students and is accustomed to adapting to the times, as it has with its recent reinvention of the historic West Campus Union building. Designed by the New York office of Grimshaw architects, the renovation and expansion transforms a creaky dining facility into a dynamic community center. "For us, there is an important relationship between the academic, residential, and social environments," says Larry Moneta, vice president for student affairs. "West Union is the nexus—where these three circles overlap." The original building, completed in 1930 at the heart of the campus, was showing its age. The 200-foot-long Great Hall refectory and adjacent Cambridge Inn dining room may have been hallowed, but they were inflexible spaces, and much of the rest of the building was given over to grab-and-go food vendors and administrative offices. There was nowhere inviting to gather or linger. And it was impenetrable. "It was like a fortress," says Mark Husser, Grimshaw's partner in charge. "You couldn't move through it."

For the building's next chapter, the university hoped to reconceive it as a hub for students, faculty, and staff to convene in a variety of spaces—formal and informal. Putting food front and center by displaying preparation, using locally sourced ingredients, and engaging local chefs at 13





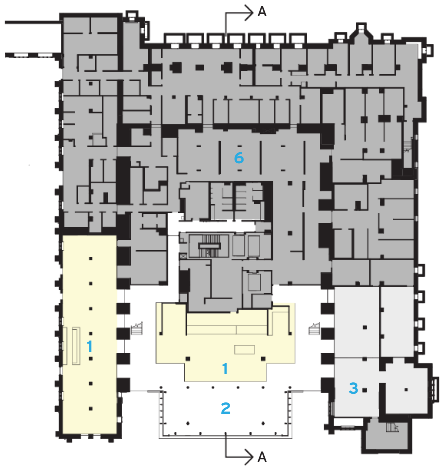
diverse venues—with offerings from Tandoor dishes to paella to soul food—draws students and encourages them to stay. The approach reflects the farm-to-table zeitgeist but was also shaped by a widely shared cultural experience. “In my house,” says Moneta, “every important family conversation was in the kitchen. There’s a little of that in our thinking as well. Where one eats is an important place for friendships and relationships and community to thrive.”

West Union is the focal point of a larger plan to reactivate this part of campus—through landscaping, infrastructure, and architecture. The project began with an invited competition that included Foster + Partners, Bohlin Cywinski Jackson, and Shepley Bulfinch with James Carpenter—a clear

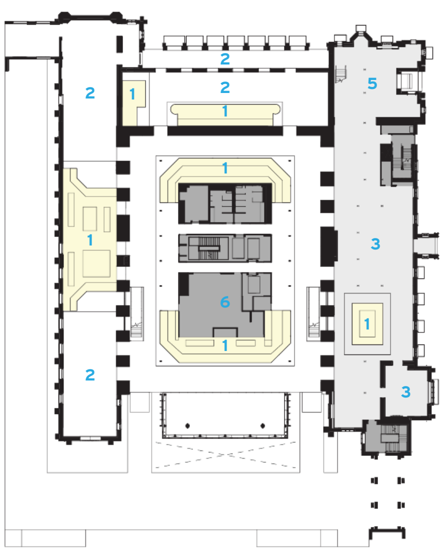
indication of the university's interest in the contemporary despite their embrace of the traditional, as well as a hint that it would probably substitute steel and glass for the ubiquitous stone. As revered as West Union had been—with its towers, clay-tile roofs, tracery, and limestone ornamentation—the love did not extend to the original volume that nestled within its core: a squat, flat-roofed rabbit warren housing a cafeteria servery. Grimshaw, which won the contract in 2012, removed this element, inserting a glass-and-steel box into the remaining U-shaped structure. Though bold in its materiality, the new West Union "bows to the historic legacy," notes project associate David Cook, pointing to the design's attention to existing elements through framed views and juxtapositions, such as the dining balconies the team has suspended amid the oak trusses in the Great Hall and the Cambridge Inn. And the building is respectful with its scale: from the sacrosanct Chapel quad to the north, the extension is not visible.

"We inverted the Collegiate Gothic," says Husser. "The building is transparent and is activated by the life inside. Because it sits at the middle of major circulation routes, we created two ground levels to allow people to pass through." Students enter at the lower level and via bridges above into a soaring atrium, buzzing with activity. Visitors flow around and through the core, which is screened in louvered Western Red Cedar and ringed by a bazaar of food stalls called "The

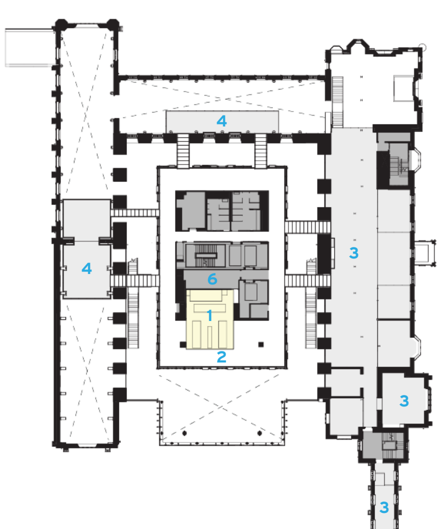
CORE CURRICULUM
The soaring atrium links to West Union's wood-screened center, with its variety of food vendors and seating. Bridges and stairs connect to the historic east wing (opposite, top). Extra-wide walls between the insertion and the existing Great Hall house mechanicals (opposite, bottom).



GROUND-FLOOR PLAN 0 40 FT. 12 M.



PLAZA-LEVEL PLAN 0 40 FT. 12 M.



SECOND-FLOOR PLAN 0 40 FT. 12 M.

credits

ARCHITECT: Grimshaw – Mark Husser, partner in charge; David Burke, principal; George Hauner, Andrew Anderson, associate principals; David Cook, Mark Rhoads, Manuel Schmidt, associates; Aimee Duquette, Yunhee Jeong, Michael Wilson, senior architects; Bec Wilkie, architect; Zach Fine, Brooke Gassaway, Vivian Cheng, architectural designers

CONSULTANTS: Reed Hilderbrand (landscape); BuroHappold (structural); Vanderweil Engineers (m/e/p/fp); Front (facade); Yui Design (food service); Celano Design Studio (branding & interior design collaborator)

GENERAL CONTRACTOR: Skanska

SIZE: 113,000 square feet

COST: withheld

COMPLETION DATE: September 2016

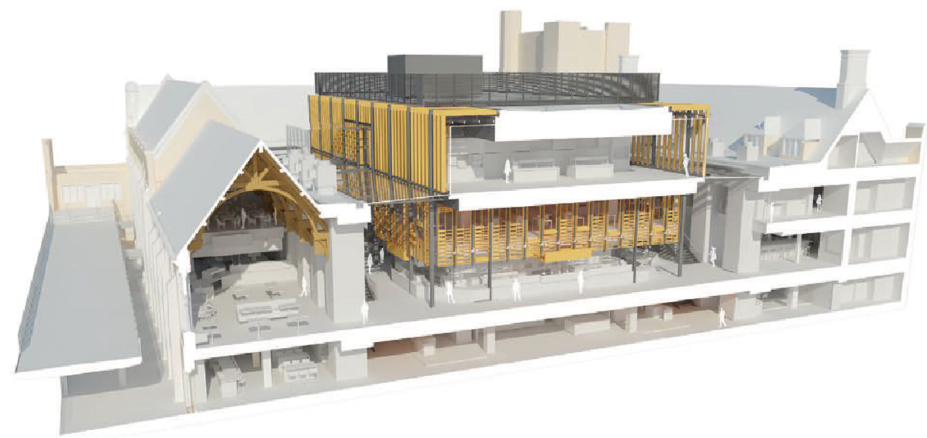
SOURCES

CURTAIN WALL: Roschmann

METAL PANELS: Reynobond

METAL FRAME WINDOWS: Wheaton Sprague, Oldcastle BuildingEnvelope

PAINTS & STAINS: Sherwin-Williams

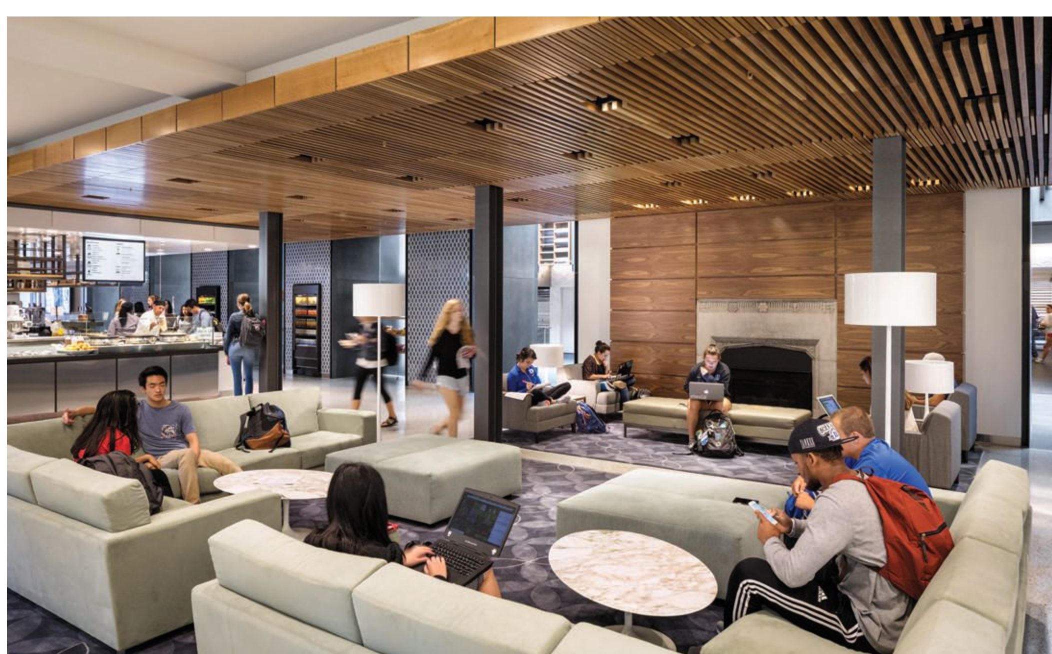


SECTION PERSPECTIVE

SECTION A - A

1 FOOD SERVICE
2 SEATING
3 STUDENT LIFE: MEETING/LOUNGE
4 DINING BALCONY
5 MULTIPURPOSE/ PERFORMANCE
6 BACK OF HOUSE/ KITCHEN
7 MECHANICAL

RAISING THE ANTE Food service continues in the historic Cambridge Inn refectory to the north, where the architects have inserted a dining balcony (right). A living room and café are some of the many social spaces that are carved out of the original east wing (bottom).



Market" and by glass-topped passages that link to the existing building on three sides. Glass-and-steel stairs and bridges lead to the balconies to the west and north and to the more compressed student-life areas—lounges and meeting rooms—in the east wing. Ample apertures enable views up, down, and across the interior, as undergraduates share meals or hunch over laptops, faculty meet over coffee, and maintenance workers break for lunch.

True to Grimshaw form, and in response to the historic precedent, the architects have put the structure on display by exposing more of it in their renovation, and also by revealing how the pieces come together in the new construction, notably with towering steel members, which frame the exterior and support the skylight-enclosure system as well as the curtain wall. Here structural glass fins tie into castellated steel columns, providing lateral bracing. Laminated with a ceramic frit, the fins also filter light, easing the transition from this bright, acoustically live space into the opaque, more hushed historic wings. To create the threshold between these spaces, the team punched openings in the dividing walls, which they designed to be extra-wide—7 feet—to hold the extensive mechanicals required by the numerous kitchens. Accommodating the services, given the constraints of the existing construction, was the biggest challenge, say the architects, who also excavated down 10 feet and out to the south, to meet the required needs. With the complex m/e/p systems and all the added ductwork and ventilation, Husser likens the process to designing a lab building.

Just as the new West Union reflects the current attitude toward food preparation and dining, it also communicates Duke University's perspective on education through interaction. The students clearly love the food, but the social element does not escape them, either. "It's helping build the community we lost when we left the freshman dining hall," says sophomore Maggie Finney. "And," underscores her friend Hawa Tucker, "you run into everyone." ■

Bridge for Laboratory Sciences
Poughkeepsie, New York | Ennead Architects

Minding the Gap

A science center at Vassar College links various disciplines while helping repair a neglected corner of the campus.

BY SARAH WILLIAMS GOLDHAGEN

PHOTOGRAPHY BY RICHARD BARNES

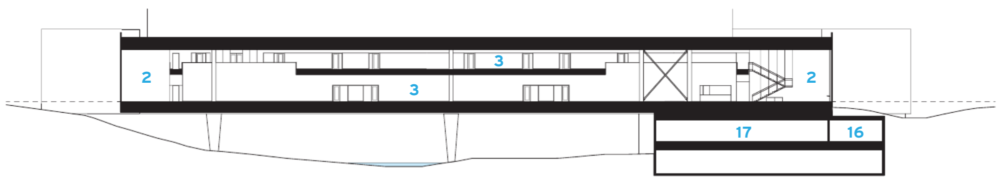
Bridging disciplines—literally and figuratively—has become a concern du jour for colleges and universities as multidisciplinary collaborations continue to proliferate. But finding a solution depends on the area of research. For those in the humanities, exploring the treasures of another field of study usually takes little more than a stroll from the English Department over to History or Geography. For scientists, who need labs and collaborate with a wider range of disciplines, it's more complicated. Computer jocks may use robotics labs; psychologists and earth scientists draw on research by chemists and biologists; physicists and astronomers need computer jocks . . . and on and on.

With this new norm in academic scientific practice come new demands on campus facilities, most of which were constructed when each scientific discipline operated in its own silo. The increase in multidisciplinary study—as well as rapid advances in research—have fueled an academic building boom in the sciences in larger universities and, increasingly, in liberal arts colleges as well.

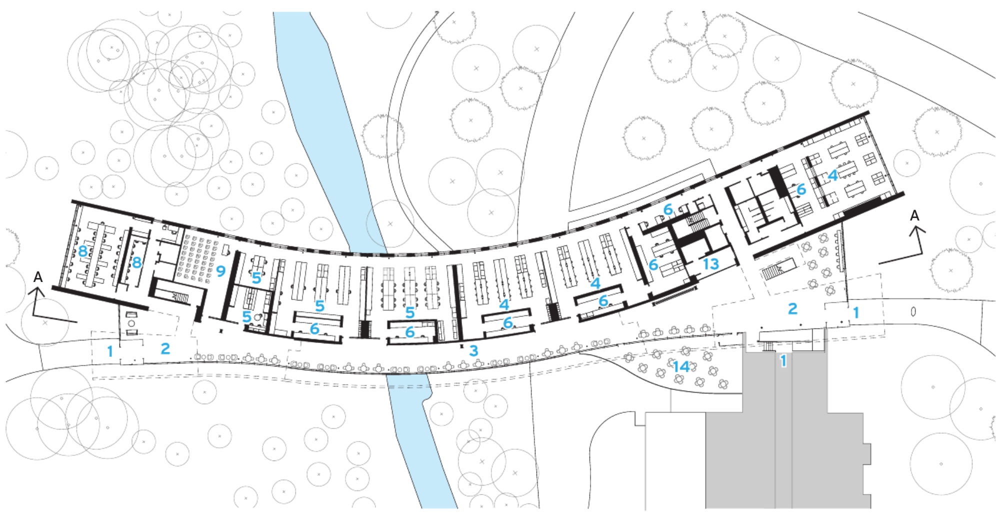
An impressive exemplar of this new trend is Vassar College's Bridge for Laboratory Sciences, part of the new Integrated Science Commons master

BIRD ALERT The curving southeast facade features the first major application of a proprietary glass patterned with a UV-reflective coating that can be seen by birds but is virtually invisible to humans. The curving building spans a steep slope and a stream in a neglected corner of the bucolic campus (right).

PHOTOGRAPHY: © LRC GROUP (RIGHT)



SECTION A - A



ENTRY-LEVEL PLAN

UPPER-LEVEL PLAN

1 ENTRANCE
2 LOBBY
3 CORRIDOR
4 TEACHING LAB
5 RESEARCH LAB
6 LAB SUPPORT
7 X-RAY SUITE
8 COMPUTER LAB
9 CLASSROOM
10 MEETING
11 ADMINISTRATIVE OFFICE SUITE
12 OFFICE
13 CAFÉ
14 TERRACE
15 MECHANICAL
16 SHOP
17 LOADING

plan, which contains renovated and new facilities for biology, psychology and cognitive sciences, and physics. Designed by Richard Olcott of Ennead Architects, the Bridge and Commons projects are the result of a decade-long planning and architectural initiative to upgrade and consolidate the school's science facilities, which had been dispersed around its 1,000-acre campus in Poughkeepsie, New York.

Vassar boasts one of this country's most beautiful campuses. One hundred of its acres constitute a designated arboretum, and 400 acres comprise an ecological preserve. The campus is also an architectural petting zoo of sorts, offering two National Historic Trust buildings, including the 1865 Main Building by James Renwick Jr., the beautiful little Ferry House by Marcel Breuer, Noyes House by Eero Saarinen, as well as other distinguished historical buildings.

The exception to the campus's manicured serenity and architectural quality lay in its south-central sector, which was functionally underutilized and, aesthetically and experientially, its least resolved. A well-trafficked shortcut to the campus, the area contained an unsightly parking lot next to a steep, unkempt slope that tumbled down to a trickle of a polluted stream called Fonteyn Kill.

How to activate a bedraggled corner of this extraordinary place and improve circulation to the nearby buildings was one question. Another: Should the college's outdated science buildings be renovated, and should any be demolished? Could the school's dispersed science facilities be knit into a cohesive commons? Could Fonteyn Kill be salvaged and its wetlands restored?

Yes, but it took skill and determination. Razing an unfortunately sited and obsolete chemistry laboratory allowed Ennead to consolidate the science facilities around three existing, adjacent buildings–the large but architecturally uninspired Olmsted Hall, the elegant New England Building, and the Sanders Physics Building. What remained necessary was to rehouse the Chemistry Department, add facilities for new science disciplines and laboratories and classrooms, and confer upon the whole complex a central gathering space to nurture interdisciplinary collaborations through informal social encounters.

With one swooping gesture—a building that is a bridge—Olcott developed the critical element to resolve these challenges. Gathered under a curved steel-truss roof and straddling a steeply sloped portion of the now-restored Fonteyn Kill, the new 82,000-square-foot Bridge for Laboratory Sciences building holds the Chemistry Department offices, classrooms, and laboratories, the Earth and Environment Lab, and the robotics research laboratory. The Bridge connects directly to Olmsted Hall and is just a short stroll from

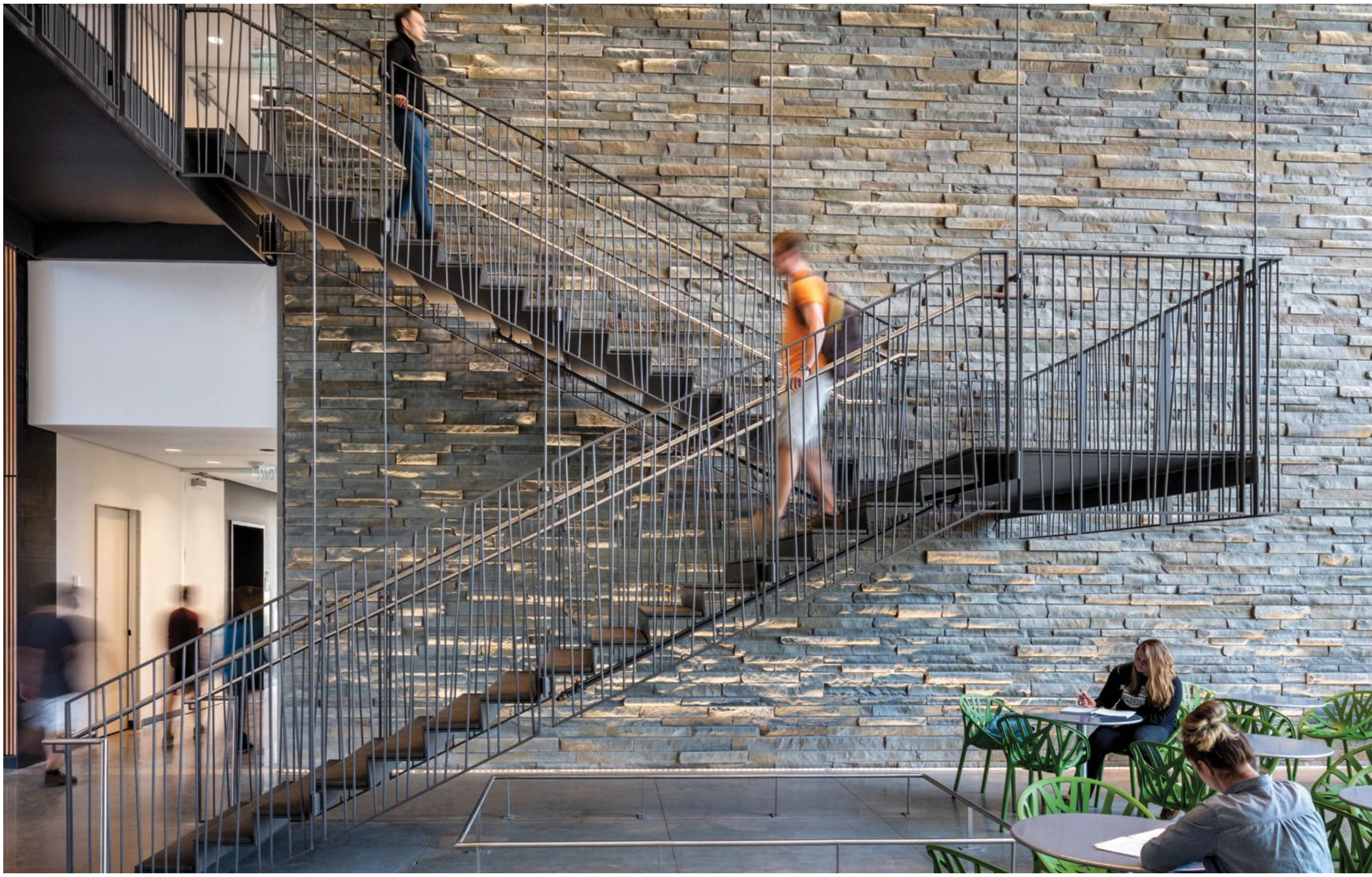
WARM WELCOME The southwest entrance (right) is clad with a local stone and fiber-cement panels. The fiber cement continues on the northwest facade, where it alternates with glass patterned in a custom frit designed by Ennead (bottom).

New England and Sanders.

Two V-shaped concrete piers support a nearly 400-foot span, and the building's two principal stories hang from a truss above. Under the "bridge," a pathway leads into the ravine, where restored wetlands and an arboretum surround the outdoor Edith Roberts Ecological Laboratory. Barberry, holly, Japanese knotweed, honeysuckle, and spicebush grace a landscape designed by Michael Van Valkenburgh and Associates.

The main entrance to the Bridge is located on its short facade. Partially clad in a local blue-gray stone that complements the masonry of the nearby College Chapel, this elevation presents a materially rich, compositionally modest identity for the building. The long elevations, inspired by the light, linear look of a birch grove, blend into the wooded site; white vertical fiber-cement panels alternate with fritted glass insets (the frit mitigates glare and heat gain and minimizes bird collisions, since Fonteyn Kill is on a flyway). "It really is a building in the trees," Olcott says. On the south elevation, projecting vertical fins add texture and also protect against the sun.

Inside, the intelligence of the design becomes most evident. The facade's highly



textured stone wall continues to form the backdrop for a delicate staircase. Beyond it flows the light-filled, double-height interior, a curved central spine that unfolds as you move through it. A café and informal seating areas with views over the ravine make this an inviting social core of the entire Integrated Science Commons scheme, as well as the first accessible at-grade path into Vassar's central campus at that point. Lining the spine of the Bridge are commodious instructional spaces that eradicate the conventional separation of lab and classroom by linking them with internal circulation. Students can freely move among these spaces during the same class period.

Demolishing one edifice just to build another—one that spans a ravine, at that!—certainly is not an obvious solution to the numerous challenges that Vassar faced in upgrading its science facilities. But, in many ways, a bridge—structurally as well as symbolically—between disciplines, between teaching and research, between different parts of Vassar's campus, between nature and architecture, makes perfect sense. ■

credits

ARCHITECT: Ennead Architects – Richard Olcott, design partner; Timothy Hartung, Guy Maxwell, management partners; Kate Mann, project designer; Todd Walbourn, Theresa O'Leary, project architects; Charmian Place, interiors; Kathleen Kulpa, technical director; Christina Ciardullo, Hiroko Nakatani, Tom Offord, Yong Kyun Roh, Suzanne Troiano, Constance Vale, Edgar Jimenez, Hans Walter, Desiree Wong, team

CONSULTANTS: Severud Associates (structural); Vanderweil Engineers (m/e/p); LRC Group (civil/survey); Langan (geotechnical); Jacobs Consultancy/ GPR Planners Collaborative (laboratory); Michael Van Valkenburgh (landscape); Heintges & Associates (curtain wall)

GENERAL CONTRACTOR: Daniel O'Connell's Sons

SIZE: 82,000 square feet

COST: $125 million (Integrated Science Commons); $61 million (Bridge building, construction)

COMPLETION DATE: May 2016

SOURCES

STRUCTURAL SYSTEM: TriPyramid

METAL PANELS: Zahner

GLASS: Viracon, Ornilux

ACOUSTICAL CEILINGS: Decoustics, Armstrong

FURNITURE: Herman Miller, Vitra, Allermuir

SOCIAL STUDIES Opportunities to meet and gather abound, as with the café seating located in the main spine of the building (opposite) and in other well-trafficked circulation areas (top). The building houses classrooms and labs dedicated to a variety of scientific fields of study (above).

PHOTOGRAPHY: © IWAN BAAN, EXCEPT AS NOTED; NIC LEHOUX (OPPOSITE)

Roy and Diana Vagelos Education Center | New York City | Diller Scofidio + Renfro

In the Heights

Spaces for collaboration take center stage at a medical school academic building.

BY JOANN GONCHAR, AIA

Approaching the new Roy and Diana Vagelos Education Center from the jumble of hulking facilities in Upper Manhattan that make up the Columbia University Medical Center, the first thing that comes into view is the tower's attention-grabbing south elevation. Its 14 stories of canted planes, transparent glass, and projecting boxes offer a striking counterpoint to both the sprawling medical complex—which includes Columbia's teaching hospital, New York Presbyterian—and the surrounding low-scale but dense Washington Heights neighborhood.

Though initially it might seem like a gratuitous formal exercise, the surprising assemblage is the exterior expression of a dynamic stair that snakes up one side of the building. Dubbed the "study cascade" by Diller Scofidio + Renfro (DSR), which designed the medical school academic building with executive architect Gensler, this element rises from a stepped plaza. As it ascends, it expands and contracts to create atrium-like spaces that Elizabeth Diller, DSR partner in charge of the project, refers to as "destinations" or "neighborhoods." These include areas of tiered seating, glass-enclosed meeting rooms, open gathering spaces, and outdoor terraces where medical students can socialize, study, or relax while taking in the views of the city or the Hudson River with the steep cliffs of the New Jersey Palisades beyond. From the street, the zigzagging circulation route is especially visible once the sun sets and the illuminated interiors begin to glow.

The 110,000-square-foot building's tower configuration, with a 12,500-square-foot footprint at the base that slims to 6,000 feet on the upper floors, is the result of squeezing all the required instructional and administrative space into the allowed zoning envelope. The cascade, meanwhile, is a response to the urban medical center's dearth of amenities and public space, says DSR's project director Anthony Saby. The vertical path, and the specialized facilities it winds past—including a state-of-the-art anatomy lab and a 275-seat auditorium—occupy about 50 percent of the trapezoidal floor plates. The education center's northern half has a more typical organization. It is a straightforward stack of offices, classrooms, and high-tech simulation rooms where students perfect their skills on sophisticated whole-body mannequins.

Glazing wraps the four sides of the education center, while the limited areas of protruding structure are delineated by glass fiber reinforced concrete cladding. Although the more conventional half is enclosed behind a unitized curtain wall incorporating a frit pattern that mitigates solar gain and conceals the interior to varying degrees, the south end's glazing system is quite different. To maximize transparency, its mullionless skin is made up of low-iron insulated glazing units supported by glass fins, some of which are as tall as 27 feet.

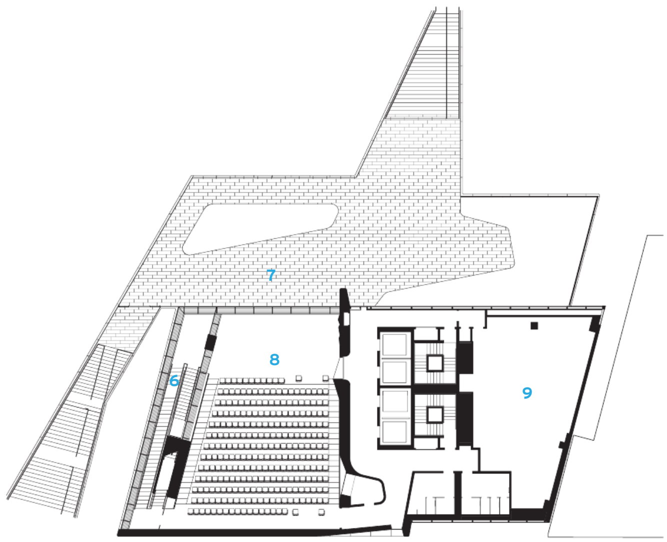
Achieving this transparent, taut skin, however, was not straightforward and required structural gymnastics, says Matthew Melrose, an associate partner at Leslie E. Robertson Associates, the project's structural engineer. To allow unobstructed views through the glass skin, the

STAIRWAY TO HEAVEN A stair, dubbed the "study cascade," snakes up the south elevation (above and opposite) of Vagelos and expands and contracts to provide areas where students can relax or study in groups or alone. It is expressed on the exterior by glass fiber reinforced concrete panels that protrude from the building's glass skin.

12TH-FLOOR PLAN

0 20 FT.
6 M.

1 ENTRANCE
2 LOBBY
3 CAFÉ
4 OFFICES
5 LOADING DOCK
6 CASCADE
7 TERRACE
8 AUDITORIUM
9 MECHANICAL
10 MEETING ROOM
11 CLASSROOM
12 LECTURE/ EVENT SPACE
13 ANATOMY LAB
14 OUTDOOR ROOM
15 SIMULATION
16 PARKING ENTRY
17 PARKING



SECOND-FLOOR PLAN

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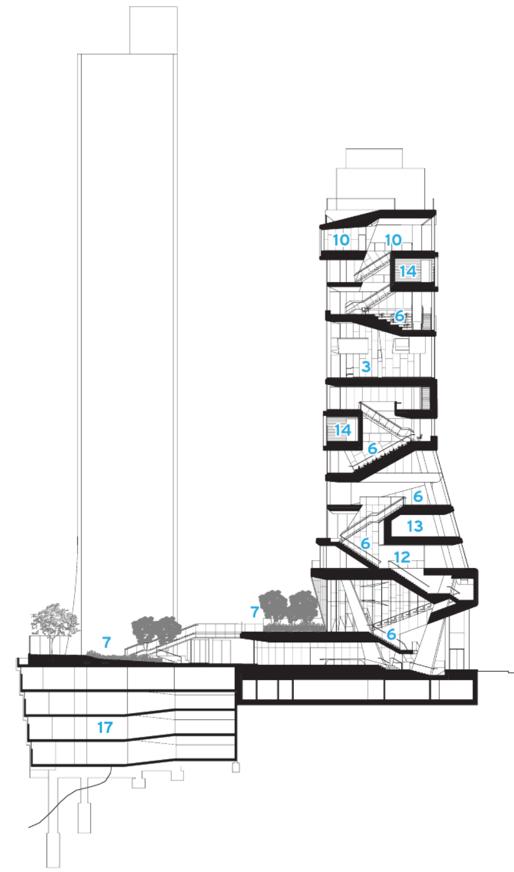

SECTION A - A

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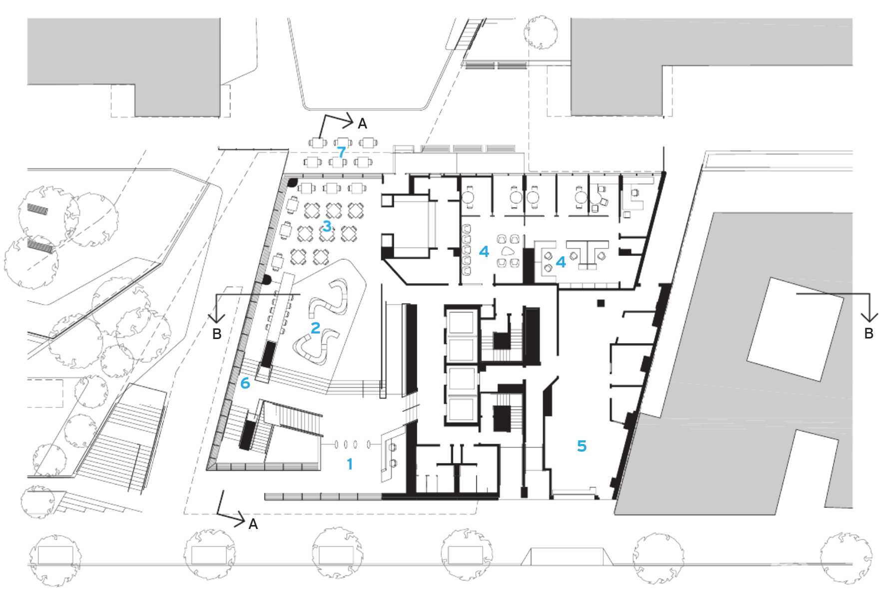


ENTRY-FLOOR PLAN

0 20 FT.
6 M.

SECTION B - B

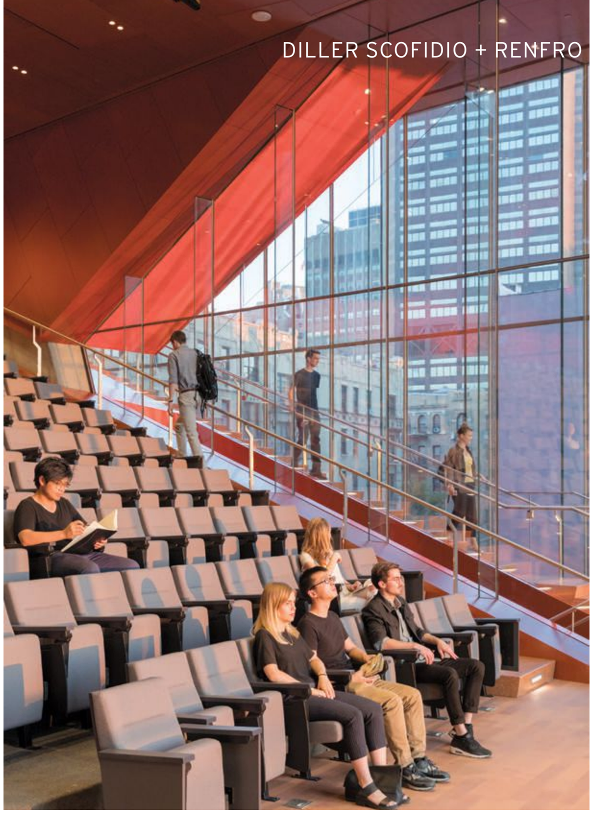
0 30 FT.
9 M.

columns at the south end of the building—two muscular elements cast in high-strength architectural concrete and sloped to create a 65-foot clear span at the auditorium—are pulled away from the perimeter, producing floors that cantilever as much as 26 feet. And to limit deflection, especially where the slabs meet the all-glass facade, the design team combined voided slabs (see page 112) with post-tensioning. According to Melrose, the Vagelos Center is one of only a handful of U.S. projects to deploy weight-saving void formers (hollow plastic balls embedded in the concrete) and the country's first to use them in conjunction with post-tensioning.

Although the unusual slab system is invisible to occupants, they are aware of the long spans, the unencumbered floors, and sloping walls and ceilings that it makes possible. The forms that result from this adventurous structure possess an almost restless energy. But a color scheme of earthy reds, including burnt sienna–stained Douglas fir paneling and end-grain floors, combined with cool grays that highlight the hue of the exposed concrete structure, help create a calm interior that is well suited to intense focus and concentration.

In some places, the meeting of these many different materials and angled surfaces is not well resolved. But for the most

STUDY HALL
The color scheme in the lobby (below) combines cool grays that highlight the hue of the exposed concrete structure with earthy red finishes, such as stained Douglas fir paneling. The palette is used throughout the building, including its 275-seat auditorium (right). But here the veneer panels are perforated for acoustics. The room also includes blackout shades so that it can host a variety of events.



LEARNING LAB The building's long structural spans are well suited to uses such as the state-of-the-art anatomy lab (left). Areas of stepped seating (bottom) are just one of several types of spaces for socializing and informal collaboration incorporated into the cascade.

part, DSR deals with the multitude of finishes and challenging geometry skillfully and inventively. Desk-height work surfaces supported by the sloping columns or extending under stairs offer one example. They project from the structural elements like diving boards, rendering areas with limited headroom usable.

On a recent early autumn afternoon, the cascade was a hub of activity: several students were seated with their laptops at the cantilevered work surfaces, others scribbling notes on a meeting room whiteboard, and a few were lounging in the tiered seating areas. The buzz is evidence that the education center has lived up to its ambitions. And, in demonstrating that social and collaboration spaces are just as necessary for training future physicians as laboratories and classrooms, the project offers a new model for medical schools. It also shows—through the use of bold forms and inviting spaces—how these institutions can energize their often bleak campuses with a strong architectural identity. ■

credits

ARCHITECT: Diller Scofidio + Renfro – Elizabeth Diller, partner in charge; Ricardo Scofidio, Charles Renfro, Benjamin Gilmartin, principal designers; Anthony Saby, project director; Chris Hillyard, project architect

EXECUTIVE ARCHITECT: Gensler

CONSULTANTS: Leslie E. Robertson Associates (structural); Jaros Baum & Bolles (m/e/p); Thornton Tomasetti, Weidlinger Transportation (civil, geotechnical); SCAPE (landscape); BuroHappold Engineering (curtain wall); Tillotson Design Associates (lighting); Cerami & Associates (acoustics, AV)

GENERAL CONTRACTOR: F.J. Sciame Construction

CLIENT: Columbia University Medical Center

SIZE: 110,000 square feet

COST: withheld

COMPLETION DATE: August 2016

SOURCES

CURTAIN WALL: Permasteelisa North America, Josef Gartner

GLASS: BGT

GFRC: David Kucera

VOID FORMERS: Cobiax USA

WOOD VENEER: M. Bohlke Veneer

LIGHTING: 1212 Studio, Prescolite, Gammalux

LIGHTING CONTROLS: Lutron

Campuses Go Green

Colleges and universities take environmentally responsible design to new levels.

By Katharine Logan

OVER THE last 15 to 20 years, the combined energies of students, faculty, and administrators have broadened the focus on sustainability at U.S. colleges and universities to encompass a wide spectrum of concerns. From a start in recycling, raising awareness, and environmental-studies programs, the higher education's sector's green endeavors have burgeoned to include curriculum and research, planning and administration, and the many facets of campus operations.

Almost 4,000 higher-education projects have been LEED certified, with the majority achieving Gold or better. More than 650 college and university presidents from all 50 states have pledged their institutions will achieve carbon neutrality under the Climate Leadership Commitments, and nearly 800 colleges and universities are measuring their comprehensive environmental performance under STARS (Sustainability Tracking Assessment Rating System), a program of the Association for the Advancement of Sustainability in Higher Education. "Sustainable design is now fully ingrained and practiced on nearly every campus," says Mike Moss, president of the Society for College and University Planning. "It's a given topic of discussion on facility projects, and people are looking for the next level."

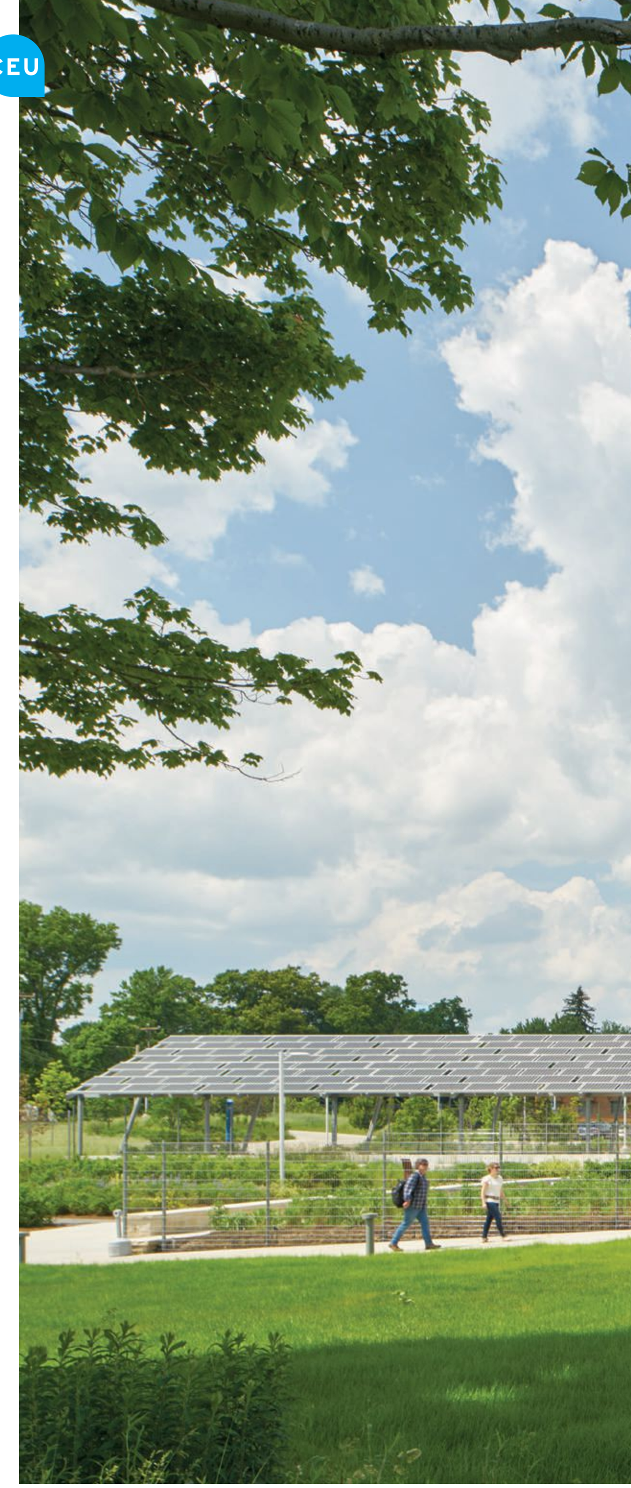
GARDEN OF EDEN At Chatham University's Eden Hall Campus, students conduct varied sustainability-related research (above). The first phase of construction (opposite, bottom), completed in 2015 and designed by Mithun, includes architectural elements that perform multiple functions such as a photovoltaic awning (opposite, top) that catches rainwater for irrigation and serves as a sheltered bus stop.

Three projects profiled here exemplify that next level: a new campus designed for sustainability from first principles, an academic building now proving itself under the Living Building Challenge, and a campus residence that takes the Passive House standard to new heights. Impressive as these projects are, their significance isn't entirely based on their technological innovations or how much energy, water, or other resources they conserve, says David Goldberg, a partner with the Seattle- and San Francisco–based design firm, Mithun. "The really big impact comes from the thousands of students, faculty, and visitors who take their lessons out into the world."

Goldberg's firm is architect and landscape architect for Chatham University's Eden Hall Campus, one of the first in North America designed for sustainability from the ground up. Home to the Falk School of Sustainability, Eden Hall sits on almost 400 acres of farmland in a rapidly developing county 25 miles north of the university's main campus in Pittsburgh. This location presented the project with its first challenge: how to reconcile a greenfield development with the core mission of a school of sustainability.

For its answer, Chatham is making the campus into a highly productive peri-urban landscape as an alternative to sprawl. Eden Hall's site development, including an amphitheater, native plantings, a greenhouse, and a constructed wetland, are all designed in compliance with the Sustainable Sites Initiative. Its buildings (a field lab, a café, a dining commons, housing, an auditorium, classrooms, and offices) are targeting LEED Platinum certification at a minimum. The first phase of construction, which focused on the core of the campus and was completed last year, has a predicted net energy surplus of 10 percent.

With full-cycle water reclamation, net-positive energy production, and zero-waste operations, Eden Hall grows food and recycles nutrients, supports habitat and healthy soils, and fosters eco-literacy. "We can't create sustainability in urban areas alone," says Sandy Mendler, a principal with Mithun. "A net productive landscape complementing the city it borders offers a strategy for deep sustainability."



An aesthetic of refined functionality with simple volumes clad in metal and wood supports the hands-on program. An awareness of the interrelatedness of systems permeates the design with architectural elements serving multiple purposes. For example, a long stretch of canopy at the campus entrance supports a photovoltaic array, catches rainwater for irrigation, provides shelter to students waiting for a bus, and defines the edge of an outdoor space. Campus gates of weathering steel are art pieces patterned with perforations representing data derived from the geology and hydrology of the site. And, as part of a perimeter fence, they prevent deer from eating the crops.

IMAGES: © BRUCE DAMONTE (TOP AND OPPOSITE); COURTESY MITHUN (BOTTOM)

Among the opportunities of designing a campus from first principles lie a few challenges. One of these is the phasing of infrastructure development: on the one hand, there's the efficiency of developing energy and water systems for an entire campus all in one go; on the other, there's the up-front cost of investing in capacity that won't be used for years. In the case of Eden Hall's geothermal wells, which provide heating and cooling energy for the buildings, their modularity meant that capacity could be easily added over time. So the geothermal field is sized for the first phase of construction, with associated mechanical equipment, housed in the dining commons,

RESTRAINED PALETTE To satisfy the tough product-sourcing requirements for the Living Building Challenge, Bruner/Cott limited the primary materials to local stone, wood, and concrete on the Kern Center (above and left) at Hampshire College.

sized for future capacity.

The wetland, which provides on-site wastewater treatment, is scaled for what the local regulators deemed necessary for the first phase only. But because the officials took a cautious approach with the unfamiliar technology, the resulting wetland is larger than what Mithun believes is necessary by a factor of three or four. The university hopes through careful monitoring and record-keeping to demonstrate that additional capacity will not be needed with future phases of construction.

The chance to design district-scale sustainability from scratch is a rare thing; more often, smaller opportunities arise piecemeal. In the higher-education sector, however, even a single building can have far-reaching impact. In constructing a new welcome center with administrative offices, a social hub, and classrooms at its campus entrance, Hampshire College, a liberal arts school in Amherst, Massachusetts, perceived a fit between its institutional values and an ambitious environmental effort. The college's recently completed R.W. Kern Center, designed by Cambridge, Massachusetts–based Bruner/Cott, is built to meet the Living Building Challenge (LBC) and has just embarked on the operational tracking year required for certification.

Widely considered the built environment's most rigorous performance standard, LBC consists of seven performance categories, called petals: place, water, energy, health and happiness, materials, equity, and beauty. These are subdivided into a total of 20 imperatives, or obligatory criteria, each of which focuses on a particular aspect of creating a project in harmony with nature.

From rooftop solar arrays to a basement compost system, the 17,000-square-foot Kern Center's orientation, form, mechanical systems, envelope, and landscaping all address the need to perform at net-positive energy and water. In fact, the building is projected to generate 25 percent more energy than it uses. But if advanced green buildings "just end up being science experiments," says Jason Forney, Bruner/Cott principal, "they won't succeed in introducing a new era."

Instead, Kern integrates its building systems into architecture that makes human scale and experience the priority and emphasizes biophilic principles. To ground the building visually, concrete bands in the stone cladding grow thicker as they descend, creating the impression of a firmly rooted mass. A double-height glazed volume provides a central focal point to orient users. A narrow footprint, with glazing on opposite sides and framed views of the surroundings, creates a sense of the outdoors flowing through the interior. The solar-opti-

PHOTOGRAPHY: © ROBERT BENSON

NEW HEIGHTS
At 26 stories, Handel's residential tower (above, on the right in picture) on the new Cornell Tech campus in New York is expected to be the world's tallest and largest Passive House building once it is complete next summer. The campus also includes a research and development hub by Weiss/Manfredi (above, at center) and an academic building by Morphosis.

WEST ELEVATION

SOUTH ELEVATION

mized form and materials from the bioregion provide a tangible connection to place.

The use of local materials, including regional stone and wood, and doors and cabinets salvaged from a nearby hospital, also proved an important strategy in meeting the LBC's materials imperatives. These criteria, which many project teams consider the standard's most challenging aspect, include a Red List of hazardous substances to avoid, requirements for responsible sourcing, and a set distance from the building site within which products must be obtained. Although the architects initially worried about assembling a materials palette that met all of the criteria, they learned "that it's very possible to source the materials for this high level of sustainability in a local economy," says Forney.

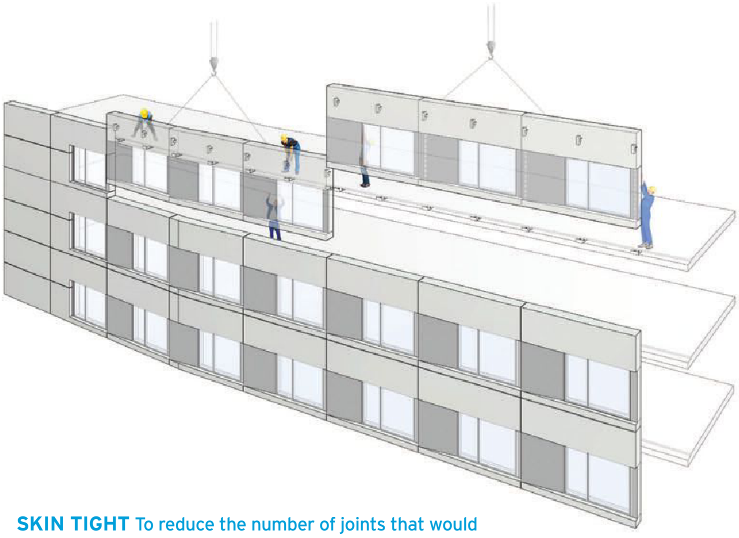
As a result of the project's achievements, students report going out of their way to spend time in the building. They say it makes them feel calm, quiet, and connected. Apparently the construction workers felt it too: Kern was the only project the superintendent had seen in 30 years where the trades preferred to eat lunch inside.

Even before the building opened, students began using it in their curricula and project work. Partway into the 12-month performance-documentation period required for Living Building certification, Kern's lessons are already reaching the larger world: with hands-on experience of the building's rainwater-management system, a group of Hampshire undergrads entered a filtration project in the American Ecological Engineering Society's design challenge and carried off first prize.

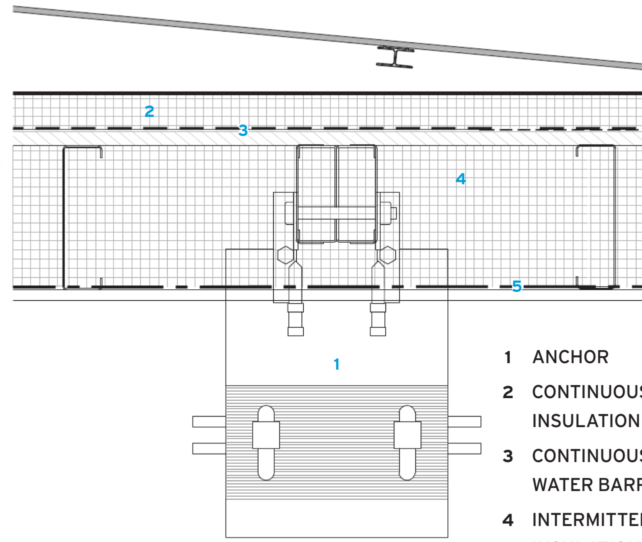
In addition to academic and administrative buildings, campus residences provide a less obvious but no less significant opportunity for universities and colleges to make sustainability memorable. At Cornell University's new technology campus on New York's Roosevelt Island, scheduled to open in the summer of 2017, 530 graduate students, faculty, and staff will come home to the world's tallest—and, at 270,000 square feet, largest—Passive House. Designed by New York–based Handel Architects and known as the House, the 352-unit, 26-story tower will be North America's first high-rise designed to this standard. (The campus is also to include a net zero academic building by Morphosis and a research and development hub by Weiss/Manfredi expected to achieve at least LEED Silver.)

Developed in Germany, the goal of Passive House is to drastically reduce energy consumption while improving occupant comfort. Based on absolute energy use rather than enhancement over code, Passive House permits a

IMAGES: © MUSTAFA ÖNDER (TOP); COURTESY HANDEL (BOTTOM)



SKIN TIGHT To reduce the number of joints that would need to be air-sealed on-site, the exterior facade for the House at Cornell Tech was built in a factory as 9-foot-tall, 36-foot-long panels. These were shipped to the site with their triple-glazed windows already installed.



FACADE ANCHOR DETAIL

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Learning Objectives

1 Describe how the sustainability movement on college campuses expanded in recent decades to include buildings and infrastructure.

2 Outline the requirements of green building certification systems such as Living Building Challenge and Passive House.

3 Discuss the strategy for sizing green infrastructure systems and phasing their installation at Chatham University's Eden Hall Campus.

4 Discuss some of the design and construction challenges presented by the Cornell Tech residential tower, slated to be the world's largest Passive House building.

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maximum heating energy of 4.75 kBtu/ft2/yr, a maximum cooling energy of 5.39 kBtu/ft2/yr, and a total building energy use intensity (EUI) of 38 kBtu/ft2/yr. Compared with the median EUI for New York buildings its size, the House is expected to reduce energy consumption by almost 75 percent.

The building relies on familiar passive design strategies, amplified to new levels. Its siting is optimized to maximize solar gains in the winter but minimize them during the summer. Its plan is a convex polygon that keeps the surface-to-volume ratio low, except at one corner. Here the polygon opens to create a reveal that houses louvers and extends up the full height of the building. It encloses an exterior space on each floor to accommodate condensing units for an energy-efficient variable refrigerant flow (VRF) system for heating and cooling. The louvered slot also allows the building to breathe: from there, filtered and tempered fresh air is supplied to each bedroom and living room (a radical innovation for a residential high-rise). The reveal also works architecturally, expressing the building enclosure as a wrapping.

To maintain a continuous blanket of insulation, eliminate thermal bridging, and reduce the number of joints needing to be sealed on-site against air infiltration, the project team designed custom curtain wall panels. Built off-site for improved quality control, the 9-foot-tall by 36-foot-long panels were delivered with triple-glazed windows pre-installed. The assembly is designed to achieve an overall R-value of 17 and a maximum air infiltration rate of 0.6 air changes per hour at 50 pascals of pressure. In order to achieve Passive House certification this infiltration rate must be confirmed with a blower door test once construction is complete.

The level of airtightness was a particular worry for team members due to the project's unprecedented scale and the many conditions that could be prone to leaks, including the panel joints, fenestration, and building systems' penetrations through the facade. So, in order to identify faulty joints before they were enclosed behind drywall and beyond reach, they devised a way to conduct preliminary blower door tests as well as a regimen for spot checks, explains Deborah Moelis, a senior associate at Handel.

Apart from the intensity of quality control, the biggest challenge in scaling Passive House up to a high-rise was the ventilation and exhaust system: adequate separation on individual units was impossible. Ventilation was solved through design, with the louvered reveal. But exhaust was solved through policy, pushing out another element on the green building frontier with a revision to New York City's building code. Regulations now permit joining bathroom and kitchen exhausts as they discharge through the roof to facilitate the energy-saving strategy of heat recovery. This change in policy "was an exciting moment for the project," says Moelis. It's societal and regulatory changes like this, along with the innumerable people who will occupy and visit the Cornell project and other ultrasustainable campus buildings across the country, that make sustainability in the higher-education sector more than just an academic exercise. ■

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

IMAGES: COURTESY HANDEL

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CIRCLE 34

Illuminating Structure

Three engaging schemes attract attention by using light to enhance the architectural details of projects with very different programs—two in landmarks and one in a new building.

SAYN FOUNDRY

PHOTOGRAPHY: © JOHANNES ROLOFF

Sayne Foundry
Carl Ludwig Althans
Licht Kunst Licht
By Mary Pepchinski

BENDORF, A RHINE RIVER city north of Koblenz, Germany, and a former center of mining and ironwork, acquired the derelict Sayn Iron Works Foundry in 2004 to repurpose it as a cultural attraction and an event space. A cutting-edge industrial building celebrated for its inventive design when it was built in 1830, the intricate structure is now illuminated by sensitively integrated LEDs that allow for contemporary use and lend an enchanting nocturnal appeal. "We wanted to use modern technology to bring the old foundry back to life," says Werner Prümm, who oversees the city's economic development.

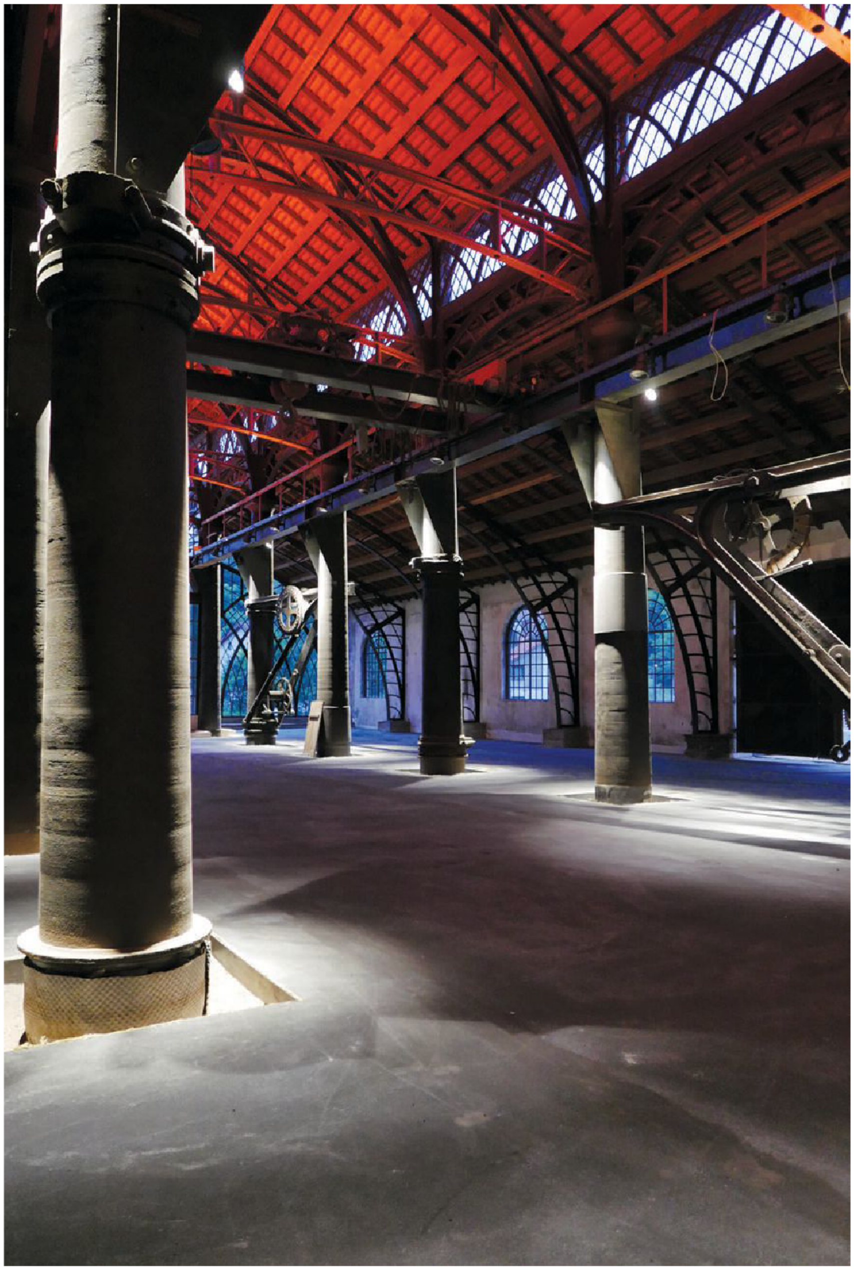
Designed by architect Carl Ludwig Althans, the building, which is situated on a site hugging a wooded slope on the city's outskirts, is a basilica-like hall with massive masonry walls. In order to flood the capacious interior with daylight, Althans installed clerestories above the central nave, fenestration along the sides, and spectacular glazing with neo-Gothic tracery on the west-facing facade. Details are both eclectic—including 20-foot-high columns topped with Doric capitals and prefabricated cast-iron structural framework devoid of rivets and screws—and functional, like the elevated tracks to transport materials flanking the central nave and the three giant pivoting cranes attached to the columns.

Following an overall renovation in 2014, the city commissioned the Bonn-based lighting-design firm Licht Kunst Licht (LKL) to develop a scheme for the newly restored foundry, now a listed building. The designers were required to preserve the physical substance and devise a no-frills yet versatile design that maintains the landmark's distinct character and can accommodate diverse functions. "The concept was spare and elegant," says designer Johannes Roloff.

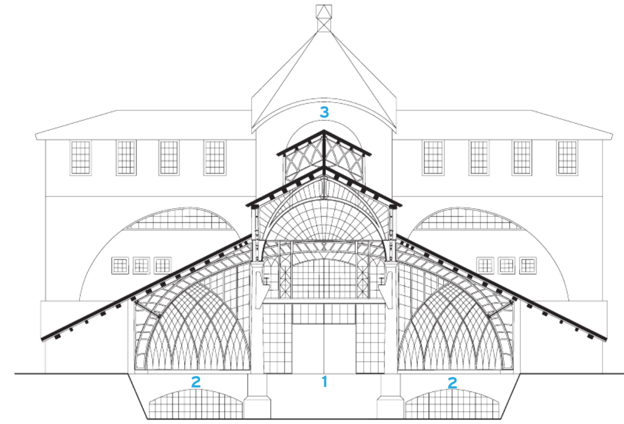
First, LKL convinced the officials to abandon using exterior illumination to draw attention to the monument at

PHOTOGRAPHY: © JOHANNES ROLOFF, EXCEPT AS NOTED

LIGHT BOX After it was renovated in 2014, the Sayn Foundry was lit entirely from within (left and above), so that it radiates a warm glow in the evening that showcases the building's intricate architectural details.



SHARP FOCUS
The ceiling in the building's nave is washed in white or red light supplied by concealed RGB LED strips, while the columns receive a cool white glow from LED spotlights.



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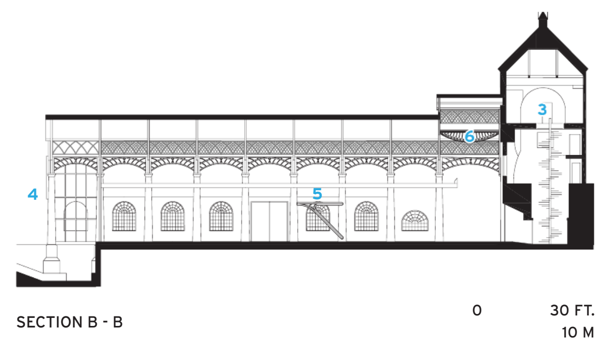
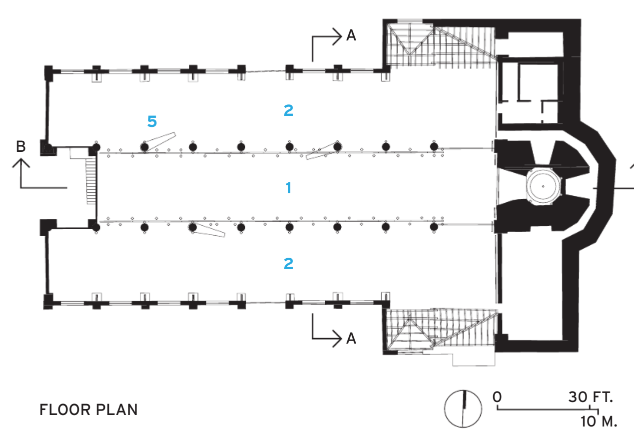


SECTION B - B



FLOOR PLAN

1 CENTRAL NAVE
2 SIDE AISLE
3 FURNACE BUILDING
4 WEST FACADE
5 JIB CRANE
6 FISH-BELLIED GIRDER

night and to replace it with more evocative interior lighting. "We wanted a building that pours warm light out into the surroundings," says Roloff, "and seems to glow from within."

To accomplish this, the design team felt it was necessary to clearly articulate the continuous interior surfaces. Concealed adjustable linear RGB LED strips bathe the underside of the roof in the nave in alternating white or brilliant red tones. Washers at the base of the rear wall uplight this surface, and the sidewalls receive indirect illumination from spotlights affixed to two elevated tracks, which transverse the hall above the columns.

Then the designers turned to the industrial artifacts and historic construction within. The cast iron elements had been coated with a special paint containing glimmering metal flakes. To emphasize this effect, LED spotlights with a cool 4000K color temperature and a narrow angle were mounted at the top of the columns and aimed at each mem-

ber along the side aisles. For those in the nave, spotlights were placed underneath the elevated tracks. Each giant crane received two spotlights, placed at different angles to enliven them and cast shadows on the surrounding floor.

Because the space will house receptions, exhibitions, and performances, adjustable LED spotlights, also positioned on the elevated tracks, are equipped with honeycomb louvers or snoots to reduce glare and direct strong, warm-white 2700K downlight to the base of the building. LED luminaires were employed throughout to minimize cost and energy, as well as to provide the ability to alter color schemes via a digital DALI lighting-control system that is equipped with a DMX interface. Most of the luminaires have casings that blend in with the historic construction to conceal them.

Lead designer Johannes Roloff worked in theatrical lighting for a decade before turning to architecture, and it is not surprising that his schemes for the Sayn Iron Works Foundry have dramatic flair—the white ceiling illumination possesses an ethereal demeanor, while the red tones conjure up visions of the smoldering furnaces and molten iron that once occupied this space. Both hint at the inner life of this restored landmark, but their means do not overwhelm it. “Licht Kunst Licht understood it was important to put the architecture in the foreground,” says Werner Prümm, “and not show off their own special effects.” ■

Berlin-based Mary Pepchinski is an author and architect who teaches at the University of Applied Sciences in Dresden, Germany.

credits

ARCHITECT: Carl Ludwig Althans (existing building)

LIGHTING DESIGNER: Licht Kunst Licht – Andreas Schulz, principal; Johannes Roloff, lead project designer

CLIENT: Municipal Administration of Bendorf

SIZE: 37,000 square feet

COST: $180,000

COMPLETION DATE: June 2015

SOURCES

LIGHTING: iGuzzini, EWO, GE (fixtures)

CONTROLS: Jung (interface)

PHOTOGRAPHY: © THOMAS NAETHE

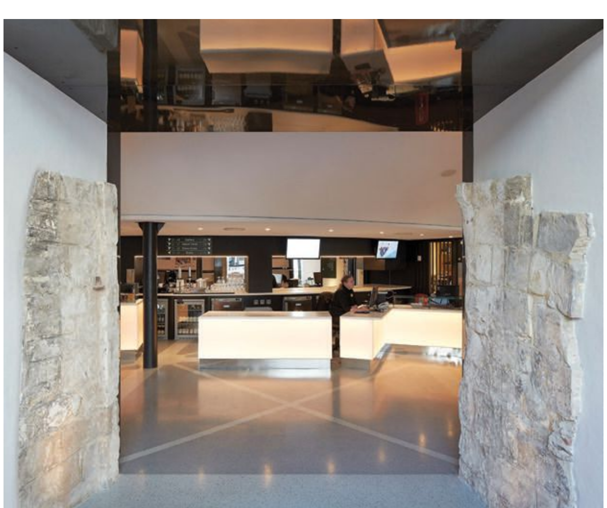
York Theatre Royal
De Matos Ryan
By Chris Foges

IN DE MATOS RYAN's renovation of York Theatre Royal, sensitive and ingenious lighting plays a vital role in lending coherence to the diverse parts of a building that has been much altered over its 272-year history. At the theater's core is an 18th-century auditorium constructed over medieval foundations, around which a larger stone envelope was built in the late 19th century. A 1967 extension by Patrick Gwynne added foyer and café spaces on two stories. Its glass walls reveal an internal forest of concrete columns whose mushroom profiles produce the impression of pointed arches when seen in perspective, subtly alluding to the gothic style of the Victorian facades.

At the time, a building review in *The Architects' Journal* noted the way that the transparent extension brought the activities of the theater into full public view, "particularly at night . . . when the interior is brilliantly lit by spotlights." By the time De Matos Ryan arrived on the scene, this effect had been largely lost. Gwynne's original fixtures had been replaced piecemeal over time, while retrofitted mechanical and electrical equipment had infested the concrete soffits.

The firm's principal task was to boost audiences and encourage building use at other times by improving the bars and foyers "in such a way that it's obvious that this is a place with life in it," says partner Angus Morrogh-Ryan.

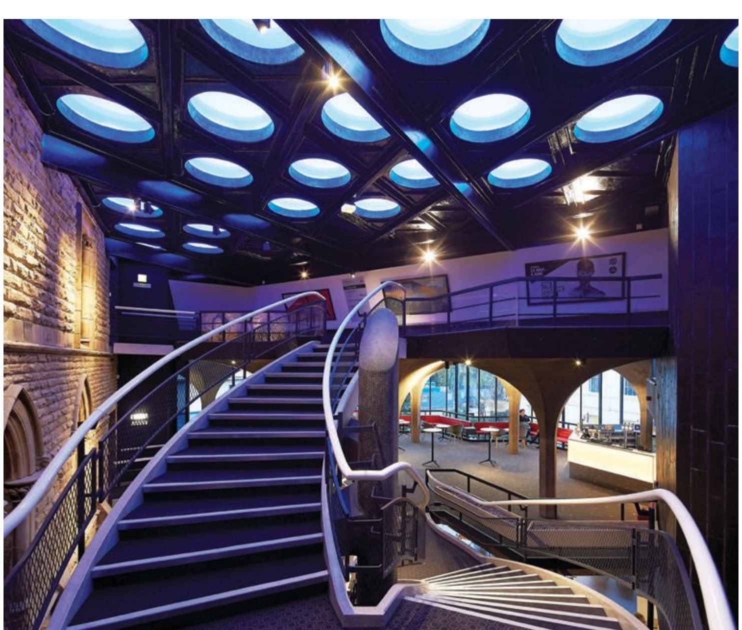
In the older building, discreet spotlights are now trained on patches of exposed medieval and Victorian stone walls, celebrating the theater's layered history. In the extension, the architects stripped out clutter and used light to capture Gwynne's original ambience. As new cable routes could not be cut through the protected concrete, a linear fixture was devised to sit within the shallow channels formed at the junctions between the spreading column tops. A black aluminum band sits flush with the concrete, forking to follow fault lines across the soffits. Spotlights mounted on recessed track hang from the center, while LED-lit translucent strips along both edges seem to detach the fixture from its surroundings. Cables for audiovisual and fire-detection equipment are also integrated in the compact installation.

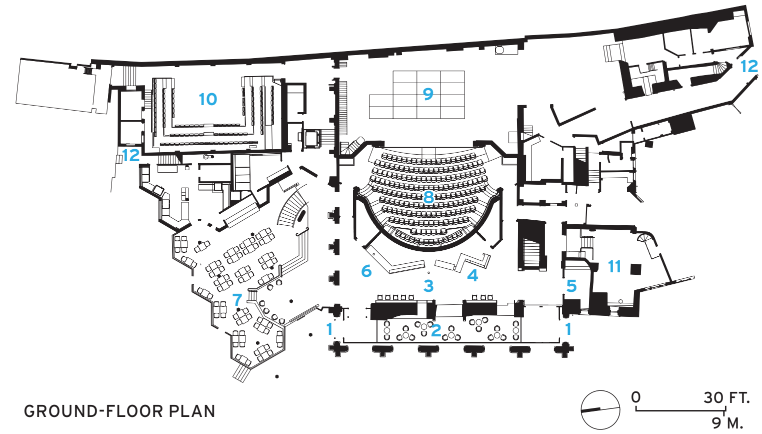


PHOTOGRAPHY: © HUFTON & CROW

IN THE SPOTLIGHT Backlit Corian counters in the foyer accommodate the café and box office (left). The new interior lighting showcases both old and new structure (this page), giving the building a commanding presence.

LAYERS OF TIME Black aluminum strips delineate concrete vaults in Patrick Gwynne's 1967 extension and house lighting and fire-detection equipment (above). Newly installed roof lights are encircled by halos of color-changing LEDs (below).





GROUND-FLOOR PLAN

1 MAIN ENTRANCE
2 COLONNADE
3 FOYER
4 BOX OFFICE
5 COAT CHECK
6 CAFÉ
7 RESTAURANT
8 MAIN AUDITORIUM
9 MODULAR STAGE
10 STUDIO THEATER
11 EVENTS SPACE
12 STAFF ENTRANCE

Relatively few spots point downward. Most are directed at columns and soffits, whose illuminated surfaces contribute to the perception of a well-lit space. Warm white light brings out the mellow, sandy hues of the locally sourced concrete aggregate that Gwynne used to harmonize with the York stone facades. Recreating Gwynne's distribution of light relied more on trial and error than calculation, says Morrogh-Ryan. "I was up ladders myself changing things until we got it right."

Circular cast-glass skylights above the main stair, originally illuminated by exterior fixtures, had long since failed and been removed. De Matos Ryan installed modern equivalents ringed by color-changeable LEDs. The ability to vary the color of light applies throughout, and allows foyers and circulation areas to reflect theater programming or to function as small performance spaces. In a new bar in the Victorian building, the counter appears as a luminous band. Its design references technologies tested by Gwynne. In place of backlit Bakelite—which he used for signage—De Matos Ryan designed translucent Corian panels backed by sheets of clear acrylic, edge-lit by LED strips on all four sides.

Another social space, a street-side café, has been prominently located in the Victorian building's former entrance colonnade, which has been partially glazed to enclose it. Downlights in its slatted ceiling radiate a warmth that draws theatergoers in. The newly cleaned gothic facade was also given low-key accents by subtle rows of uplights. "Local conservation officers might still say we've done too much," says Morrogh-Ryan, "but we wanted to give the building a civic presence." With the glazed café and extension glowing like lanterns, the welcome offered by the theater's exterior is an enticing prelude to the warmth now found within. ■

credits

ARCHITECT: De Matos Ryan – Angus Morrogh-Ryan, director in charge; Raquel Borges, project architect

ENGINEERS: Price Myers (structural); P3r (services); James Edgar (heritage)

GENERAL CONTRACTOR: William Birch & Sons

CONSULTANTS: Bilfinger GVA (project management); Charcoalblue (theater and acoustics)

CLIENT: York Citizens Theatre Trust

OWNER: York Conservation Trust

SIZE: 34,500 square feet

COST: $5 million

COMPLETION DATE: April 2016

SOURCES

LIGHTING: IBL Lighting; Astro Lighting; Light Projects; Lighting Logic

SOLID SURFACE: DuPont Corian

GLAZING: Gresson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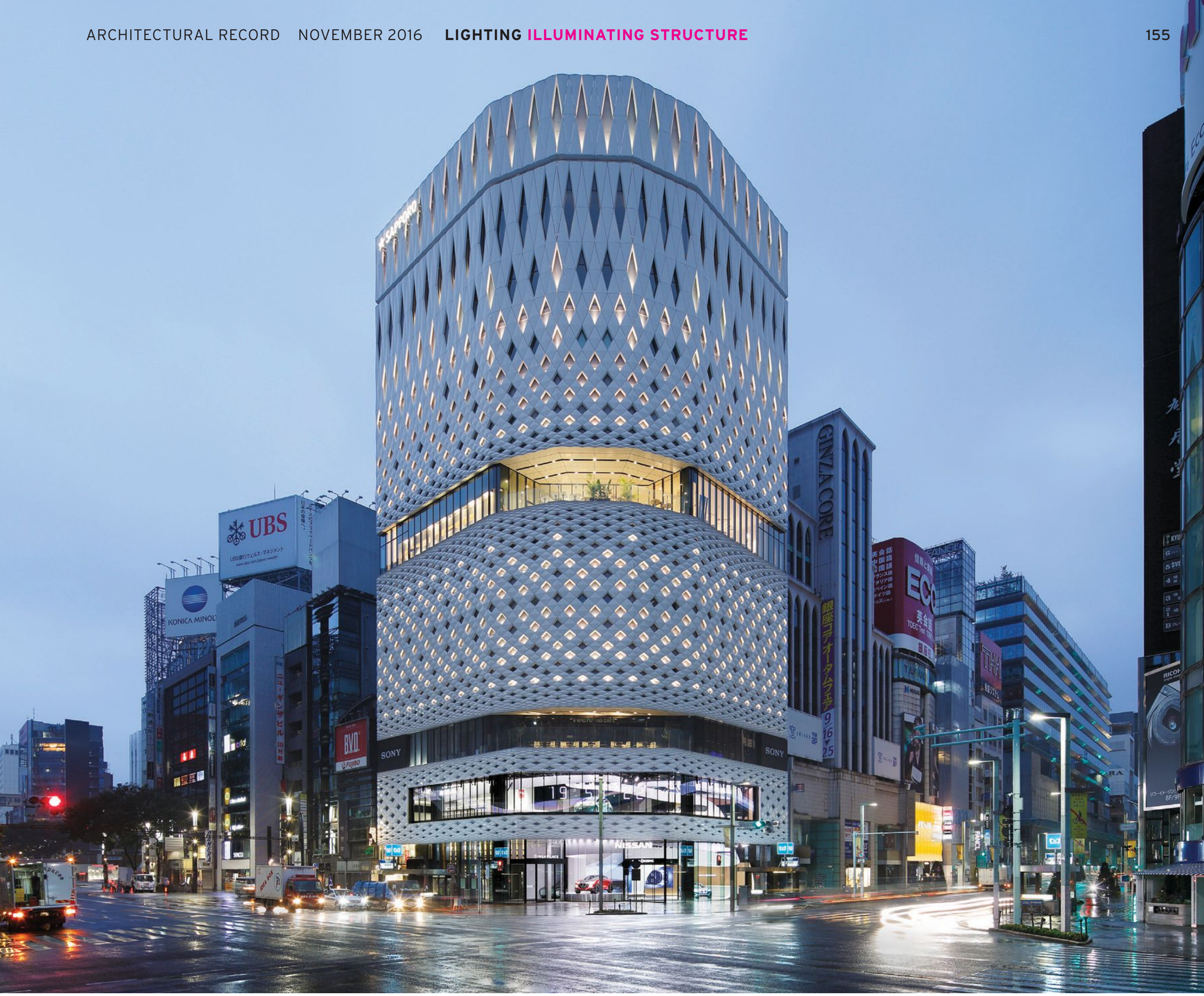

PHOTOGRAPHY: © NACASA & PARTNERS

Ginza Place

Klein Dytham Architecture

By Naomi R. Pollock, AIA

AN ICON in the making, Ginza Place is the latest addition to Tokyo's Ginza 4-Chome Crossing—the city's equivalent of the intersection at New York's Fifth Avenue and 57th Street. Marking one corner, this 11-story commercial building is defined by webs of metal panels tautly stretched across its wraparound facade. By day, the eye-popping surface is hard to miss. But at night its backlit front becomes a focal point of the city's most famous junction.

Recently completed by Klein Dytham architecture (KDa), the project began after the Tokyo-based firm won a 2013 competition to design the building's facade and massing. Though the landowner, Sapporo Real Estate, and the construction company, Taisei Corporation, had already determined the floor plate size and reinforced-concrete structure, the project needed a signature architect to give it a strong identity, explains KDa coprincipal Mark Dytham. Known for clever and highly creative solutions, KDa was a logical choice for this extremely high-profile job.

"It was a one-in-a-million chance," says Dytham's partner, Astrid Klein. Making the most of the opportunity, the architects developed a freestanding L-shaped volume for the tight site that accommodates an existing building in the back and maximizes tenant space with a faceted front. To smooth out the resulting kinks and edges on the exterior, KDa created a bold facade with an illusory curved surface that the architects separated into three horizontal bands—small, medium, and large—that echo the tripartite composition of a 1932 department store kitty-corner from the site. These bands are

CITY LIGHTS
The delicately perforated facade wrapping Ginza Place is gently backlit with color-changing LEDs that showcase the building's form in the evening and provide seasonal hues throughout the year.

SKIN DEEP The aluminum panels that comprise the facade have a three-dimensional quality and pearlescent white finish that reflects movement and sunlight during the day.

interspersed with rows of windows and balconies at a third-floor café and seventh-floor restaurant, both overlooking Ginza's main street. A radical move in a shopping district where balconied buildings are nonexistent, these openings resulted in an unprecedented relationship between the interior and the elegant boulevard below. Plus, they place restaurant patrons directly in line with a historic clock tower at the top of the adjacent building. Additional glass walls on the ground and second floors reveal the showrooms of anchor tenants Sony and Nissan.

The entire facade consists of 5,315 aluminum panels that expand in size as they rise up—like bubbles in a beer glass, according to Dytham. Within each of its three segments, the diamond-shaped pieces align diagonally. Barely separated by 0.3-inch joints, they read as a series of overlapping curved lines with a checkerboard of voids in between. Some of the gaps are plugged with small windows; others are open to the concrete wall behind. The motif culminates at the top where swooping parabolas guide the gaze upward.

Ranging from 1 to 16 feet high, the panels consistently measure 3 feet across and 2 inches deep. Each one is backed with L-shaped hardware that attaches to rails affixed to the building. Developed by KDa and Taisei, this patented system enables the panels to slide without racking during an earthquake. Folded flaps at the panel edges conceal these underpinnings, while center creases create depth.

The panels' three-dimensionality not only articulates the facade, it also helps mitigate the building's north-facing orientation. Coated with pearlescent white paint, the metal surfaces pick up movement and light outside. "They reflect Ginza back on itself," says Dytham. At night, the panels are lit from behind with a ColorBlast 6 LED system created by Philips Color Kinetics. Attached to the rails via a simple 90-degree bracket between the metal screen and the concrete base building, these lighting fixtures are positioned between some of the panels so that they illuminate the perforations in the facade, following the overall flow of its geometry. Designed to subtly adjust the building's character seasonally, the lighting ranges in color from a cool blue in the summer to a warm candlelight in winter and a neutral white for fall or spring.

Like a beacon in the dark, Ginza Place draws attention to one of Tokyo's symbolic centers with an intricate facade that bows politely to Japan's tradition of craft and also showcases its cutting edge technology—bringing the best of the city to light. ■

credits

ARCHITECT: Klein Dytham architecture – Astrid Klein, Mark Dytham, partners in charge; Yukinari Hisyam, director

ARCHITECT OF RECORD/GENERAL CONTRACTOR: Taisei Corporation – Minoru Yamamoto, director; Koji Ashtani, project architect

ENGINEERS: Sanki Engineering (HVAC); Kinden (electric)

CONSULTANTS: SIRIUS (lighting design); Kume Sekkei (construction management)

CLIENT: Sapporo Real Estate

SIZE: 79,100 square feet

COST: withheld

COMPLETION DATE: August 2016

SOURCES

LIGHTING: Philips

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LafargeHolcim Awards Silver 2014 – $50,000 USD. Lieu de vie on the new Paris-Saclay university campus hosts a mix of activities including indoor and outdoor sports facilities, food outlets and various public spaces across more than 4,000 sq m of floor area. Using rough materials, robust and long lasting techniques, the "urban shelf" is organized vertically with its different activities superimposed on one another, using the roof as a panoramic playground for football and basketball games. Paris, France

LafargeHolcim Awards Silver 2014 – $50,000. The Dryline (BIG U) addresses the vulnerability to coastal flooding with a protective ribbon in Southern Manhattan. Embankments that add green areas and spaces beneath elevated roadways are built out with pavilions for public use. New York, NY

LafargeHolcim Awards "Next Generation" 3rd prize 2014 – $25,000. Developed by students at MIT, Pleura Pod: Air purification wall transforming carbon dioxide into oxygen. Pleura Pod is a wall that is composed of multiple layers that are made out of natural or recycled materials. Cambridge, MA

Global LafargeHolcim Awards "Innovation" Silver 2009 – $50,000. Self-contained day labor station is a minimal physical urbanistic intervention with maximum social equity and neighborhood enhancement effects. San Francisco, CA

For more information: application.lafargeholcim-awards.org

CIRCLE 94

LafargeHolcim Awards

Bright Ideas

With subtle effects and brilliant designs, LEDs continue to transform the lighting industry.

By Julie Taraska

LiniLED RGB

These specification-grade color-changing LED light strips measure a discreet ½" wide x ¼" high; they have a bend radius of 1¼" and use less than 2W per foot. Dimmable, they suit applications indoors and out, including wet locations. They're shipped in single-piece runs of up to 33' and can be field-cut every 8".
organiclighting.com
CIRCLE 111

Plumen 003

The faceted gold element contained within Plumen's latest lamp has two functions: it focuses a clean spotlight on the surface below and casts a warm accent light around its sides. The glass-and-anodized-aluminum bulb provides 250 lumens of illumination; its central structure rests on a specially engineered plinth that draws heat away from its 6W LED, keeping it cool.
plumen.com
CIRCLE 110

Truss

The ADA– and Title 24–compliant Truss comprises a steel back plate flanked by two opal-glass tubes illuminated by LEDs with a 93 CRI. The luminaire may be mounted to a wall horizontally or vertically in any dry setting. Truss comes in a choice of two sizes, wattages, and finishes. Pictured is the 13"-wide option with a 20W bulb and brushed-nickel finish.
progresslighting.com
CIRCLE 112

Lumenalpha Spot Large

Delivering up to 3,000 lumens, this adjustable spotlight offers better color stability and lower energy consumption than comparable metal halide models. Options include three beam angles and four color temperatures. The fixture also can be specified with Lumentalk, which allows for digital dimming of individual luminaires over existing track installations. Pictured with a honeycomb louver.
lumenpulsegroup.com
CIRCLE 113

Durabulb

Designed for rugged settings such as factories and construction sites, this LED bulb has a polymer exoskeleton that protects it from impact, vibration, and external stresses. The 7.5W A19 lamp—equivalent to a 60W incandescent—is compatible with E26 bases; it offers omnidirectional light and comes in dimmable and nondimmable versions as well as 2700K and 5000K color temperatures.
lsgc.com
CIRCLE 114

Lightolier Calculite LED

The latest generation of Philips's LED downlights features a frame independent from the rest of the luminaire. The driver and light engine snap into this kit and can be swapped out or upgraded without replacing the frame. A mounted spring secures the reflector to the luminaire, which comes in a range of trims, aperture sizes, and beam spreads.
philips.com
CIRCLE 115

Ruby MC

The surface-mounted Ruby floodlight contains six quad-chip LEDs that allow for color mixing of RGBW or dynamic white light. The fixture also offers a 0 to 100% dimming range as well as spot to wide-beam distributions. Its integral driver accepts an input of 120 to 277 volts at 50/60Hz.
griven-usa.com.
CIRCLE 116

RS Series 1000W MHO

The latest option for this plug-and-play LED replacement for 1,000W metal halide lamps delivers 52,000 lumens at 460W. The dimmable bulb offers a 5000K color temperature, 83 CRI, and 50,000-hour life. It also works with existing magnetic-probe and pulse-start ballasts.
foreverlamp.com
CIRCLE 117

T-Light

This linear pendant features a ¾"-thick piece of etched white glass sandwiched between parallel L-shaped lengths of extruded aluminum. Illuminated by two 3000K LED strips—each of which can be dimmed separately—the luminaire provides warm up- and downlight. T-Light is available in three lengths and nine standard powder-coat options, including Rusted Bronze, shown.
boydlighting.com
CIRCLE 118

Vive

A series of dimmers, switches, and controllers paired with a wireless hub, Lutron's scalable lighting system allows facility managers to monitor and adjust fixtures from any computer or smart device. Vive installs up to 70% faster than similar products and integrates via BACnet with other HVAC, IT, audio-video, and energy-management systems.
lutron.com
CIRCLE 119

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Photo courtesy of Skidmore, Owings & Merrill LLP/© Scott Frances, OTTO

Categorized by Design: Architecturally Exposed Structural Steel

Sponsored by American Institute of Steel Construction

LS PM ST

CREDIT: 1 AIA LU; 0.1 IACET CEU

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The Core of the Matter

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PM ST SU

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Extruded Concrete in Rainscreens

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Photo courtesy of Huber Engineered Woods LLC

Continuous Insulation in Framed Exterior Walls

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Collaborating Through Design Challenges

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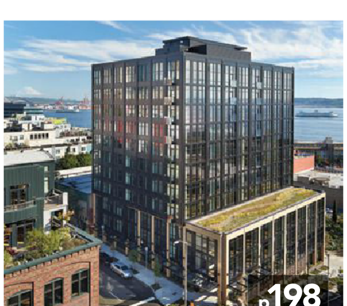

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Green Globes Certification Overview

Sponsored by The Green Building Initiative

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Image courtesy of Sefaira

The Benefits of a Performance-Based Design Process

Sponsored by Sefaira and SketchUp

PM PMD SU

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CATEGORIES

BE BUILDING ENVELOPE DESIGN
LS LIFE SAFETY AND CODES
PM PRODUCTS AND MATERIALS
PMD PRACTICE, MANAGEMENT, DIGITAL TECHNOLOGY
RR RENOVATION AND RESTORATION
ST STRUCTURAL
SU SUSTAINABILITY

Categorized by Design: Architecturally Exposed Structural Steel

Specifying architecturally exposed structural steel (AESS) with defined categories to meet project expectations for appearance, budget, and schedule

Sponsored by American Institute of Steel Construction | *By Jayshree Shah, AIA, NCARB, LEED AP BD+C*

Lee Hall III, Clemson University, Clemson, South Carolina

Photo courtesy of Skidmore, Owings & Merrill LLP/© Scott Frances, OTTO

Expressing the structural integrity of a building is both a meaningful and impactful message in architecture. Today, many architects integrate architecturally exposed structural steel (AESS) in their designs to give identity and recognition to a building. Diligent coordination must take place among the design professionals and contractors to achieve a higher degree of finish desired for the structure. It is understood that these efforts are no simple task. New guidelines have been published in 2016, on behalf of the U.S. structural steel industry, to streamline the process of communication and documentation. In this course, design professionals will learn the tools to achieve their design and construction goals with a new category system for AESS.

THE CODE OF STANDARD PRACTICE

Structural steel has long been recognized for its flexibility in member shape and size, durability of material, and high strength-to-weight ratio. Since

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Learning Objectives

After reading this article, you should be able to:

1. Explain the factors that impact the implementation of AESS.
2. Describe how to identify and specify AESS in the contract documents using the category method.
3. Discuss the expectations of fabrication and erection of AESS under the 2016 AISC Code of Standard Practice.
4. Define methods for efficiently achieving AESS quality with relation to budget and schedule.
5. Identify available resources for additional information when applying AESS on upcoming projects.

To receive AIA credit, you are required to read the entire article and pass the test. Go to **bit.ly/K1611B** for complete text and to take the test for free.

AIA COURSE #K1611B

Photo courtesy of Skidmore, Owings & Merrill LLP/© Scott Frances, OTTO

Lee Hall III at Clemson University incorporates AESS as an educational example of elegantly expressing the method of support for the building with the steel structural system. Slender "tree columns" draw attention to the building exterior, acting as feature elements that create an identity with purpose. This addition to the College of Architecture, Arts, and Humanities is a display of clarity between architecture and engineering, as well as an expression of fine craftsmanship.

the 1980s, AESS has become more widely used and continues to grow in popularity by providing architects and engineers with a common medium for building design and expression. The American Institute of Steel Construction (AISC), which establishes the standards for steel construction in the United States, bases its guidelines on accepted industry practices. Since 1924, the AISC Code of Standard Practice has provided acceptable standards for contracting structural steel among owners, architects, engineers, general contractors, fabricators, detailers, and erectors.

The 2016 AISC Code of Standard Practice, an approved ANSI document AISC 303-16, implements a defined approach to specifying AESS in the contract documents by using five categories (AESS 1, 2, 3, 4, and C) to differentiate levels of steel fabrication and erection (see category matrix and image chart provided later in course). As the numbers in this tiered system rise, the cost and time for fabrication and erection typically also increase. A similar approach was adopted in the Canadian Code of Standard Practice in 2009 with the CISC Code of Standard Practice for structural steel, seventh edition. Previous versions of the codes did not define the terms of AESS as distinctly, leaving room for interpretation and cost escalation. The 2016 document, AISC 303-16, may be referenced as a standard in contract documents prior to municipalities adopting it.

The new guidelines establish the same level of expectations between designers, fabricators, and erectors for the visual appearance of architecturally exposed structural steel in the design. The category system provides architects with a method of articulating AESS on their projects with a much clearer understanding of deliverables.

AESS VS. EXPOSED STRUCTURAL STEEL: WHAT'S THE DIFFERENCE?

The 2016 AISC Code of Standard Practice defines structural steel as elements that are required to support the design loads of a building and fit within the components of a structural frame. For clarity, the AESS category system is typically only applied to fabricated structural steel as referenced in Section 2.1 of the code: anchor rods, base plates, beams, bracing, canopy framing, columns, connection materials, crane stops, girders, lintels, posts, shear stud connectors, trusses, etc. Unfinished, reused, galvanized, or weathering steel may all be fabricated with AESS requirements.

AESS is a step beyond standard fabrication and erection. During fabrication, shipment, and erection, extra care is taken to avoid blemishes and unwanted surface appearance when handling the steel and removing temporary braces or fixtures. Additionally, all backing and runoff tabs are removed, and welds are to be ground smooth for those areas. Basic unpainted steel must also be cleaned of oil, grease, dirt, and loose mill.

There are "other steel, iron, or metal items" that are not typically specified under AESS, though there may be exceptions depending on project requirements. Cables, castings, catwalks, chutes, cold-formed steel products, corner guards, flagpole support, grating, handrail, ladders, ornamental metal, stacks, stairs, steel deck, open-web steel joists, joist girders, trenches, etc. are examples of components that do not typically receive AESS identification. Reference Section 2.2 of the 2016 AISC Code of Standard Practice for the full list, available for free download at www.aisc.org/freepubs.

THE FUNDAMENTALS OF EXPOSING STEEL

In any project using exposed steel, it is fundamental to determine if structure requires additional architectural treatment in the design. As fabricated, exposed structural steel often suffices as an appropriate level of finish for a project without special requirements. Architecturally exposed structural steel (AESS) inherently means the steel is handled with substantially more care and is given a higher level of finish during fabrication and erection. The key to specifying AESS is to base it on the visibility and prominence of the exposed steel.

COORDINATION, COORDINATION, COORDINATION

Everyone in the building industry is familiar with the phrase "location, location, location." When architecturally exposing the structure as an integral part of the design intent, keep in mind the significance of the three Cs: coordination, coordination, coordination. While the architect chooses the locations of AESS in a project, the structural engineer should document it. According to Bill Andrews, SE, a principal at structural engineering firm Walter P. Moore, fabricators and detailers will typically look to the structural drawings in the contract documents as the primary source of information for structural steel, including AESS. This methodology saves time and costs during construction, with the intent of consolidating references to AESS as much as possible. It is of utmost importance that successful coordination between these disciplines takes place to ensure the contract documents are bid per the design intent.

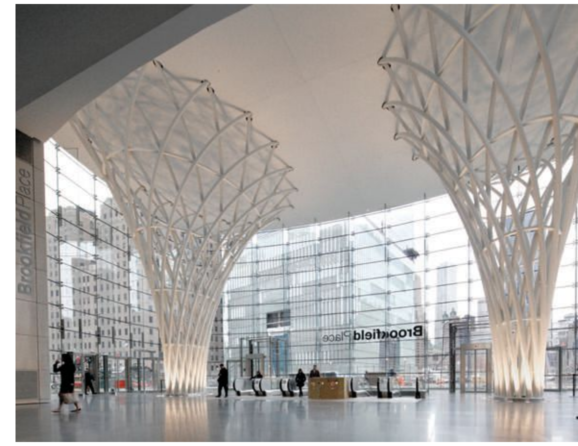
Photo courtesy of American Institute of Steel Construction (AISC)

Pictured is a steel beam, recently cut to size and the ends coped per the standard requirements of the AISC Code of Standard Practice for structural steel. The edges have not been ground smooth. Etched numbers and heat marks are visible from the fabrication process. This member is not specified to meet AESS finishes.

Photo courtesy of wHY Architecture/Jeremy Bitterman

The Pomona College Studio Art Hall in Claremont, California, exposes the steel roof structure as an aesthetic feature visible from below. The height of the steel diagrid is well over 20 feet from the typical viewing distance at ground. The project was completed in 2015, prior to the implementation of the AESS category system in the 2016 AISC Code of Standard Practice. AESS Category 2 could have been specified for the roof structural expression as the appropriate level of fabrication.

Photo courtesy of Thornton Tomasetti/Bess Adler



AESS steel trees are the feature elements in the Brookfield Place Entry Pavilion in New York City. Uplighting the structural elements creates a dramatic effect but also highlights the importance of surface finish. Welds were ground smooth and made flush with the exposed surface for a cleaner aesthetic. Additionally, fitting multiple steel pipes together in the Brookfield Place Entry Pavilion necessitated stringent erection tolerances for the sculptural tree columns. These showcase elements typically fit the requirements of AESS Category 4.

Equally imperative is selecting the correct category for all AESS components in a project. Per the 2016 AISC Code of Standard Practice, it is required that all AESS is identified by categories 1, 2, 3, 4, or C. "This is a dramatic improvement over the previous code edition [in 2010]," says Andrews, "in terms of better clarity, articulating expression...and giving everyone a better understanding of relative costs when choosing AESS and at what level." Sufficient coordination and understanding of best practices are essential to keeping a project within budget and schedule.

THE IMPACT OF CONTEXT

There are many factors that influence the level of finish and detailing on an exposed member. It is important to understand the context surrounding the exposed steel before choosing an AESS category. The following explains which elements impact AESS and how it is perceived in the built environment: member visibility, viewing distance, location, lighting, coatings, style, and adjacency.

Member Visibility

Simply put, if it is not readily visible, there is no need to identify exposed steel as AESS. There are often conditions where one side of an exposed steel column or braced frame may be blocked from view by a wall or other component. It is possible to only note a specific AESS category on the side of an exposed member that is visible to view. Specifying AESS incurs more time and care during design, fabrication, and erection and should only be spent on portions of the project that are visible and prominent. Identifying specific locations for AESS takes careful consideration, but thoughtful analysis can greatly reduce costs and schedule during construction.

Viewing Distance

Details tend to disappear from the naked eye the further away they are located. When an object is beyond 20 feet, the distinction between components is not as clearly seen as when it is within reach. Consider objects 100 feet away from the closest point of view and the level of visible detail is even less distinct. The category system for AESS recognizes that viewing distance is critical to the level of fabrication and erection required for structural steel. The 20-foot viewing distance separates categories AESS 2 from AESS 3.

Location

Whether AESS is placed interior or exterior makes a significant impact to the type of coatings and protections selected for the member in addition to how it is detailed. If placed on the exterior of a building, the exposed steel must withstand more corrosive or harsh climate conditions. Additional surface preparation and protective coatings are often implemented to promote long-lasting AESS. Methods of detailing at joints or connections must also take special care to keep water out to avoid rusting of steel members.

LIGHTING

According to Steve Weiss, principal and founder of Weiss Architects, lighting typically has the greatest impact on interior AESS, whereas sight lines are the most important for AESS located on the exterior. Details are not as visible in high ceilings with low lighting, but when elements are brightly lit, they may tend to expose more texture and blemishes on the surface. The location and type of lighting with relation to AESS components should be determined prior to specifying the appropriate category.

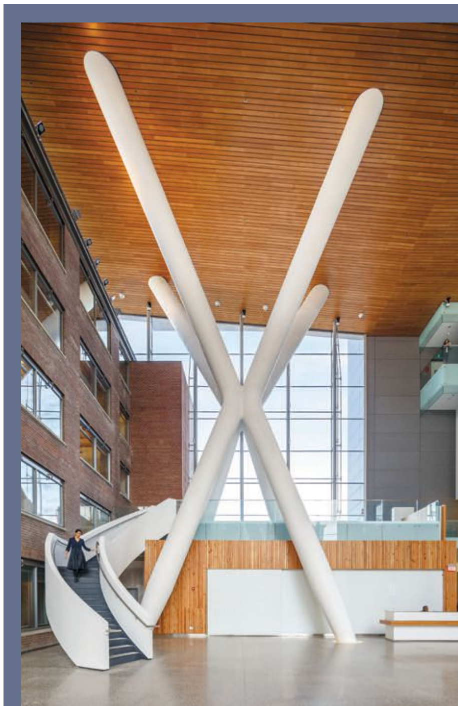
SMOOTH INTUMESCENT COATINGS

Intumescent-coated structural steel may inherently provide a smooth and uniform appearance for AESS components. Surface marks and blemishes are not apparent in this application of intumescent coating on exposed structural steel.

Intumescent-coated and painted connection detail, Michigan State University Wells Hall Addition, East Lansing, Michigan.

Photo courtesy of SDI Structures/Paul Dannels

Photo courtesy of CastConnex/doublespace photography



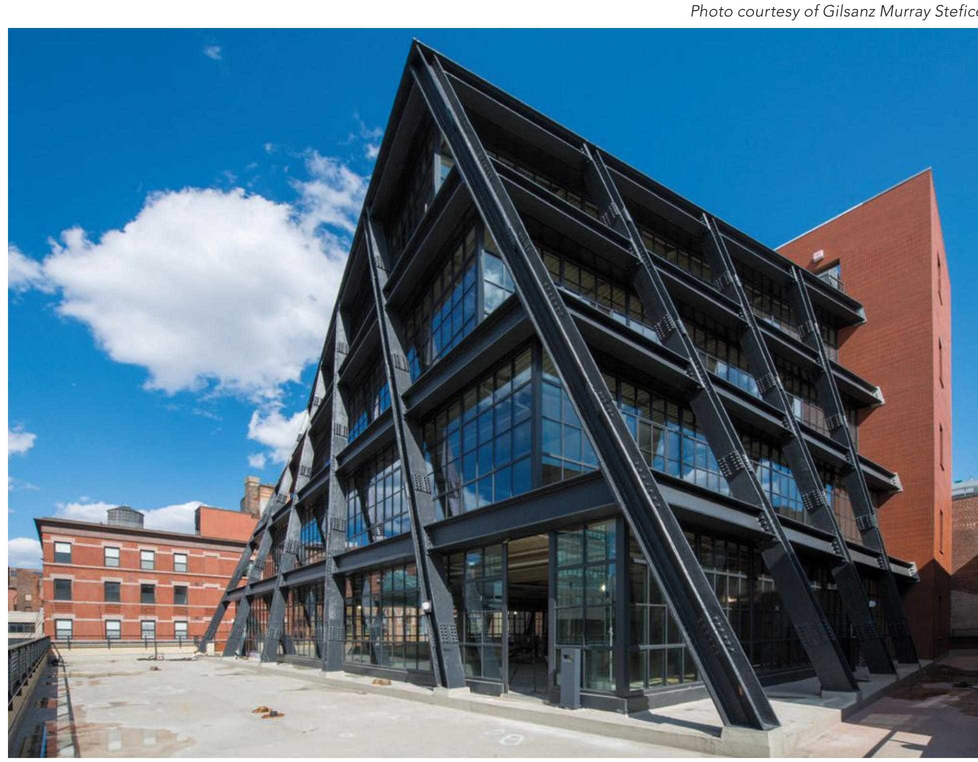
STEEL CASTINGS

The casting of steel technically falls under "other steel" per the 2016 AISC Code of Standard Practice. Exposed elements that are cast can support structural loads and connect to the structural frame, but typically do not fall within the same category requirements as listed under AESS. Different levels of surface finish may be specified by the designer, as related to the project budget, to achieve the final aesthetic.

Photo courtesy of Walter P. Moore/Brian Wancho (left); © Skidmore, Owings & Merrill LLP (right)

The Southwest University Park stadium represents a more tectonic style (left), emphasizing bolts and connections. The intersection of multiple AESS members in the close-up image of the Loyola's Institute of Environmental Sustainability Ecodome (right) are much more plastic, seamless, and smooth.

Photo courtesy of Gilsanz Murray Steficek



837 West Washington in New York City faced the challenge of designing to tight tolerances and straightness requirements so that all steel members would precisely align in this visibly twisting form. The exoskeleton structure is exposed to the exterior and requires additional applied treatment to prevent corrosion.

Coatings

The selection of a coating, whether it be paint or intumescent fire protection, should be coordinated with the location and lighting intent for an AESS member. "Glossy coats tend to show every imperfection and surface variation," says Larry Kloiber, PE, vice president at fabricator shop LeJeune Steel. A glossy coat combined with bright accent lighting within a close view range requires greater care and surface preparation for AESS. A thicker intumescent coating or matte finish tends to cover surface marks and blemishes, thereby reducing the need for certain characteristics of surface preparation to the steel. Kloiber stresses that it is always important to keep in mind how the material will be viewed, as it will impact the AESS category specified.

Style

There are two basic styles that govern the design intent with AESS: tectonic and plastic. A tectonic look is more expressive of the details that showcase the steel assembly and tends to emphasize bolted construction. A plastic aesthetic is uniform and smooth, using more welded or cast connections for a near-seamless appearance. The approach to the design style is an integral part of determining which AESS category is suitable based on the desired level of finish.

Adjacency

Structural steel is an ideal material for achieving tight tolerances, as it is fabricated with great precision. The 2016 AISC Code of Standard Practice distinguishes between standard tolerances and tighter tolerances with different AESS categories. Depending on the composition of the structure, tighter tolerances may or may not be necessary.

Several factors have a direct impact on the selection of an AESS category. Coordination during the design phase can be better facilitated by understanding the context that surrounds the expression of steel.

CHOOSING A CATEGORY

There are five categories which identify the level of AESS for a project:

- **AESS 1:** Basic Elements
- **AESS 2:** Feature Elements not in Close View
- **AESS 3:** Feature Elements in Close View
- **AESS 4:** Showcase Elements
- **AESS C:** Custom Elements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FOUNDED 1921
There's always a solution in steel.

Image courtesy of American Institute of Steel Construction (AISC)

AESS CATEGORY MATRIX

Identify AESS components specifically by category in the contract documents

***Reference Table 10.1 of the 2016 AISC Code of Standard Practice*

AISC COSP SECTION	I.D.	CHARACTERISTICS	AESS C CUSTOM ELEMENTS	AESS 4 SHOWCASE ELEMENTS	AESS 3 FEATURE ELEMENTS - IN CLOSE VIEW *view distance < 20 ft*	AESS 2 FEATURE ELEMENTS - NOT IN CLOSE VIEW *view distance > 20 ft*	AESS 1 BASIC ELEMENTS
10.4.11	**1.1**	Surface preparation to SSPC-6		x	x	x	x
10.4.11	**1.2**	Sharp edges ground smooth		x	x	x	x
**	**1.3**	Continuous weld appearance		x	x	x	x
10.6(f)	**1.4**	Standard structural bolts		x	x	x	x
10.4.8, 10.4.11	**1.5**	Weld spatters removed		x	x	x	x
10.1.1, 10.1.2	**2.1**	Visual samples		mock-up required	mock-up required	optional	
10.4.3(b), 10.4.5	**2.2**	One-half standard fabrication tolerances		x	x	x	
10.4.1	**2.3**	Fabrication marks not apparent		x	x	x	
**	**2.4**	Welds uniform and smooth		x	x	x	
**	**3.1**	Mill marks removed		x	x		
10.4.9	**3.2**	Butt and plug welds ground smooth and filled		x	x		
10.4.12	**3.3**	HSS weld seams oriented per *contract documents*		x	x		
10.4.3(a)	**3.4**	Cross sectional abutting surface aligned		x	x		
10.4.6	**3.5**	Joint gap tolerances minimized		x	x		
**	**3.6**	All welded connections		x	x		
10.4.12	**4.1**	HSS seam not apparent		x			
10.4.8	**4.2**	Welds contoured and blended		x			
10.4.7, 10.6(g)	**4.3**	Surfaces filled and sanded		x			
10.4.10	**4.4**	Weld show-through minimized		x			
10.1.1, 10.2(c)	**C.1**	<Per design: additional characteristics may be					
	C.2	added for custom elements. The AESS matrix					
	C.3	included in Table 10.1 of the 2016 Code of Standard					
	C.4	Practice shall be used to specify the required					
	C.5	treatment of elements.>					
commentary		*Estimated cost premium above standard structural steel*	*low to high*	*high*	*moderate*	*low to moderate*	*low*

Note: I.D. numbers correspond to adjacent AESS image chart. Table 10.1 (similar) of the AISC Code of Standard Practice.

More requirements and therefore typically greater costs are inherent as the AESS category number increases. AESS C is Custom and could require fewer levels of finish than Basic Elements in AESS 1, or go even further beyond what is included in Showcase Elements of AESS 4. When choosing AESS C, more information should be included in the drawings and specifications to clarify the intent. It is required that one or more of these five AESS categories be annotated in the contract documents when AISC 303-16 is referenced as a standard.

"Section 10 of the 2016 AISC Code of Standard Practice provides specifiers with a much clearer roadmap to convey what they are looking for," acknowledges Babette Freund with fabricator Universal Steel of North Carolina. Freund serves as chair of the Code of Standard Practice Committee to recognize and document standards within the U.S. structural steel industry to meet the expectations of design between fabricators and designers. Larry Kloiber, PE, who serves on the committee with Freund, encourages architects to consider the appearance they really need to achieve for the design intent prior to selecting an AESS category.

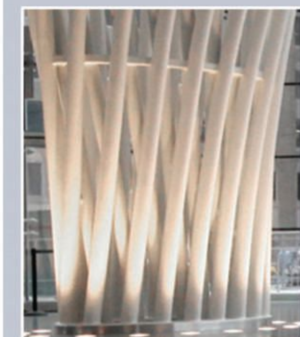
AESS 1: Basic Elements

By default, AESS 1 is the minimum treatment of exposed steel beyond standard fabrication of structural steel. This category is typically the lowest cost of the AESS categories and also serves as a prerequisite for AESS categories 2, 3, and 4. There are aspects of AESS 1 that meet the same requirements of standard fabrication. For example, the tolerances required for standard structural steel are the same for AESS 1 and can be referenced in the 2016 AISC Code of Standard Practice, available for free download at www.aisc.org/freepubs.

Surface preparation in AESS 1 is different from standard fabrication, as the exposed steel must receive commercial blast cleaning to meet the provisions of SSPC SP 6. The Society for Protective Coatings (SSPC) sets the standards for coatings and protection on structural steel. The SP 6 standard requires steel be cleaned of oil, grease, dust, oxides, rust, etc. In order to complete this surface preparation, weld spatter and similar surface discontinuities must be removed and sharp edges ground smooth. Specifications for paint and coatings should be thoroughly reviewed for use with the required surface preparation of AESS members.

Images courtesy of American Institute of Steel Construction (AISC), except as noted

AESS 4
SHOWCASE



PHOTOGRAPHY: BESS ADLER

4.1: Seams on HSS members are to be treated so they are not apparent

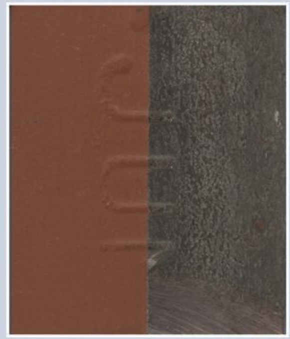
4.2: Welds between members are to be contoured and blended

COURTESY OF © SOM LLP

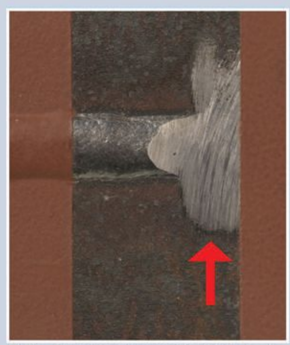
4.3: Surfaces are to be filled and sanded to achieve a smooth surface

4.4: Welding which shows through back side of components (left) is to be minimized (right)

AESS 3
FEATURE - IN CLOSE VIEW

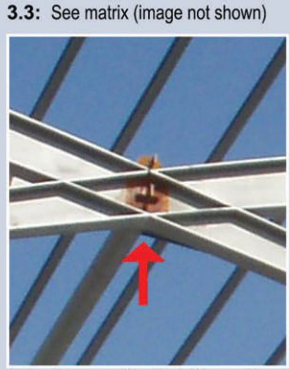


3.1: Mill marks, shown above, are to be removed from view



3.2: Butt and plug welds (left) are to be ground smooth (right)

3.3: See matrix (image not shown)



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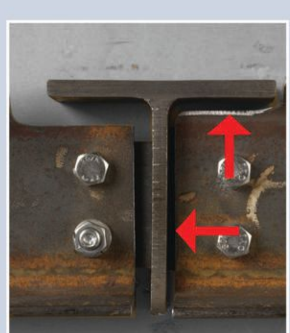
3.4: Cross-sectional abutting surfaces should align



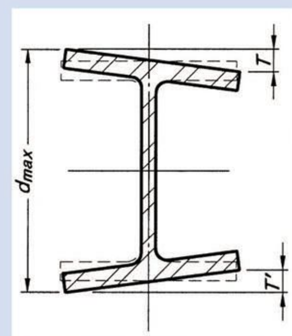
3.5: Gaps between joints are to be minimized (right) from standard gap tolerances (left)

3.6: See matrix (image not shown)

AESS 2
FEATURE - NOT IN CLOSE VIEW

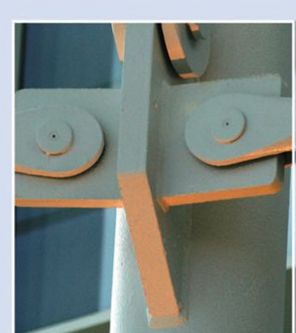
AISC AESS SAMPLE BOARD

2.1: Visual samples are optional in AESS 2 (i.e. 3D renderings, physical samples, mock-ups, etc)



2.2: Tolerances are one-half standard fabrication tolerances for structural steel

2.3: Member marking, shown above, during fabrication and erection are not to be visible



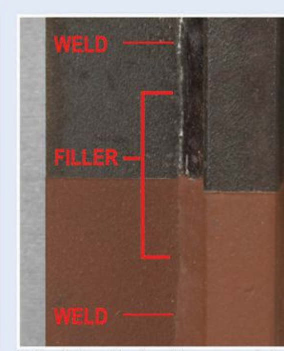
PHOTOGRAPHY: PAUL ASP

2.4: Welds are to be uniform and smooth

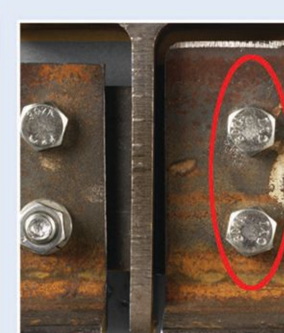
AESS 1
BASIC

1.1, 1.5: Grease, oil, weld spatter, and surface discontinuities removed

1.2: Rough surfaces are deburred and ground smooth



1.3: Intermittent welds are made to appear continuous



1.4: bolt heads on connections are on the same side, consistent from one connection to another

Note: Reference adjacent AESS Category Matrix for I.D. numbers and characteristics.

Consistency of appearance between components is also a key strategy when specifying AESS. The AESS 1 Category requires that bolt heads be consistently located on the same side of a member as well as on adjacent steel members. The goal is to provide a uniform appearance beyond the standard requirements of structural steel.

When steel components are welded together, there may not always be a need for a continuous weld per the structural design. Visually, however, the appearance of a continuous weld is more desirable than intermittent welds. AESS 1 requires that all welds are to appear continuous and can be caulked, filled, or additionally welded to achieve this look. The projection of welds can be no higher than $^{1}/_{16}$ inch above the surface.

AESS 2: Feature Elements not in Close View

It is important to recognize that details are much less visible at 20 feet away as compared to an element 5 feet away. AESS 2 serves a level of fabrication and erection specific to structural steel elements viewed from a distance greater than 20 feet. The intent of creating such a distinction is to establish the same level of expectations for elements that are deemed as AESS but are located further away. The cost range is typically higher than AESS 1, as it builds on the characteristics of the basic elements in addition to meeting more requirements.

AESS 2 is more refined than AESS 1, as it mandates fabrication tolerances for straightness be half that of standard requirements. This is especially important when adjacent materials and components must closely integrate with steel members in a design.

During fabrication and erection, steel members are marked for inventory and tracking purposes. These numbers are visible on the steel even through certain coatings unless AESS 2 or a higher category is specified. The marks can either be ground out, filled, or simply turned away from view.

Continuous welds are already included with AESS 1, but AESS 2 goes a step further by requiring greater consistency in the welding process. The latter expects additional care and refinement during fabrication and erection. AESS 2 calls for uniform and smooth welds, which entails a consistent appearance on all welds in view range but does not necessarily deem welds are to be ground smooth.

AESS 3: Feature Elements in Close View

A higher level of fabrication and erection is provided as the number of AESS category increases. AESS 3 represents the next level of characteristics, specifically for components within a viewing distance of 20 feet or less. This category includes all the requirements for AESS 1 and 2 along with a more specific attention to detail as exposed elements are visibly closer.

Steel is marked with slightly raised characters, called mill marks, when it is delivered to a fabricator from the mill. Mill marks identify the steel mill from which the component was produced. A raised or depressed surface on structural steel members is also created with butt and plug welds. These marks and visible welds are deemed undesirable in AESS 3 and are required to be removed from view, typically by grinding them out or filling any depressions. Grind

Photos courtesy of American Institute of Steel Construction (AISC)

Numbers are etched into a steel beam (left) during the fabrication process. After receiving a painted finish coat in the shop, the tracking number for the project can still be seen.

Photo courtesy of American Institute of Steel Construction (AISC)

Mill marks from Steel Dynamics Inc. (SDI) are visible through the painted finish on this structural steel member.

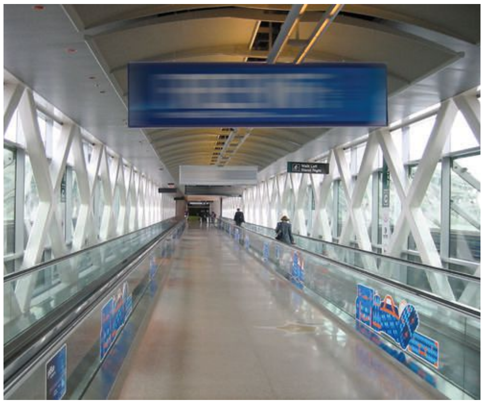
WHEN TO SPECIFY A MOCK-UP

AESS 3, 4, and C all require mock-ups unless providing one is impractical and other visual samples can suffice. “The key to a mock-up is to set expectations for shop work and fieldwork,” notes Steve Weiss of Weiss Architects. He goes on to say, “Mock-ups show the capability of worker craftsmanship in a particular shop. If [an assembly] is to be created in the field, then the mock-up should also take place in the field with the same contractors doing it under the same field conditions.” Lighting and placement impact the appearance of AESS, therefore similar conditions should be replicated when reviewing a mock-up for finish.

In general, as schedule and budget permit, mock-ups or visual samples are recommended for all categories. Shaina Saporta, PE, of ARUP, notes that majority of her projects involve AESS located in exterior conditions. Saporta encourages specifying physical mock-ups for larger, more complicated projects. She advises, “It will cost more in the long run if you do not do [a mock-up].”

Table 10.1 in the 2016 AISC Code of Standard Practice breaks down the requirements of each AESS category. An example of Table 10.1, AESS Category Matrix, can be found later in the course. The table denotes visual samples as optional for categories AESS 2, 3, and 4. Visual samples are a broad category inclusive of full-scale mock-ups, mock-ups of connections only, finish samples, 3-D renderings, photographs representing built AESS categories, and more. Fabricator Babette Freund of Universal Steel of North Carolina suggests tours of existing AESS projects and visual examples as methods to help communicate expectations for delivery of the desired finished product. There are multiple approaches to establish a basis of expectations during construction. To determine what level of visual sample is necessary, each project should take into consideration what ultimately needs to be achieved.

Photos courtesy of American Institute of Steel Construction (AISC)



Weld seams are to be less visible and consistently located in AESS Category 3. A series of intersecting hollow steel sections are visible along the pedestrian bridge (left) at Boston Logan International Airport. A close-up view (right) slightly shows the weld seams, which have been ground out consistently at each architecturally exposed member and coated with intumescent paint.

Photo courtesy of Walter P. Moore/Bob Perzel

MULTIPLE CATEGORIES IN ONE APPLICATION

It is commonplace to apply multiple AESS categories per project and per space. AESS 3 may be specified for elements within a close view range, whereas AESS 2 may be used for high ceiling elements. Provide clear notes on the contract documents to distinguish the location of different AESS categories. To reiterate, typically the architect will provide the design intent and location but should coordinate the documentation with the structural engineer's drawings and specifications.

Multilevel open concourses highlight the efficient use of multiple AESS categories in one space. The Sprint Center in Kansas City, Missouri, was completed prior to the implementation of the categories. Analysis of the space from eye level may imply AESS categories 1, 2, and 3 were used in the large concourse.

marks on exposed steel are easily visible, but applying a surface coating nearly or completely eliminates their appearance.

A weld seam is typically apparent when steel is joined together by welding. Welds are required to be continuous and consistent in appearance as noted in categories AESS 1 and 2. It is required that weld seams are to be less visible in AESS 3, as these elements are much closer in view range. Hollow structural steel (HSS) often includes weld seams as a typical method of connecting steel. An option to reduce visibility of seams is to simply orient them away from view. When such a strategy is not available, then aligning the seams in a consistent manner across all members is another solution. There are multiple methods of fulfilling this requirement, some which are less costly than others.

When two cross sections of steel come together, such as a column splice with connection plates, it is critical the sections align when in close view range. Lighting showcasing an AESS component can expose misaligned surfaces in an obvious and undesirable manner. AESS 3 specifically addresses components within range of touch or within closer view distances up to 20 feet away. Misalignments are not acceptable and require greater care in fabrication and erection to avoid these issues at cross-sectional surfaces that abut one another.

The tolerance for straightness must be tighter than the standard level, as noted under AESS 2. Tolerance requirements in AESS 3 go further to minimize the gaps between the components that have bolted connections. Greater precision during fabrication and erection is required so that these gaps are no greater than $\frac{1}{8}$ inch and are uniform among all adjacent components.

The appearance of a bolted connection is not always desirable, especially when trying to achieve a seamless, "plastic" look. Determining the style of aesthetic is a prerequisite of choosing the appropriate AESS category. AESS 3 includes an option to utilize all-welded connections or reduce in the appearance of bolts. This can be achieved by coordinating the design intent with the structural engineer to use only welds for a

Photo courtesy of SDI Structures

BENDING STEEL

Expressing curved steel is an art form, both in design and fabrication. The Robert B. Aikens Commons at the University of Michigan represents an artistic approach of structural elements supporting a glassy skylit roof. As the column supports extend to the roof, the branches curve and taper into delicate forms to lighten the space as it moves upward. Curved structural steel members typically go through a fabrication process called bending and rolling. Designers should discuss the design intent of curving steel in an AESS project early on with specialty fabricators known as bender-rollers. The tooling process for curved steel can sometimes cause scratches or blemishes on the surface, which can be addressed in the specifications. Early involvement with a steel fabricator will assist in setting the appropriate expectations for the final product, including special care and handling for curved AESS.

"All cold rolled members experience some type of distortion in the forming process," notes Ken Pecho of Chicago Metal Rolled Products. "Square and rectangular shapes are more than able to curve to AESS tolerances, but producing a circular shape to create complex geometries is much easier." The radius of curvature impacts the type of steel member used in the process. Pecho advises specifying thicker steel members to avoid visible distortion or deflection issues for AESS components. The 2016 AISC Code of Standard Practice addresses specific requirements for AESS curved steel. Camber and sweep tolerances for any curved steel members are to be equal or less than standard tolerances for straight members.

particular connection. An alternate solution may be to hide the bolts by placing cover plates over them, a detail which should be clearly expressed in the contract documents.

AESS 4: Showcase Elements

The sculptural nature of steel is meant to be the main focus when specifying AESS 4. This category draws inspiration from the expression of form as the featured aesthetic in a project. Making material connections appear seamless in a project can sometimes be the most challenging to design and construct. The latter is also true of structure, especially when architecturally exposed structural steel is to have a very smooth and sleek finished appearance. It is generally understood that AESS 4 components may entail the highest premium over the previous categories, not only per the desired "glove" smooth finish, but more often due to the complexity of structural geometry. The design approach should be discussed between the architect and structural engineer in advance of selecting the AESS category.

The characteristics of the previous categories, AESS 1, 2, and 3, are all included with the selection of AESS 4. In AESS 3, it is acceptable to reduce the visibility of weld seams. The "glove" smooth finish desired for showcase elements in AESS 4 necessitate that weld seams are no longer visible. Certain structural steel shapes and sections, such as pipes or some types of hollow structural shapes, lend themselves to have fewer or no seams. If at all possible, turn the seam away from view for the most cost-effective strategy.

The smooth and contoured appearance of welds enhances the style of the more plastic look of AESS 4 components. Majority of steel designs in this category focus less on bolted connections and implement more welded connections for a seamless aesthetic. There are cases where welds may show through the back face of an exposed steel element. Locations where welds show through to the other side of the AESS component are to be addressed to reduce their undesirable appearance. Open holes placed in the steel members, often for the welding process, are to be closed off and smoothed out for a clean, finished surface.

More labor and time is often necessary during fabrication and erection to achieve the quality of AESS 4 compared to the previous categories. Surfaces that are in view range are to be free of imperfections. Filling any deviations with a body filler as well as sanding textured surfaces are methods of fabrication used in this category. This higher level of care and detail allows for glossy coats on steel to be a truly successful aesthetic in close view range, as depicted in the Brookfield Place Entry Pavilion in New York City.

AESS C: Custom Elements

Any deviation from the requirements of AESS 1, 2, 3, and 4 falls under the Custom category AESS C. Occasionally, there are situations when sharp edges do not need to be ground smooth or erection and painted marks are not required to be removed from view. Allowing this flexibility in choosing characteristics provides designers with greater freedom but also notifies steel fabricators and erectors that there is a noteworthy difference from the typical category requirements. Custom elements should be clearly defined in the contract documents with AESS C located as needed.

The 2016 AISC Code of Standard Practice recommends using Table 10.1, similar to the AESS Category Matrix shown previously in the course, as a checklist for architects to coordinate or customize AESS requirements with structural engineers. The matrix should be used to specify special requirements for AESS C in the contract documents.

THE LAST PIECE

The last portion of the AESS process is just as critical as a well-coordinated design phase. The 2016 AISC Code of Standard Practice addresses requirements for erection of AESS in Section 10. The higher-quality finish and treatment of AESS necessitates extra care and handling during transit and placement. The timeline for erection may be slightly longer when AESS is specified on a project. Erectors are tasked with assembling the steel with careful planning and methods to avoid damage to the finished product.

CONCLUSION

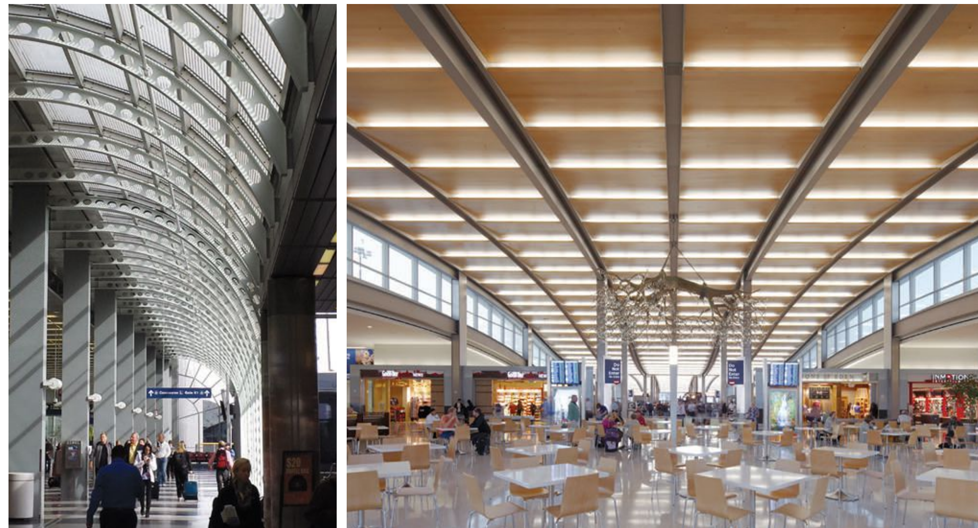
The decision to architecturally expose structural steel can add significant value to a building. Improvements in the 2016 AISC Code of Standard Practice satisfy the desire to create efficient and cost effective measures when implementing AESS on a project. The five categories (AESS 1, 2, 3, 4, and C) that distinguish architecturally exposed structural steel require sufficient evaluation and coordination in order to meet project expectations within budget and schedule. Establishing the same level of expectations between owners, architects, engineers, general contractors, fabricators, detailers, and erectors is critical to achieving the best end results for a project.

RESOURCES

- "Exposing the Beauty of Steel." American Institute of Steel Construction. 2016. <www.aisc.org/aess>.
- Section 10: Architecturally Exposed Structural Steel. 2016 AISC Code of Standard Practice. <www.aisc.org/freepubs>.
- CISC Code of Standard Practice for Structural Steel. Canadian Institute of Steel Construction. Seventh Edition, 2009. <www.cisc-icca.ca/files/publications/techpubs/codes/csp/codestandardpractice7eng.pdf>.
- Boake, Terri Meyer. "CISC Guide for Specifying Architecturally Exposed Structural Steel." Canadaian Insitute of Steel Constrcution. Second Edition, 2012. <www.cisc-icca.ca/files/publications/techpubs/codes/AESS/AESSGuide2E.pdf>.
- Architecturally Exposed: Understanding the Art and Science of Architecturally Exposed Structural Steel. American Institute of Steel Construction. <steelday.org/aessvideo>.

Continues at bit.ly/K1611B

Left: Photo courtesy of American Institute of Steel Construction (AISC); Right: © Tim Griffith



Daylight penetrates through the interior of both the United Airlines Terminal at O'Hare International Airport in Chicago (left) and the Sacramento International Airport, Central Terminal and Concourse B Expansion (right).

CASE STUDY: TRANSFORMING AIRPORT DESIGN

Travel by commercial flight has grown considerably in the past few decades. This popular form of transportation has given designers the challenge of expressing lightness and airiness now commonly represented in airport design. Trends of integrating architecturally exposed steel in public spaces and airport terminals have grown since the design of the United Airlines Terminal at O'Hare International Airport in Chicago. Curved steel beams throughout the United Airlines atrium and passenger terminal support a sky-lit roof. The circular openings within the beams allow for light to filter through the space and create different patterns on the walls and floors throughout the day. Exposing the structure created the appearance of thinner and more slender elements, supporting the building and creating more space in the interior. O'Hare is a classic example of how AESS is integral to the design and serves as a prominent, visible feature.

More recently, the concourse and terminal at Sacramento International Airport was expanded to enhance the experience of travelers navigating through the airport. Large column-free spaces, sky-lit roofs, clerestory windows, and architecturally exposed structural steel create a world-class environment to greet passengers in Concourse B and the Central Terminal. It was critical for the project team to develop the aesthetic and structural requirements in tandem in order to achieve the design goals with efficient methods of construction. Due to the scale and complexity of the design, two steel fabricators were contracted for the project. Herrick Steel and Schuff Steel fabricators worked directly with the architects and engineers to achieve the higher-quality appearance of AESS with a framing system governed by high seismic requirements. The connections between steel members were critical to the seismic design, but exposing them architecturally added additional challenges. Custom solutions necessitated a peer review process to ensure code compliance in the structural design. The fabricators created custom equipment to assist in the welding process of the curved girders supporting the roof. Temporary bracing, which can often leave behind blemishes and unwanted surface appearance, was minimized as much as possible with careful planning for the erection process. Multiple levels of AESS were used throughout the project, though at the time of design and construction the category system was not in place.

Coordination between disciplines is critical to the success of any project utilizing AESS. Understanding the level of expectations in fabrication is much simplified by selecting categories to convey the design intent. Early involvement with steel fabricators and the design team can assist in project development and lead to efficient and cost-effective solutions.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CIRCLE 102

The Core of the Matter

Leveraging steel-braced cores for material savings, expedited construction, and simplified trade coordination

Sponsored by The Steel Institute of New York | *By Barbara Horwitz-Bennett*

Supporting a sophisticated steel building core, Arup innovated a unique design of viscous dampers for a 40-story office tower at 250 West 55th Street in Midtown Manhattan. Attached to a series of outriggers that connect the core to the building perimeter, the dampers add additional stiffness.

Photo courtesy of Arup/Kevin Chu

The structural design for many of today's commercial buildings is frequently focused on the building core, especially in the choice of materials used to construct it. Usually a fixed programming zone that does not obstruct things like views and mechanical equipment placement, the building core is a convenient place to satisfy the structure's wind and seismic requirements.

"We have found that the geometry of the core aligns well with the geometry required by the lateral loads," relates Mark P. Sarkisian, PE, SE, LEED, partner, SOM, San Francisco. "Beyond structural, the core can also provide greater resilience, particularly for egress in emergency situations."

While the choice of building material for the core is dependent upon a variety of factors—including the height of the building, the size of the floor plate, and site logistics—a strong argument can be made for choosing steel-braced cores over their concrete alternatives.

CONTINUING EDUCATION

1 AIA LU/HSW

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Learning Objectives

After reading this article, you should be able to:

1. Explain the various reasons why structural steel is an ideal material to meet the lateral loads and wind and seismic requirements supported by the building core.
2. Identify the safety and durability benefits of various long-standing steel core systems, including X-bracing, outriggers, and damping systems.
3. Discuss the latest data and applications on newer systems, including steel plate sheer walls, composite systems, and pin-fuse frames.
4. Describe case study applications where the different steel-braced systems were successfully applied.

To receive AIA credit, you are required to read the entire article and pass the test. Go to **ce.architecturalrecord.com** for complete text and to take the test for free.

AIA COURSE #K1611G

Offering a bit of history, Matt Jackson, PE, SE, associate, Arup, New York, relates that early high-rise towers were steel framed, generally with rigid connections between columns and beams, in order to create a stiff frame to resist the wind loads. "As the design and analysis techniques developed, and the height of towers increased, it was found that in most cases, bracing added around the core was a more efficient way to carry the wind loads, and this allowed for less steel weight, and lighter columns and beams, as compared to a moment frame system."

"Steel-braced frames have been designed for decades with stiffness suitable for even the tallest buildings," reports Charlie Carter, PE, SE, vice president and chief structural engineer, American Institute of Steel Construction, Chicago, citing the Windy City's John Hancock Building and Hong Kong's Bank of China Building as two well-known examples.

As a lighter material, a steel-braced core supports a smaller foundation and a more efficient speed of erection, thereby impacting construction schedules for the better. For example, Arup recently started work on a 16-story building in New York City. The engineers and project team chose to go with all-steel construction because the ground conditions are very challenging, so keeping the building weight to a minimum was a big driver.

"Cycle time is paramount in tall building construction, and steel framing can typically be erected much quicker than concrete can be formed and poured," adds Tim Santi, principal, senior project manager, Walter P. Moore, Atlanta.

Attaching steel to steel is also more efficient than connecting steel to concrete, and larger floor spans from the steel core wall out to the glass facade can be achieved, explains John D. Hooper, PE, SE, senior principal/director of earthquake engineering, Magnusson Klemencic Associates (MKA), Seattle.

"Concrete systems work to tolerances that are measured in whole inches, whereas steel systems work to tolerances that are fractions of an inch," adds AISC's Vice President John Cross, PE.

Santi also points out that when concrete cores are used in conjunction with a steel-framed floor, embedded plates must be cast within the core, which can be a challenge for many builders to place properly. And when it comes to supporting future service penetrations into the core, in the space between braces, a steel core is much more forgiving and flexible, as compared to the expense involved in cutting or drilling into a concrete core.

Of course, another big advantage with steel-braced cores is avoiding the complexity and additional time involved in dealing with two trades—one erecting a steel structure, while the other works to form a concrete core.

"For low- and mid-rise steel buildings, steel bracing is likely to be the most economical solution, as the main structure is installed in one go, with no separate operation to form the concrete for the core," reports Jackson.

In fact, steel-braced cores have largely been adopted as the go-to solution in New York City, where speed of erection and construction efficiencies are priorities. "NYC has become very efficient at erecting steel framed cores for steel framed building," notes Jackson.

Although construction practices have improved over time, the safety issue of contractors placing concrete for the core above where ironworkers are erecting the steel frame still exists. In New York, this can result in project slowdowns. Modular concrete cores eliminate this problem entirely, as their erection is typically under the jurisdiction of the ironworkers. In most cases, components of these cores are manufactured off-site in custom molds, then quickly installed on-site. Because shafts are manufactured as a series of boxes, temporary structures are minimized during installation. These cores can be designed as shear walls to provide lateral stability, or as an efficient replacement for block-work or poured-in-place concrete. Working with a crane, the installers can also ensure that all components, including elevator channels and control panel recesses, are positioned precisely. According to one supplier, capping slabs are also designed with all temporary and permanent anchors cast into the concrete, ensuring safe installation of other mechanical and electrical components.

X MARKS THE SPOT

While steel-braced core technology has advanced significantly in recent years, now providing building teams with various options, one of the most long-standing systems still in use is X-bracing.

Delivering both tension and compression on both sides, thanks to the symmetrical X-brace, the system is an efficient way to support a building's lateral loads. While it can be applied to core, its diagonal members will obstruct the building's views and fail to deliver sufficient stiffness to the structure, so this core approach is typically limited to lower-rise facilities with few openings.

"X-bracing is typically avoided in core framing," confirms Eli B. Gottlieb, PE, senior principal, Thornton Tomasetti, New York City. "The X-brace layout results in gravity loads traveling through the braces in an indeterminate manner that results in additional material being required for the project. While that geometry is very efficient, for lightweight structures, it is often undesirable in the core of a tower."

However, applying the X-bracing to the outside curtain wall—as clearly seen in the Hancock Building—is commonly done. Lending an interesting aesthetic to the exterior, keeping the views intact, and providing additional stiffness, the exterior X-brace frame has traditionally been a common choice.

At the same time, more recent steel-core innovations have opened up the range of possibilities, offering better costs, construction schedules, and more leasable square feet.

STEEL PLATE SHEAR WALLS

For example, steel plate shear walls (SPSW) embrace the same concept as a braced core, only instead of a diagonal member, a steel plate is used.

"By welding a steel plate to the beams and columns, you've created a steel plate all made of steel. It can be as stiff as a brace, while using less materials because it's thinner," explains Michel Bruneau, Ph.D., PE, professor, department of civil, structural, and environmental engineering, University at Buffalo, Buffalo, New York. "It's also thinner than the concrete walls and offers more occupiable square footage."

With a plethora of steel plate manufacturing facilities on the market, the flat material is made in abundance. "You can prefabricate the plate and bolt it into place," explains Sarkisian. "Stitching the columns together with the plates, even one step behind the erection of the columns, makes for a very efficiently constructed system that doesn't require welding."

Offering a number of advantages over conventional bracing, Gottlieb relates that SPSW are better at providing a ductile frame for seismic energy dissipation and providing a thinner profile for potentially more floor area. "For fabrication and construction, the connections are simple and clean, as the panels are rectilinear elements, ideally bolted into positions, although for higher loads, welded joints may be required."

With thinner-plate walls, additional strength is provided from the tension-field action created by their design, according to Carter, but SPSW can also be designed as thick-plate walls, which are designed based upon plate yielding.

Offering his opinion, Mark Garland, PE, president of the Toronto-based construction management firm LCL BUILDS, explains that the performance of a steel plate shear wall is significantly enhanced if the steel plate is made thinner, and outfitted with Nelson studs, when used to function as a form for the concrete shear wall.

When furnishing SPSW, Hooper stresses the importance of making the plates as modular as possible coming from the fabrication shop. This includes minimizing or even eliminating the need for complete joint penetration welds so that these connections are minimized as much as possible on-site. "Otherwise, these welds take a lot of time and are difficult to do up in the air."

If building teams are looking for guidance, AISC's *Design Guide 20: Steel Plate*

Photo courtesy of SOM

As the world's tallest steel shear wall building, the 75-story Jinta Tower in Tianjin, China, utilizes perimeter and core ductile moment-resisting frames and outrigger and belt trusses to withstand seismic and wind forces.

Shear Walls, authored by Bruneau and Rafael Sabelli, SE, director of seismic design, Walter P. Moore, San Francisco, is a good resource. "Anything you wish to know about SPSW is pretty much in there, including lots of research," says Bruneau.

In addition, AISC's *Seismic Provisions for Structural Steel Buildings* offers guidelines such as standard thickness for plates. "We go beyond what the specification requires, as we're dealing with a lot of high seismic projects in California," relates Hooper.

MKA uses the latest data on SPSW performance to help inform their designs, taking advantage of test results conducted by universities like Purdue and State University of New York Buffalo State.

While AISC is in the process of updating its seismic provisions document, that guideline won't be available until 2017. In the meantime, Bruneau's textbook, *Ductile Design of Steel Structures*, is a helpful reference with a lot of up-to-date information on SPSW, as well as other steel-braced core options.

CHINA'S JINTA TOWER

For the Jinta Tower in Tianjin, China, described as the world's tallest steel shear plate wall building at 75 stories, the building team, led by SOM, evaluated a number of options for the core before selecting a SPSW system.

In particular, an all-concrete dual system with perimeter moment-resisting frames and core shear walls was ruled out because the large shear wall and column sizes would have decreased the rentable area, and consequently the project's financial viability.

Composite concrete and steel plate shear walls were also considered, but ultimately, there was insufficient research and testing data—addressing specific features of the project—to satisfy the authorities. Meanwhile, dual steel systems with braced cores would have required as much as 20 percent to 25 percent more steel. So ultimately, SPSW proved to be the most appropriate choice.

For the very slender, uniquely shaped skyscraper, with an overall aspect ratio of close to 1:8, SPSW also delivered an efficient lateral system capable of resisting significant wind and seismic lateral loads, while keeping wind-induced lateral drifts and oscillations under acceptable limits.

Altogether, the main lateral force-resisting system consists of a frame-shear wall system with perimeter and core ductile moment-resisting frames and core SPSW linked together with outrigger and belt trusses. As for the ductile moment-resisting frames, in an American Institute of Physics (AIP) Seismic Engineering Conference white paper, "Steel Plate Shear Walls: Efficient Structural Solution for Slender High-Rise in China," authored by Sarkisian and his SOM colleagues, the frames are described as concrete filled steel pipe composite (CFT) columns and structural steel wide-flange beams. Similarly, the SPSW are CFT columns and structural steel wide-flange beams in-filled with structural steel plates.

To ensure that the perimeter columns resist overturning, outrigger trusses are placed in the short direction of the tower plan. Meanwhile, belt trusses at the outrigger levels work to better distribute the axial loads resulting from outrigger action among the perimeter columns. Four sets of outrigger and belt trusses are positioned at the mechanical levels, and strengthened diaphragm slabs are used at the outrigger levels.

"The columns are circular, and the framing is built up with plate running two-thirds the height of the building and then changes to a braced frame," relates Sarkisian.

As explained in the AIP conference white paper, "The building frames are designed to carry gravity loads while neglecting the contribution of the SPSW plates, which ensures that the building frames have sufficient capacity to support the gravity loads during seismic events when the plates could experience buckling due to the development of the tension-field action."

The SPSW plates were sized to respond elastically without tension-field action or buckling from the region's frequent earthquake loads and wind loads. In the event of a moderate earthquake, tension-field action is expected to be the primary lateral load resisting mechanism in the SPSW plates.

LA LIVE PROJECT

Delivering more programming space than thick concrete walls were capable of doing, SPSW were selected for the core of the LA Live project in Los Angeles to resist lateral loads, add stiffness, support seismic needs, and decrease gravity loads. Combining hotel rooms and condos, the Gensler-designed dual towers stand 26 stories and 29 stories, respectively.

Specified by structural engineer Nabih Youssef Associates, unstiffened thin steel plates—ranging from ¼ inch to ⅜ inch thick—inside fully welded unreinforced flange-welded (WUF-W) connected moment frames act as boundary members. As described in an AISC case study, the infill plates buckle in shear and form a diagonal tension field, which resists lateral loads and delivers a high level of post-buckling ductility.

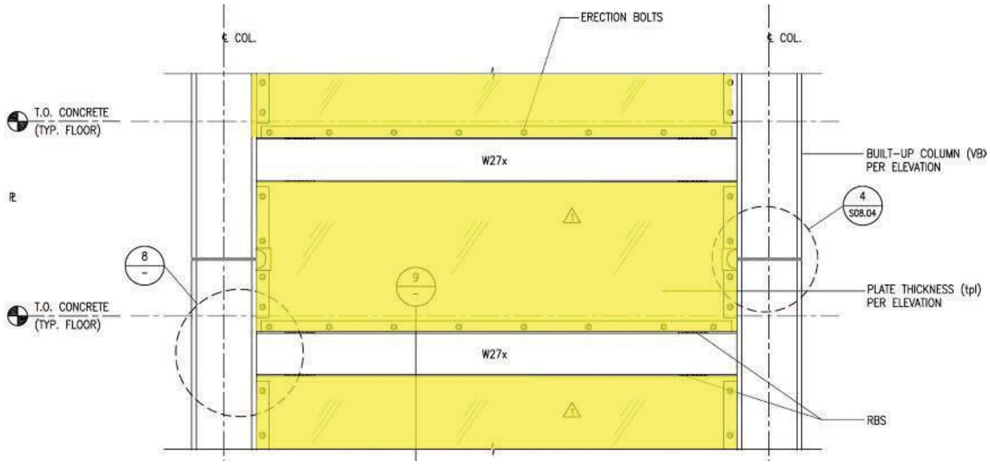
In absence of a centralized core of walls and due to the fact that the 26-story tower floor plan is designed as a "T" shape, the steel plates work to "tune" the stiffness of the separate wings.

Further limiting building drift, outriggers designed at mid-height and the roof level work to reduce the aspect ratio from 20:1 to 10:1. Buckling restrained braces (BRBs), some as large as 2,200 kips, are applied as fuse elements to control the maximum forces the outrigger trusses are capable of imposing upon the surrounding elements. Although this is no longer the case, at the time when the towers were designed, the BRBs bore the distinction of being the largest applied global system to be tested.

In addition, the ⅜-inch-thick steel plate shear walls add significantly more usable square footage than 3-foot-thick concrete core walls are capable of delivering.

Images courtesy of Nabih Youssef Associates

Offering more programming space than concrete, Nabih Youssef Associates specified steel plate shear walls to resist lateral loads, add stiffness, support seismic needs, and decrease gravity loads for the LA Live project in Los Angeles.



The unstiffened thin steel plates inside fully welded WUF-W moment frames are between ³/₈ inch and ¼ inch thick and act as boundary members for the LA tower. The infill plates buckle in shear and form a diagonal tension field, which acts to resist lateral loads and offers a high level of post-buckling ductility.

RIGGING UP WITH OUTRIGGERS

The taller a lateral system is, the harder it is to control lateral movement in a building, so outriggers are a good way to boost the stiffness and strength of the core.

"Outrigger systems can provide a lot of additional stiffness to a core by effectively mobilizing the perimeter columns, and hence the overall width of the building, to resist the overturning forces from the wind," adds Jackson. "Due to this increase in width that they can mobilize, less steel is needed to provide the same stiffness."Defined as braces connecting the outside of a building structure to the inside, outriggers work to keep a building's aspect ratio to between 12:1 or 13:1, to prevent the building from moving too much.

Comparing an outrigger to the process of people losing their balance and reaching out to brace themselves, Cross explains that the outrigger leans on the gravity framing to help secure the building.

▶ Continues at ce.architecturalrecord.com

Barbara Horwitz-Bennett *is a trade press journalist who has covered the design and building industry for the past 17 years. She contributes regularly to a number of leading architectural publications.*

Photo courtesy of Echelon Masonry

Masonry Wall Systems Well Positioned to Meet Evolving Codes

New technology ups masonry's high-performance quotient

Sponsored by Echelon™ Masonry by Oldcastle

A wall is a complicated thing. It can keep a structure warm or not; let moisture in or not; improve occupant comfort or not; serve as an effective structural element or not; and be efficiently constructed and installed or not. A wall combines all of these features to play a major part in determining the energy efficiency and ultimate performance of a structure. Designers have numerous options in creating effective walls, and the government along with industry organizations have set guidelines to improve wall design practices to help reduce impacts of the built environment.

A worthy goal to be sure. Widely publicized and accepted statistics point toward the impact of buildings on energy use and the environment. The World Business Council for Sustainable Development (WBCSD) maintains that buildings account for 40 percent of the world's energy use.[1] Besides using more energy than any other sector of the U.S. economy, in the United States, buildings account for approximately 70 percent of electricity consumption, 40 percent of CO_2 emissions, and 14 percent of potable water consumption.[2]

Accordingly, greener targets, codes, and regulations have evolved. Energy codes are regarded as one of the quickest, most economical and cleanest ways to reduce energy use in the built environment and help ensure a sustainable future. Not only do energy codes reduce needless energy consumption and help protect the environment, they provide common benchmarks that drive new designs and technologies.

Among the most promising of these new technologies from an energy-efficiency perspective are preassembled masonry wall systems. Of course, the history of masonry is as old as

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Learning Objectives

After reading this article, you should be able to:

1. Explain why energy codes are important to the building industry and how they have affected the built environment over time.
2. Discuss the prevailing energy codes and how they work together to achieve increasingly stringent energy objectives.
3. Identify the characteristics of a code-compliant, high-performance wall.
4. Describe the ways in which masonry wall systems can work to meet code and result in other efficiencies.

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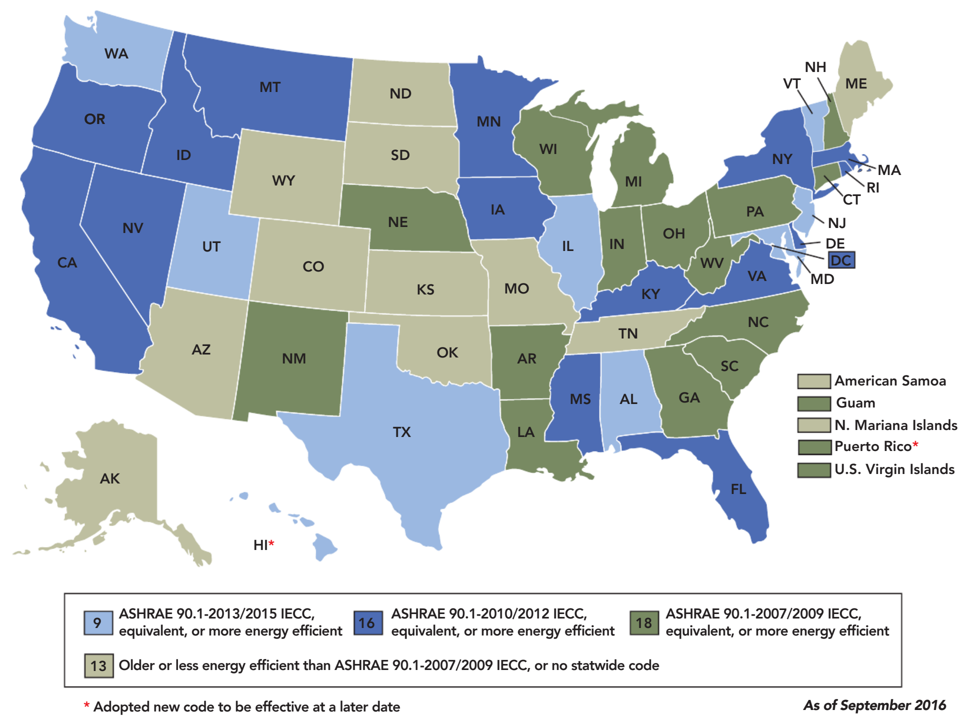
the history of architecture itself. The pyramids, the Colosseum, and Notre Dame are all iconic masonry structures that have endured for centuries. Historically, masonry has been used for its longevity and low life-cycle cost, its permanence and quality, and its aesthetic value. But what's new here are today's masonry wall systems, which incorporate the inherent characteristics of masonry along with improved quality control, more advanced construction methods, a better understanding of masonry's properties, and more sophisticated design. This course will review relevant code considerations, focusing on these new masonry wall systems, and how they've become a game changer in meeting and exceeding prevailing energy targets.

Source: EnergyCodes.gov

State Energy Code Adoption



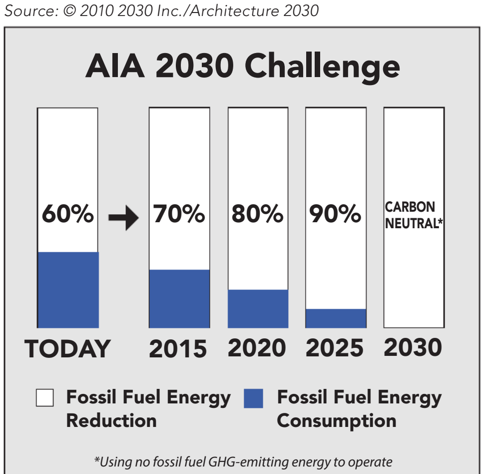
EVOLVING ENERGY TARGETS: THE BASICS

There are a plethora of energy codes and rating systems today, and making sense of them can be a labyrinthine and time-consuming undertaking. The critical theme, however, is that all of the codes are moving toward more stringent energy targets and higher R-values. A few of the major initiatives and code families are discussed next.

Architecture 2030

Composed of several industry groups including the AIA, Architecture 2030 issued The 2030 Challenge, calling for a dramatic reduction in greenhouse gas (GHG) emissions by changing the way buildings and developments are planned, designed, and constructed. The ultimate objective: carbon-neutral buildings by the year 2030. Interim goals are also targeted: fossil fuel reduction for all new buildings and major renovations, which was increased to 70 percent in 2015, 80 percent in 2020, and 90 percent in 2025.

Source: © 2010 2030 Inc./Architecture 2030



The 2030 Challenge sets achievable and affordable targets to dramatically reduce the energy consumption of the Building Sector by 2040 and beyond.

These goals far exceed those of the current energy codes. Architecture 2030 suggests that targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power, and/or purchasing (20 percent maximum) renewable energy. Of these three approaches, sustainable design strategies are by far the most important. While manufacturers can help with new and better products, the bigger opportunity falls to architects, who can employ such design strategies as building size—volume and floor space—orientation, air tightness, higher R-values, thermal mass, and continuous insulation to reduce energy costs.

ASHRAE 90.1

Rather than develop actual building codes, ASHRAE sets standards that are typically followed by such organizations as the International Code Council (ICC), the association of construction industry members that develop I-codes, which are used in the design, build, and compliance process to ensure safe, sustainable, and affordable construction. The ASHRAE standard provides minimum requirements for energy-efficient designs for buildings except low-rise residential buildings. Originally published in 1975, ASHRAE 90 has undergone multiple editions due to the rapid change in technology and energy objectives. It was updated many times, and its name was changed to the ASHRAE 90.1 standard in 2001. Many states apply the standard or equivalent standards for all commercial buildings, while others do so for all government buildings. The most recent AHSRAE update occurred in 2013.

International Energy Conservation Code (IECC)

The IECC is published by the ICC. The IECC, which references ASHRAE standards, is an I-code, a model code adopted by many state and municipal governments to establish minimum design and construction requirements for energy efficiency. Introduced in 1998, the IECC addresses energy efficiency on several fronts, including cost savings, reduced energy usage, conservation of natural resources, and the impact of energy usage on the environment. The IECC 2009 was updated in 2012 and then again in 2015, with proposals for 2018 already being considered. Each revision of the IECC ratchets up energy-performance requirements.

IECC does not mandate across-the-board changes, and its changes are only enforceable when they are adopted at the state or local level, where they may include the core provisions combined with the objectives of the adopting jurisdictions—a situation which makes it imperative that architects build to the applicable code for the jurisdiction where the project is located.

While most states have adopted some form of the IECC, many jurisdictions do not adopt new versions of the code immediately after publication. As of August 2012, the commercial code status is as follows. As of July 2016, most states and U.S. territories—43 out of 56—require ASHRAE 90.1-2007/IECC 2009 equivalent or more. Seven jurisdictions have adopted the latest codes and require ASHRAE 90.1-2013/2015 equivalent or more, and 10 have either no statewide energy code or less-efficient standards than ASHRAE 90.1-2007/IECC 2009. See the State Energy Code Adoption map for the status of state adoption of energy codes.

The U.S. Department of Energy (DOE), through its Building Energy Codes Program (BECP), has worked to enable 70 percent of states to adopt either the 2009 IECC, the ASHRAE Standard 90.1-2007 or better by 2015—a goal which has been met—and 90 percent of states to adopt these codes or better by 2017.

With the plethora of codes—ASHRAE, IECC, IBC, and state and local versions thereof—and the fact that codes frequently reference each other, it is critical that all design professional are on the same page concerning which code to follow at the beginning of the project.

IECC ITERATIONS

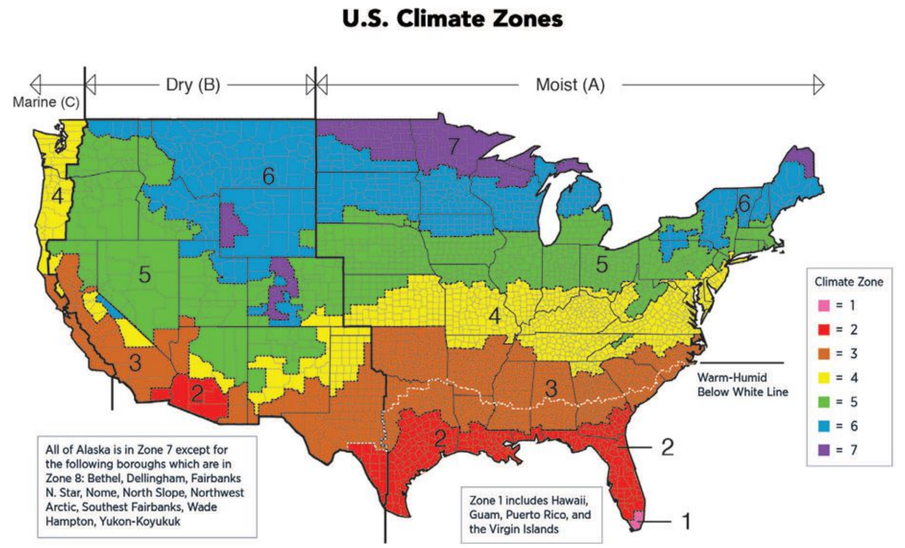
The constant in all of the iterations of the IECC code is that greater energy efficiency is required. The 2012 code called for buildings that use 30 percent less energy than that required by the 2006 IECC edition. The 2015 targets of the IECC, in turn, are 20 percent above the 2012 edition.

Most of the changes in the 2015 IECC code involve HVAC, lighting, and other systems. In terms of wall design, the changes are primarily directed toward steel stud and wood-framed walls. The IECC 2015 made only minor changes regarding above-grade walls in the cavity insulation or continuous insulation requirements on prescriptive table. Masonry walls were essentially left alone, with no mandated R-value increases. This may reflect the inherent thermal value of masonry's mass wall. The benefit of thermal mass, which is a measure of a material's capacity to store heat for future distribution, is that its slow rate of heat transfer keeps interiors warm in winters and cool in summers. When used with complementary products or systems, concrete masonry units (CMUs) are particularly energy efficient. Mass walls can also prevent easy sound transmission, reducing noise pollution, a feature much sought after in public buildings with numerous users.

Mass walls make sense in light of the fact that ever more insulation is required as each three-year code adjustment is made. If the AIA 2030 Challenge is the timeline, the resulting template will require ever thicker amounts of insulation. Thicker insulation takes inches away from "living space,"

> **CODE EVOLUTION**
> - ASHRAE 90.1 2010 = IECC 2012
> - Compared to ASHRAE-2004 = 30% Energy saving
> - 2015 IECC = +20% above IECC 2012
> - Higher R-Values are here to stay
> - Continuous Insulation is here to stay

Source: U.S. Department of Energy



which can be undesirable from an economic and user standpoint. In view of these constraints, mass walls present a compelling alternative to meeting increasing R-value requirements.

Compliance

Complying with R-Value requirements for building envelope components is determined by climate zone and is also impacted by building occupancy types, wall types, and the compliance path chosen.

Climate Zone: It is first necessary to determine in what climate zone the project is located. Today, there are eight climate zones for the entire United States, a vast improvement over 1989 when there were 38.

Building Type: The code contains one set of provisions for commercial buildings and one for residential buildings. The commercial provisions apply to all buildings with the exception of residential structures of three stories or less.

Wall Type: While the IECC has reduced the number of climate zones, R-value tables have become more complex. The commercial table lists multiple variations within each envelope component, except for walls below grade, where only one type is listed.

Compliance Path: The main compliance paths are the prescriptive and performance paths. In the 2015 IECC, there were no important changes in the prescriptive requirements. A new performance method was the Energy Rating Index, which allows builders the option of meeting a target ERI score via several performance options. This compliance method is for the residential market only, however.

Building size and complexity may determine which path to use. Smaller commercial buildings with one HVAC, hot water, and lighting system lend themselves more to a prescriptive approach, while larger commercial buildings with multiple systems, uses, and loads are more suitable to the tradeoffs found in a performance-based code.

> **COMPLIANCE PATHS**
> 1. Prescriptive Path
>   a. R-value method
>   b. U-factor method
>   c. Envelope tradeoff approach (COMcheck and REScheck)
> 2. Performance path

In the prescriptive path, building design and components must meet R-values listed in the tables. Minimum mandatory requirements must be met for mechanical equipment, including lighting, HVAC, water heating systems, and electrical power systems.

While architects have traditionally used the prescriptive path, it has recently fallen out of favor because of the tedious use of tables and lack of tradeoffs. It can curtail design freedom and reflect the notion that the building is composed of separate, unrelated systems.

Prescriptive building envelope paths include R-Value and U-Factor options. Historically, every material is R-value rated. In order to meet the prescriptive requirements using the R-value method (table C402.1.3 of 2015 IECC), every wall type (mass wall, wood framing, metal framing, and metal building) is described. This prescriptive option specifies the minimum continuous insulation to be added at each assembly to meet the code.

The second, the U-factor method, allows the designer to configure the wall so that the wall assembly configured is permissible, provided its overall thermal transmittance (U-factor) is less than that specified in the code (Table C402.1.4 of 2015 IECC). Values used in the calculation of the overall U-factor are provided by the ASHRAE 90.1.

Both options aim at the same total heat loss target, but the second option (U-factor method) is less restrictive. This approach is more flexible than the R-value method.

In the IECC 2015, compliance with the first path requires compliance with ASHRAE Standard 90.1-2013, which is more stringent than ASHRAE 2010.[3]

Designers can use COMcheck software to see how to comply and to demonstrate compliance with ASHRAE 2007 and 2010, where allowed by the jurisdiction. It is applicable for demonstrating compliance with the three prescriptive options. Inputs include compliance the project is seeking, as well as details on the building envelope and various systems, including HVAC and lighting. A distinct advantage of using this software is that it produces not only a project summary but a certificate of code compliance for the specified code. Because of its clarity in defining a project, many states now require the use of COMcheck. The program is available for free download at www.energycodes.gov/comcheck.

The performance path offers more flexibility but involves more complex energy simulations and tradeoffs between systems; COMcheck is insufficient here for compliance. It is necessary to use ASHRAE 90.1 Section 11: Energy Modeling, which is much like LEED-required energy modeling, and takes into account actual environmental conditions and includes input on all major building systems, with mechanical and lighting systems factored into the building envelope equation.

CHARACTERISTICS OF A HIGH-PERFORMANCE, CODE-COMPLIANT WALL

High-performance walls have a great many elements in common. They are energy efficient, with a high R-value, high air tightness, and little or no thermal bridging. They also score high marks in moisture management, with no leaks, the ability to control condensation, and the ability to dry should moisture infiltrate the wall cavity. Other qualities include sound and fire resistance.

To promote these characteristics, a variety of code-compliant components have been developed.

Continuous Insulation

ASHRAE has required continuous insulation (CI) for many years. CI is defined as insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. The amount of insulation is climate-zone dependent and listed by ASHRAE in its 2004, 2007, 2010, and 2013 editions. There are prescriptive insulation requirements for wood-framed walls, steel-framed walls, and mass (concrete, stone, or CMU) walls for each of the eight United States climate zones.

Code requires a layer of CI in most U.S. climate zones for the purpose of limiting or eliminating thermal bridges that compromise a wall's energy efficiency. Exterior continuous insulation has a variety of benefits. First, it reduces the condensation in the wall frame and inside the building, and the dew point of the wall is displaced toward the exterior where condensation will not cause damage.

Moisture management is critical to a successful wall and, in addition to creating a high-performance building, can head off the potential for health, legal, and financial concerns. Some moisture is likely to infiltrate even the best constructed walls, whether it is in the form of bulk moisture, capillary action, water vapor, or groundwater. Walls that control any water that has breached the cavity and enable it to drain quickly and the wall assembly to dry are the ideal.

It is important to mention that exterior CI also contributes to reducing the air leakage through the wall. For example, a rigid EPS foam continuously covering an exterior opaque wall is a contributor for reducing air leakage through the wall. It seals tears and other accidental defects occurred in the weather-resistive barrier (WRB).

Due to its mass, a masonry wall is a barrier against sound transmission. Moreover, a multilayer concrete wall like a CMU wall in addition to a veneer with insulation in the cavity gives excellent result.

The 2015 IECC, Section 402.2.1 adds language regarding multiple layers of continuous insulation and describes the installation methods for multiple CI layers, effectively upping the stringency of the 2012 IECC.[3]

Air Barriers

Of prime importance to designers of masonry systems are the air-barrier requirements. Air-barrier systems are comprised of a number of materials that are assembled together to provide a complete barrier to air leakage through the building enclosure. They control the unintended movement of air into and out of a building enclosure—an important consideration in reducing energy costs, as air leakage from a building can result in an increased use in energy costs of up to 30–40 percent in heating climates and 10–15 percent in cooling costs.

The 2012 version of the IECC required air barriers in both commercial and residential construction, and the directive has remained essentially the same in 2015.

According to the U.S. DOE, in the 2015 IECC, "Continuous air barriers are required except in Climate Zone 2B:

- Air barrier placement allowed inside of building envelope, outside of building envelope, located within assemblies composing envelope, or any combination thereof
- Continuous for all assemblies that are part of the thermal envelope and across joints and assemblies
- Joints and seams sealed, including sealing transitions in places and changes in materials, securely installed in or on the joint for its entire length to not dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect, and mechanical ventilation."

There are two ways to comply with air-barrier requirements: Materials – C402.5.1.2.1 or Assemblies – C402.5.1.2.2.[4]

Fire Safety

In multistory projects where the wall assembly contains a combustible material, the IBC code requires NFPA 285 test compliancy to verify vertical and lateral fire propagation. The IBC also establishes minimum requirements for hourly fire rating based on building types, fire separation distance, and occupancy group. The fire rating of a specific wall configuration is evaluated using ASTM E119 test method.

WHY SYSTEMS MAKE SENSE

Many maintain that the best way to comply with the IEEC and other codes is a systems approach. To meet more ambitious energy targets, manufacturers have developed innovative masonry wall systems that are single solutions for thermal performance, water management, sound transmission, fire resistance and aesthetic benefits. Targeted to meeting AIA 2030 and DOE goals, these systems approaches are gaining traction in the construction industry. Further, newer systems usually have thinner and/or lighter units and often employ different anchoring techniques and CI, and have been engineered to control thermal transfer, reduce or eliminate thermal bridging, and offer air leakage and moisture control, all of which make sense from an energy-efficiency standpoint.

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Arizona State University, Sun Devil Fitness Complex Expansion

Rainscreens made from extruded concrete can complement building design features while providing protection from the elements.

Extruded Concrete in Rainscreens

Extruded concrete has become an increasingly popular material choice because it is thinner, offers more design options, and is noncombustible

Sponsored by Rieder North America | *By Andrew A. Hunt*

The concept of a rainscreen appears to have originated in Norway centuries ago, where builders used the technique to protect church and barn walls with a layered structure, usually back-ventilated wood cladding that was placed over the top of a stone or wood wall, with an air gap in between. The layers—and the air gap—included open joints and promoted drainage of any moisture that entered the cladding layer.

Over time, the rainscreen design was modified for more modern use and was formalized as an architectural principle in 1962 by Scandinavian designer Birkeland, who took inspiration from old Norwegian barns. Later, the concept was amended in 1963 by Canadian architect G.K. Garden, who introduced the pressure-equalization concept to the design in Canada and coined the term "rainscreen." Over the past several decades, the design principles have been tested and refined, and builders have increasingly been including rainscreen systems, commonly known just as rainscreens, as part of their building envelope. In the modern design, ventilation was built in through both top and bottom ventilation and drainage openings. These systems have been used extensively in both Canada and Europe since the 1980s. However, they have only started to become common in the United States over the past decade or so.

Rainscreen systems consist of three essential layers: the exterior cladding (the "screen"), a sealed air gap (or pressure-equalization chamber/PEC), and a water-resistive barrier

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Learning Objectives

After reading this article, you should be able to:

1. Discuss the overall durability and performance benefits of including rainscreens in commercial buildings.
2. List the common materials used to produce rainscreen.
3. Compare and contrast common rainscreen materials.
4. Describe the manufacturing process and performance benefits of extruded concrete.

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(WRB) that is attached to the building's frame. The rainscreen assembly must also include openings or vents that connect the air gap to the outside. This combination helps protect the structure by controlling external moisture (rain, snow, etc.) so that it does not reach the building's internal substructure. The two standard rainscreen designs either drain water through the back-ventilation, as noted above, or use pressure equalization to moderate the air and moisture. Designers need to evaluate their project requirements and the environmental factors of the build site before deciding which rainscreen works best for their building.

The rainscreen itself usually refers to the actual siding, which can be made from a variety of different materials. Designers often choose the materials based on the potential impacts on the local environment (e.g., climate, pollution), the desired aesthetics, installation requirements, lifetime maintenance, and the project budget as a whole. Designers may also consider whether the panels are fire rated and if they add to the building's green ratings. Rainscreen materials will be discussed in more detail later in this course.

When compared to other common systems, such as external thermal insulation systems (ETICS), the rainscreen has several advantages, such as moisture management and lower lifecycle costs. ETICS are wall insulation systems that are designed to provide the building with an added layer of insulation to protect against energy loss. The systems can be designed to change the face and character of the building, and consist of a base coat, a thermal insulation, adhesives, and a finishing coat. The main difference between ETICS and rainscreens is the former lacks an air gap in between the exterior and the interior, and that gap provides an added level of moisture management.

Building professionals may view the higher capital cost of rainscreens as a reason not to install them. However, the lifetime performance when compared to other alternatives show that the investment is usually worth it. Rear-ventilated rainscreens are highly efficient because of their high durability and low-maintenance design. This design, which includes an air gap between the cladding and the building substructure, means that the interior is protected, and thus has a longer life. In addition, it's easy to add fire and lightning protection as well as noise buffers to rainscreens, thus adding to the overall benefits. ETICS systems, which lack that gap, insulate well and are useful in many situations. However, they are more prone to damage over time.

When we add in the differences between the initial manufacturing costs and ongoing maintenance costs throughout the product lifetime, the overall cost of different facades can vary. However in a head-to-head comparison, the rainscreen has features that boost its long-term performance and balance out the capital costs of the system when compared to less-durable designs.

Regardless of what kind of system designers choose, the rainscreen needs to be correctly installed. A properly installed rainscreen will help deflect water through eaves and cladding, will protect the walls by diffusing air via ventilation in the panel, and will drain any water that develops behind the cladding (for example, from condensation or seepage). The system also must dry any moisture and be durable enough to withstand environmental conditions and time.

© Ditz Fejer

Regardless of the climate, rainscreens can help protect the building year-round, even for the largest projects. The New Street Apartment Building in Boston utilized extruded concrete panels for the 16-story tower, the tallest building for the East Boston neighborhood.

COMPONENTS AND INSTALLATION OF RAINSCREENS

As noted earlier, the three main elements of a rainscreen system are the exterior cladding layer (the "screen"), the pressure-equalization chamber (PEC), which has a water-resistant barrier along its sides, and the air gap, which is vented to the outside. Each of these three components has additional features to help keep the water out and to ensure that the system functions properly. It helps to look at the requirements for each element one at a time.

Cladding: Ideally, the cladding is made of a nonporous, durable material, usually formed into panels. The goal of the cladding is to allow water to run off of it—and this means down both sides.

Air gap and vents (also "open joints"): The required air gap provides ventilation between the other two layers. Comments on the recommended gap size are discussed below.

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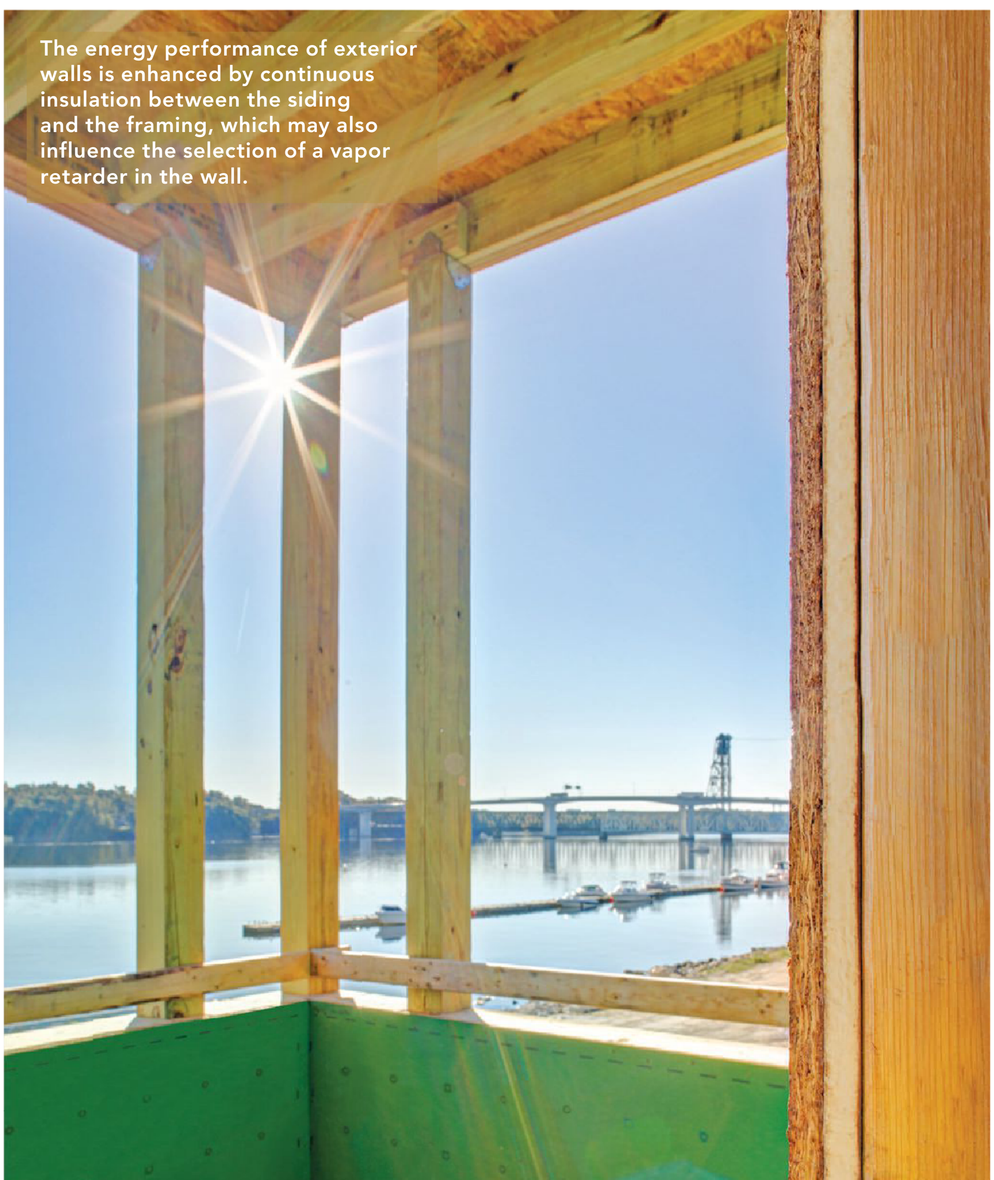
***Andrew A. Hunt**, vice president, Confluence Communications, has 16 years of experience in green building and has produced more than 100 educational and technical publications.*
www.confluencecommunications.com

Continuous Insulation in Framed Exterior Walls

How to determine the amount of continuous insulation required by codes, while still retarding water vapor according to climate zone locations

Sponsored by Huber Engineered Woods LLC | *By Peter J. Arsenault, FAIA, NCARB, LEED AP*

Building codes and green building standards are continuing to raise the bar on energy efficiency and high performance in buildings. This is achieved in wood-framed buildings by addressing both insulation levels and air tightness. While this is a positive trend, there are some notable wall design issues to address. Specifically, determining the best amount and type of insulation to use may be unclear, particularly in light of controlling water vapor or moisture that can become trapped in constructed wall assemblies. This is especially true in the case of providing continuous insulation as part of a framed exterior wall. Codes and best practices suggest different amounts of continuous insulation for different climate zones. There is also concern that the continuous insulation can impact the ability of the wall to "breathe" and release any trapped moisture from within the assembly so, in some cases, it can impact the choice of an interior vapor retarder on the warm, inner side of the building. All of these variables and options have led to some significant confusion concerning the best way to properly address both code-required thermal insulation and vapor management in wall assemblies. This course will help provide clarity on the differences between the varied prescriptive code requirements for continuous insulation in different climate zones, along with principles and choices related to proper moisture management.



The energy performance of exterior walls is enhanced by continuous insulation between the siding and the framing, which may also influence the selection of a vapor retarder in the wall.

All images courtesy of Huber Engineered Woods LLC, except as noted

WHY CONTINUOUS INSULATION?

Framed wall construction, whether using wood studs or metal studs, has an inherent weakness from a thermal efficiency point of view. Simply put, the framing allows more heat to flow through it than insulation does. This is quite observable and measurable using standard techniques that test different materials for the amount of heat flow or heat transfer through them. Those tests are grounded in the

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Learning Objectives

After reading this article, you should be able to:

1. Explain the concept of thermal bridging and how it impacts building energy usage in green and sustainable building design.
2. Define the commercial and residential wood-framed wall insulation requirements found in the 2015 International Energy Conservation Code (IECC).
3. Discuss how condensation forms in wall cavities, and investigate strategies to mitigate risk of damage to construction, while maintaining sustainable and healthy indoor environments.
4. Identify the practical and green building characteristics of continuous insulation as part of the exterior wall sheathing with other alternatives.

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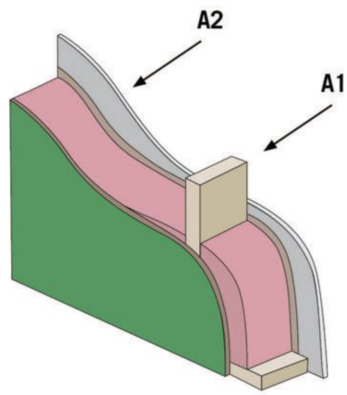
fundamental laws of physics and thermodynamics that, among other things, point out that heat always seeks a balance by flowing from a warm source to a cooler place.

Heat Transfer

The means to measure heat transfer in building products is based on U-factors, which indicate how many British thermal units (BTUs) of energy pass through a defined size of material (i.e., one square foot) over time (specifically one hour) for each degree Fahrenheit in temperature difference. (The greater the difference in temperature between the two sides of the material, the faster or more intensely that heat flows.) In order to determine how much heat is transferred through any specific material, its U-factor is determined by testing that material on a square-foot basis over time, while measuring the temperature difference between the two sides. The resulting number is generally a decimal (e.g., 0.5), with smaller numbers indicating small amounts of heat transfer (think insulation) and higher numbers indicating more heat transfer (think conductive metal). Applying this to a building, the fundamental formula used is (U x A) x dT where U= the tested U-factor for one square foot of material, A= the area in square feet installed in a construction assembly, and dT is the design or actual temperature difference between indoors and outdoors. All thermal energy calculations in building enclosures (i.e., walls, roofs, etc.) are based on this fundamental formula.

It is worth pointing out that while scientists and engineers like to work and think in fractional U-factors, most of the general population prefers whole numbers, which has made R-values the popular means to talk about thermal capabilities of materials. This is still very legitimate since the testing and calculation process is exactly the same. The difference is that instead of indicating the results as heat transfer through a material, they are reported as heat resistance—the direct inverse to heat flow. Since U-factors and R-values are the multiplicative inverse of each other, to convert U-factors to R-values and vice versa, you divide one by the number you are attempting to convert. So, an insulating material with a tested heat flow U-factor of .05 is easily then divided into 1 (1/.05) to indicate a resistance R-value of R-20. Similarly, an insulation product with an R-value of R-20 is converted to a U-factor as $\frac{1}{20}$ = .05. Hence, it has become common for individual materials and products to be promoted and marketed based on their R-values. It is also somewhat easier to think in terms of higher R-values equaling greater resistance to heat flow, which essentially translates into better energy performance in building enclosures. From a calculation point of view, R-values of multiple materials can be added together to determine a total R-value, but U-factors cannot be combined together.



U-FACTOR EXAMPLE 1 - CAVITY INSULATION ONLY

WALL COMPONENT	A1	A2
CONTINUOUS INSULATION	R-0.0	R-0.0
OSB SHEATHING	R-0.62	R-0.62
FRAMING OR INSULATION	**R-6.88**	**R-20**
DRYWALL	R-0.45	R-0.45
TOTAL R-VALUE	R-7.95	R-21.07
U-FACTOR (1/R)	U-0.126	U-0.048
% OF WALL AREA	22%	78%

Calculation: Area weighted average U-factor

U = (0.22 x 0.126) + (0.78 x 0.048)

U = 0.065 Effective R = 1/U = 15.38

Calculating the thermal performance of framed walls with only cavity insulation needs to account for the heat transfer through the studs as well as through the insulation.

Thermal Bridging

As most design professionals are well aware, construction assemblies are very rarely monolithic. Rather, they require different materials that are assembled to make up the overall construction. In framed exterior walls, the framing members are spaced at 16 or 24 inches on center with upper and lower plates, not to mention additional framing around door or window openings. This framing defines the fundamental thickness of the wall and the spaces between or around the framing are commonly filled with insulation. Then, continuous layers of interior and exterior sheathing, such as gypsum board or wood panel products, cover the framed and insulated areas to create a wall ready for finishing. In order to accurately determine the true thermal performance of this typically constructed wall, at least two calculations are needed: one based on cutting a cross section through the framing and the other based on a cross section through the insulation. Then the resulting numbers need to be applied to the appropriate percentage of the total wall area to produce a weighted average UA for the whole wall.

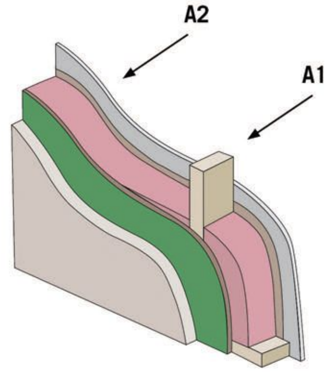
In typical situations, the framing can account for 20 to 30 percent of the area of any given exterior wall with only about 70 to 80 percent of the wall area actually containing insulation. Since the framed sections will not have the same U-factor/R-value of the insulation, the thermal effectiveness of the wall is directly compromised. It is easy to ask, is this 20 to 30 percent framing area really a big deal? It turns out that the answer is yes. Any building material, including framing or sheathing, that has a capacity to transfer heat more than insulation will follow the laws of physics and do so. In this case, every stud or other solid structural item, like floor band joists, columns, etc., is acting as a breach in the insulated wall, allowing heat to transfer through it. This solid connection between the warm side and the cool side of an assembly acts as a "thermal bridge," allowing heat to flow freely between the sections where the insulation is present.

To illustrate this, let's look at U-Factor Example 1 showing 2-by-6 wood stud framing at 16 inches on center with R-20 insulation between the studs. We have identified the section through the studs as A1 and the section through the insulation as A2. Entering the tested and known R-values (from independent sources) of the various materials, we find that the total R-value through the studs is only R-7.95 (U-0.126) compared to an R-21.07 (U-0.048) through the insulated portions. Assuming 22 percent framing and 78 percent insulating areas, the weighted average for the total wall produces an overall effective R-value of R-15.34 (U-0.065). This is a reduction in overall thermal performance of more than 27 percent due to the thermal bridging of the studs, which is quite significant.

Continuous Insulation

What is the solution to all of these thermal bridges and lack of performance in the wall system? For those who want to stay with the tried and proven method of framed construction, the answer is in providing continuous insulation (CI) that is not interrupted by the framing. Such insulation is commonly thought of as a rigid foam insulation made into board products, foamed in place on site, or in the newest instances, included as an integrated part of the exterior wall sheathing. In any of these cases, in order to make the insulation truly continuous, it needs to be placed either on the inside or outside face of the studs, with the outer surface usually being preferable. An outer face installation allows for complete coverage of all framing, including headers, corners, floors, and other structural elements. It also doesn't interfere with interior dimensions or finishing and, as we will see, can be managed well for moisture and water vapor in a wall assembly.

So how much of an impact can this continuous insulation have on the wall? Let's look at another U-factor calculation example but this time, let's see the effects of continuous insulation over the outside of the wall assembly. In U-Factor Example 2, we will use 2-by-4 framing at 16 inches on center with R-13 insulation in the cavities (instead of the previous 2-by-6 framing with R-20). Again, we need to calculate the A1 and A2 performance through the studs and the cavity insulation respectively. However, this time we are able to add in R-5 to both cases in order to account for the layer of continuous insulation that covers the entire wall. The results in this scenario show that the total R-value through the studs plus the continuous insulation and sheathing has increased to R-10.45 (U-0.95) compared to an R-19.07 (U-0.052) through the insulated portions. Assuming here 25 percent framing and 75 percent insulating areas, the weighted average for this total wall is an overall effective R-value of R-15.93 (U-0.063). Comparing this example to the first one, we find virtually the same overall results using 2-by-4 framing with R-13 cavity insulation and R-5 continuous insulation as using 2-by-6 framing with R-20 cavity insulation. The 2-by-6 cavity insulation alone has to have a higher R-value (R-20) than the sum of the 2-by-4 cavity insulation plus the continuous insulation (R-13 + R-5 = R-18) in order to make up for the thermal bridging of the studs and still perform as well overall.



U-FACTOR EXAMPLE 2 - CAVITY INSULATION PLUS CONTINUOUS INSULATION

WALL COMPONENT	A1	A2
CONTINUOUS INSULATION	R-5.0	R-5.0
OSB SHEATHING	R-0.62	R-0.62
FRAMING OR INSULATION	**R-4.38**	**R-13**
DRYWALL	R-0.45	R-0.45
TOTAL R-VALUE	R-10.45	R-19.07
U-FACTOR (1/R)	U-0.095	U-0.052
% OF WALL AREA	25%	75%

Calculation: Area weighted average U-factor

U = (0.25 x 0.095) + (0.75 x 0.052)

U = 0.063 Effective R = 1/U = 15.87

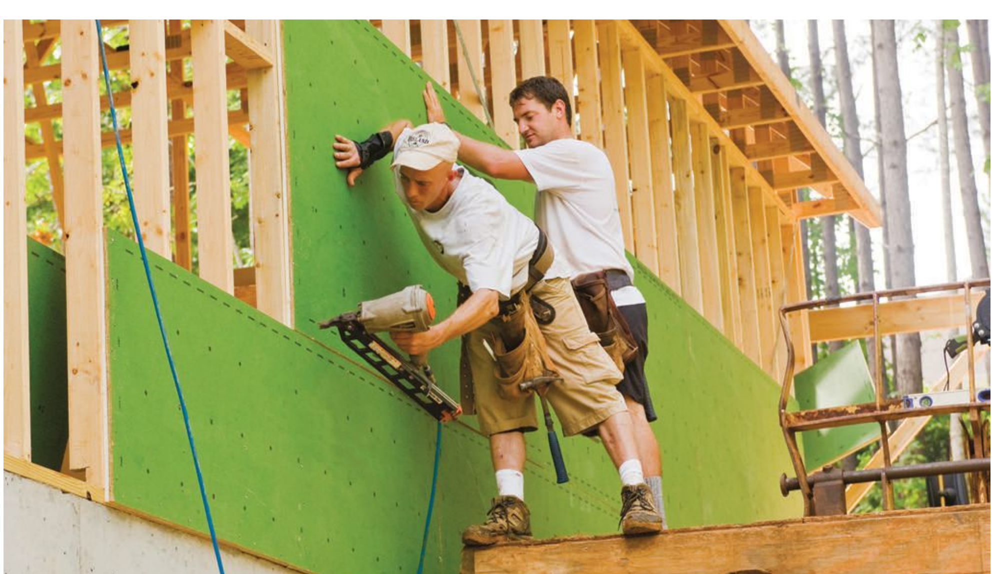
When continuous insulation is added to a framed wall assembly, its R-value is added to both the R-value of the framing and the stud cavity insulation.

CONTINUOUS INSULATION CHOICES

As noted, there are choices in the type of materials that can be selected and specified as continuous insulation. Over the past few decades, nonstructural insulating sheathing products of different types have come on the market and are now available in common construction sizes and in varying thicknesses. These products are essentially rigid foam insulation that may or may not have a facing depending on the material. They are foamed from plastics such as polystyrene, polyurethane, and polyisocyanurate, with each carrying different thermal and physical characteristics. Of these, polyisocyanurate (or simply "polyiso") has become popular because of its performance. According to the Polyisocyanurate Manufacturers Association (PIMA), polyiso has the highest R-value per inch of any rigid foam board insulation. It also points out that polyiso is unique in that the R-value per inch increases with the thickness of the foam, so 3 inches of polyiso has a higher R-value per inch than 2 inches. This superior performance compared to other foam insulation products can mean less material is needed overall, making it very cost effective.

Of course, in framed walls, there is also the need for solid sheathing over the studs that can provide structural bracing for the wall and a nailbase for the attachment of siding, cladding, brick ties, etc. Most foam sheathing products aren't rated to be structural and don't necessarily provide a good nail base. That usually means that the foam insulation is put up after structural sheathing goes over the studs. In some cases, the structural sheathing may only be required in strategic locations, such as corners, and thicker rigid insulation can be put up in between. However, in some cases, another layer is needed to provide a nail base or else the exterior cladding needs to be carefully attached to the studs. This multistep process obviously adds to the labor involved in constructing the wall, but it also requires attention to the fastening pattern.

One of the more simplified choices to address both the structural and thermal needs of exterior continuous insulation is a single product that contains both a structural sheathing panel and an integrated layer of continuous insulation. This type of nail-base insulation product has been commonly used on commercial roofing systems for years, but it has taken some engineering and development for it to be ready for use on walls. As a single, combined product, it eliminates a labor step by installing both continuous insulation and a structural, nailable sheathing all at once. Some



Continuous insulation is available as part of an exterior sheathing system that can be used as a structural panel when properly fastened according to the manufacturer's instructions.

are even preprinted with the manufacturer's recommended nail patterns to take the guess work out of assuring appropriate structural strength. And to further assure structural integrity, the best option is to rely on a product that has been tested as a complete, combined panel under laboratory conditions. One engineered wood exterior sheathing manufacturer has obtained third-party documentation through the International Code Council's Evaluation Services to be used as an acceptable structural panel.[1] From a thermal performance standpoint, this multifunctional, single-panel exterior sheathing system product is commonly available with different thicknesses of continuous insulation ranging from R-3 to R-12.

CONTINUOUS INSULATION IN CODES AND STANDARDS

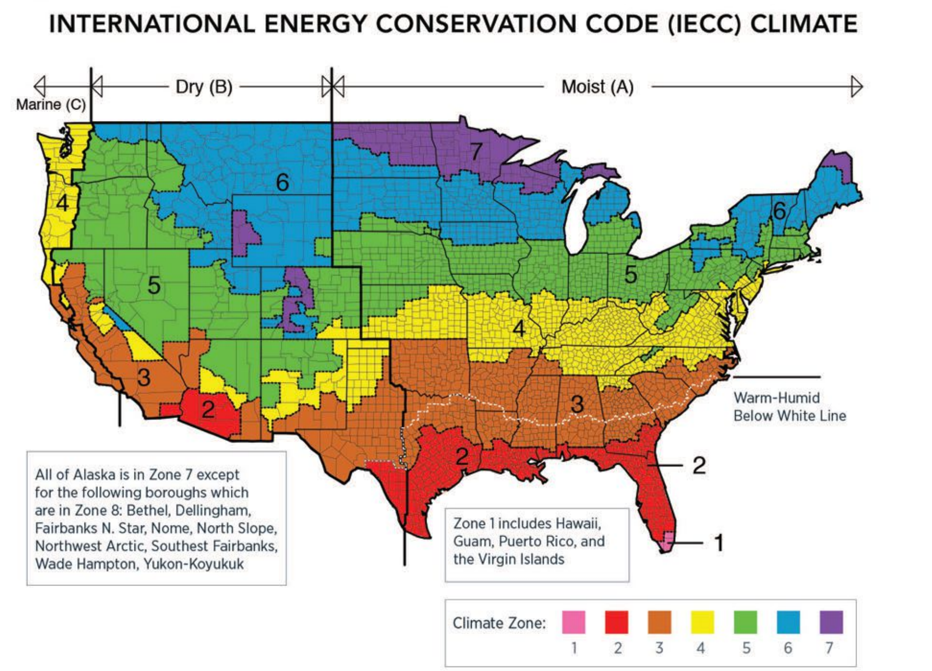
With the clear benefits demonstrated in using continuous insulation and its increasing availability as a practical material, it is not surprising that building and energy codes are not only recognizing it, but in some cases are now requiring it to be used. In fact, some designers might say they are surprised that it hasn't happened sooner. For purposes of our discussion here, we will be referring to the 2015 codes published by the International Code Council, specifically the 2015 International Residential Code (IRC), the 2015 International Building Code (IBC), and the 2015 International Energy Conservation Code (IECC).

2015 IRC and IBC

As general construction codes, both the IRC and the IBC have always been similar in intent (i.e., general health, safety, and welfare of people in buildings) but different in their focus on different types or classes of structures. The IRC covers detached and attached one- and two-family residential units, including attached townhouses, up to three stories in height. The IBC covers everything else, including residential buildings, such as multifamily occupancies like apartments, dormitories, boarding houses, hotels, and motels.

Both the IRC and IBC allow for either metal- or wood-framed wall construction with particular limits based on fire and safety criteria. They also both address durability and protection of the construction assemblies by requiring a weather-resistant barrier (WRB) over exterior wall sheathing and in some climate zones, a warm-side vapor retarder. Both of these are intended to protect the wall assembly from being damaged by water or weather intrusion, which could lead to possible decay or mold that is not only a concern for building owners but also a possible health risk to occupants.

Source: U.S. Department of Energy, www.buildings.gov



The International Energy Conservation Code has established eight climate zones across the country based on heating and cooling needs as well as humidity conditions.

2015 IECC

This latest version of the Energy Conservation Code is essentially two documents in one—it contains six chapters for residential buildings and a separate but similar six chapters for commercial building energy conservation requirements. There are several critical points to understand with this code:

- **Residential vs. Commercial:** The applicability of the IECC residential portion is actually different from the distinction between the IBC and IRC. Under the IECC, the residential portion applies not only to detached one- and two-family dwellings and multiple single-family dwellings (townhouses) as in the IRC, but also to Occupancy Group R-2, R-3, and R-4 buildings that are permanent residences and are three stories or less in height above the grade plane. These occupancy group buildings are defined in the IBC to include things like apartment buildings, dormitories, halfway houses, and long-term care facilities. The rationale behind this distinction appears to be that these permanent, residential classifications up to three stories in height are more akin to residential construction and therefore should be subject to the more appropriate and stringent requirements of the residential portion of the IECC. R-2, R-3, and R-4 buildings that are more transient in nature or over three stories in height are to follow the commercial provisions of the IECC.
- **Climate Zones:** The IECC recognizes eight different climate zones (simply numbered 1 to 8) across all states and counties in the United States. These climate zones are calculated on the basis of the need for heating or cooling using common degree-day methodology. Climate zones 1 and 2 show up in the warmest areas in Florida and the Gulf Coast, plus an area around southern Arizona. Climate zone 3 covers a varying-sized swath from the southeastern United States across to much of California. Climate zones 4, 5, and 6 cover most of the country from coast to coast above the southern states. Climate zones 7 and 8 identify the coldest areas in places like northern Maine, Minnesota, some places in the Rocky Mountains, and in Alaska.

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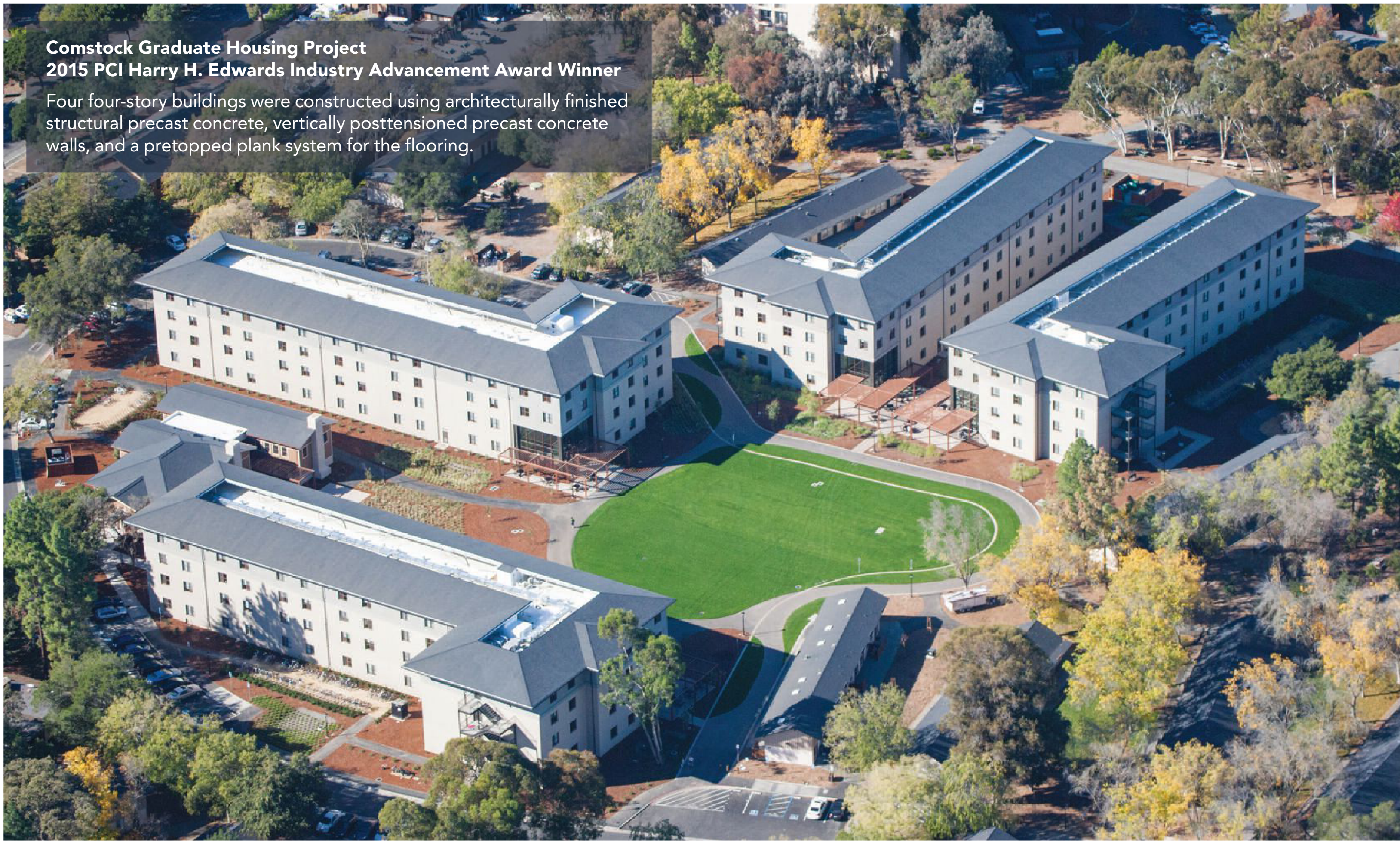
Photo courtesy of Digital Sky Aerial Imaging/Todd Quam



Comstock Graduate Housing Project
2015 PCI Harry H. Edwards Industry Advancement Award Winner
Four four-story buildings were constructed using architecturally finished structural precast concrete, vertically posttensioned precast concrete walls, and a pretopped plank system for the flooring.

Collaborating Through Design Challenges

The attributes of precast concrete enable realization of aesthetic and structural goals for new student life environments

Sponsored by Precast/Prestressed Concrete Institute (PCI) | *By Amanda C. Voss, MPP*

If there's one certainty in life—and construction—it's that things change. But change does not have to be painful or difficult. Change can offer a superb opportunity to reevaluate paradigms, processes, and the "why" behind the way things are done. As English Clergyman William Pollard once said, "Without change, there is no innovation, creativity, or incentive for improvement. Those who initiate change will have a better opportunity to manage the change that is inevitable."

A revolution is underway on today's job sites, as compressed timetables, complex trades coordination, and challenging aesthetic elements become the new norm. This change has swept into university housing, just as a majority of institutions are planning to renovate or replace aging residence halls. In addition to shifting construction demands, the concept behind student housing is undergoing its own "tectonic shift," a shift placing a larger emphasis on student living as an integral part of the learning process.[1] The style of university housing also is not exempt from this wave of change. The aesthetics behind student housing are now called on more and more to extend the university's brand and lifestyle message.

CONTINUING EDUCATION

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Learning Objectives
After reading this article, you should be able to:

1. Identify new trends in university housing.
2. Explore how precast systems play a vital part in the aesthetic appearance, resiliency, and process-driven early occupancy of new student life environments.
3. Explain how precast systems work within BIM, design assist, and other occupancy-driven processes, and how it leads to aesthetically pleasing structures that are also safe, durable, and easy to maintain.
4. Discover unlimited aesthetic diversity through precast concrete.

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"Our industry is now asking owners and designers to dream a little with them so that we can offer iconic structures that will outlast most of us," says Jim Lewis, RA, LEED AP BD+C, manager, Architectural Services, PCI. "The geometric shapes of these residential living environments is changing to help in recruiting students. It is a fun time to be in the construction industry."

From concept and design to construction and occupant comfort: change has affected them all. It is not often that such a diverse set of demands is met with a ready solution. Yet precast concrete's attributes can meet the needs of the institution, the student, and the design-build team. Precast systems can play a vital part in the aesthetic appearance, functionality, resiliency, and process-driven early occupancy in new student life environments.

TRENDS IN UNIVERSITY HOUSING AND DESIGN

The realities of escalating demands placed on student housing and the need for outstanding student housing in order to be competitive come at a time when university budgets are more constrained than ever. Complicating the issue for facility directors and student housing developers, the majority of campus housing stock is old, with a median age of 40 to 50 years.[2] University housing needs new, remarkable structures to attract an increasing student population—projected to reach 19.6 million students by 2024. And those structures need to combine the attributes of aesthetics, functionality, resiliency, and compatibility with process-driven early occupancy.

Meeting the Academic and Facility Demands of Today's Students

The Center for Facilities Research, APPA, conducted a study of nearly 14,000 students to determine "the relative importance of an institution's physical assets on a student's choice of higher education institutions" and "the relative importance of various facilities in the decision process."[3] The study found that "two-thirds of the respondents indicated the Overall Quality of the Campus Facilities and half of the respondents indicated the Attractiveness of the Campus were 'Essential' or 'Very Important' to their decision."

The Center for Facilities Research also asked student respondents to rank facilities to better determine which facilities had the greatest impact on initial student attraction and retention. "Residence Halls on Campus" were ranked second in order of impact, with 53.1 percent of surveyed students feeling they were important to see on a campus visit. Ranked first were facilities related to the major course of study. Respondents were asked to pick the one facility that "had the greatest impact on their decision" in selecting a college. Ranked third, with 11.5 percent, was residential space. Poorly maintained or inadequate facilities were listed as the number-one reason for a student's rejection of an institution.[4]

New Designs Take Student Housing Beyond a Place to Sleep

In order to transform student housing beyond the limitations of traditional dormitories, new design strategies are emerging. In June 2016, Syracuse University announced plans to shift all student housing to its Main Campus, constructing groups of residences that will form housing neighborhoods, each with its own identity. The use of words like "neighborhood" and "community" when describing university dormitories reflects the importance of New Urbanism in forming student life communities.

When planning student housing developments, a majority of universities are embracing the tenets of New Urbanism. Broadly, New Urbanism is a design movement that takes a holistic view of development. Under New Urbanism, a planned neighborhood encompasses factors like measuring walkability, enabling a diversity of jobs, and planning a wide range of housing types. When applied to student residences, dormitories are transformed into buildings with a diversity of uses and occupants, becoming a "student-life complex." Dormitories become places where students eat, learn, sleep, study, shop, and recreate.

The University of Cincinnati's Main Street project exemplifies New Urbanism's impact: the new Campus Recreation Center combines 224-suite style residences, a restaurant, classrooms, and a convenience store.[5]

Designs that emphasize the social, blended nature of learning, while maintaining students' desire for privacy, hallmark housing as modern, innovative spaces. University housing directors are faced with balancing the importance of community, the need for flexible design, and the demand for amenities with today's student's desire for privacy.

This desire for privacy is important to include alongside strategies for fostering common spaces and illustrates the tensions faced in planning contemporary housing. According to college housing consultant and author Jim Grimm, former housing director for the University of Florida, 90 percent of freshmen arrive at the University of Florida campus never having shared a bedroom. "These same kids have been raised during a time of great abundance in America. They're used to seeing condo complexes with pools and workout rooms in their communities; they're accustomed to Internet access on a 24/7 basis, and having a safe place to study and hang out with friends—but that's only for starters."[6]

Modern Student Housing Must Also Embrace Sustainability

Balancing amenities, private space, and shared areas is a large enough challenge. Yet a well-planned location and thoughtful design can be undermined if sustainability isn't accounted for. The term 'sustainability' in student housing encompasses a number of factors; besides incorporating 'green' or efficient features, it also means an adaptable, multipurpose building that is eminently usable and maximizes both square footage and dollars. "Mixed-use, multifunctional residence halls will continue to make sense in the future, as institutions may choose to decrease beds in favor of adding classrooms

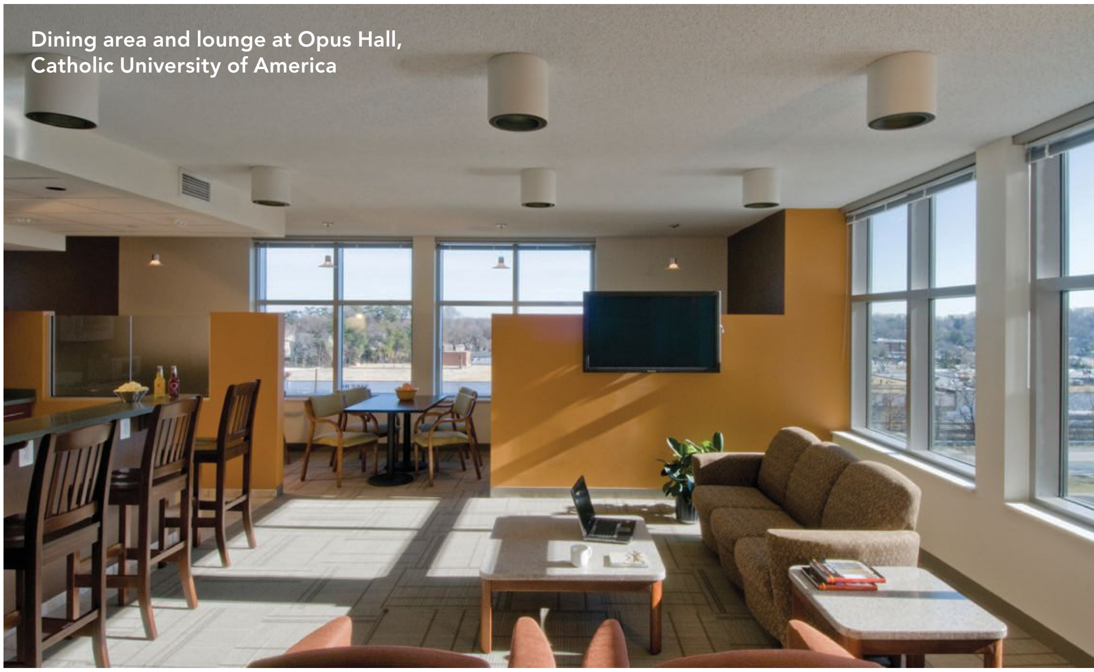
Dining area and lounge at Opus Hall, Catholic University of America

Photo courtesy of Little/© John Cole, 2009

CASE STUDY: RESIDENCE HALL, VALPARAISO UNIVERSITY

Fall of 2014 inaugurated not only a new year at Valparaiso, but also the opening of an 85,000-square-foot suite-style residence hall brimming with amenities, made feasible through the partnership of precast concrete and building information modeling, or BIM. The residence hall was built entirely with precast concrete, which was selected in order to meet an aggressive 12-month construction timeline. "We knew that by using structural and architectural precast, we could meet the deadline with fewer jobsite quality issues," says Andy Frank, construction executive for Mortenson Construction.

Planning for the project took two months. "We work hand-in-hand with architects and precast producers very early in the design process to make sure the structural requirements fit with the aesthetic design," says Frank. "Rework is easily cut in half because the work is so much more accurate when all the trades are coordinated." Frank estimated that by using BIM and a design-assist approach, coupled with the benefits of precast, the team eliminated two to three months from the project schedule.

"Speed through collaboration is the main benefit of using BIM," says Corey Greika, precast sales manager and vice president of Coreslab Indianapolis. "The 3D model educates each partner when they come on to the project so they know what limitations exist and can make decisions more easily."

Using BIM enabled the construction team to realize the architect's complex building footprint angles. The manufacturer designed and fabricated the total precast structural system along with the brick-inlay panels via the 3-D model. The hollowcore floor systems was fabricated by a second manufacturer. This 'kit of parts' system was quickly assembled on site, despite the region's unusually harsh winter.

or social areas, whether to address shifting student populations or facility needs."[5]

Concern for "improved health and well being" is the number-one reason for constructing sustainable buildings on campus, according to McGraw-Hill Construction.[7] A sustainable structure not only conserves dollars by keeping utility costs down, it also bolsters indoor air quality and comfort.

Attracting and Retaining Students While Minding the Budget

With the reality that the median cost for a residence hall is $20 million, or $171 per square foot, how dollars are spent is vital to both the bottom line and the ability for the university to attract and retain students.[8] While more students than ever before are entering undergraduate schools, resulting in a high demand for housing, university budgets for this housing are being extremely curtailed.

Given time constraints, inflexible budgets, and the need for precise coordination, the design-assist movement is gaining prominence as a best practice in managing construction of student housing. The design-assist practice uses a three-step process: development of a clear statement of work; research and creation of specifications; and adaption of the construction contract to reflect the goals created in steps one and two. "Design-assist contracting is a construction management method to improve quality and maintain cost. It is most commonly used when a specialty trade, fabrication or building method requires a unique solution or set of trade skills," writes David Hart, AIA. "Design-assist contracting is best suited for design-build or construction management at risk (CM@R) projects in which the architect and owner work with trades people, manufacturers, and subcontractors to develop a budget and project schedule for a unique solution, material, or construction application, such as reproducing historic windows or finishing plaster walls."[9]

By investing time and thoughtful planning at the initial stages of a project, universities and housing managers can better define goals for their buildings and better ensure the buildings' full realization within set timeframes and budgets.

WHAT STUDENTS ARE ASKING FOR IN HOUSING (AND WHY IT'S IMPORTANT)

With record numbers of students coming through the doors of American universities and colleges in 2016, the market for campus housing is strong. The goal for institutions of higher learning competing for this pool is not only to attract, but to retain, students. A key to gauging the demands of this audience comes via refocusing perspective. "Reduced attrition and increased retention is dependent upon a shift in perspective from an institutional to a student perspective."[10] While not a client in the traditional sense, by understanding and incorporating student desires, universities and colleges can better leverage a campus necessity—housing—as a strong suit. As institutions and housing managers adopt the mindset of students as clients, we ask the simple yet vital question: "What do students have to say about campus housing?"

Surveys Say...

In 2010, Longwood University released results from its "Student Housing Preference Survey," published in *Contemporary Issues in Education Research*: "When asked to rank the most important consideration in choosing housing, 'security' was ranked first, followed by proximity to campus and cost. For a majority of respondents, a 'deal breaker' in the housing decision included: no Internet access (92.9 percent), no laundry facilities on premises (84.9 percent), no cable TV (75.7 percent), and no kitchen (57.4 percent). For approximately half of the respondents, sharing a bedroom was a 'deal breaker' (49.3 percent) as were twin beds (42.1 percent). Surprisingly, sharing a bathroom was only a deal breaker for 11.7 percent."[4]

"Gauging Student Living Preferences," a survey of 7,095 graduate and undergraduate students, was published and prepared for *Multifamily Executive* by Houston-based J Turner Research. Mirroring results from Longwood's survey, J Turner Research found that apartment size is "a significant driver behind student housing decisions," ranking as "extremely important" by 65 percent of survey respondents. A majority of students indicated a preference for a midrise building, a community cottage, or a townhouse. Only a small percentage of students (9 percent) indicated a preference for high-rise living. Students preferred

Photo courtesy of Little/© John Cole, 2009

Pictured is the tower facade of Opus Hall at Catholic University of America. Installation of all precast concrete exterior wall panels took only 35 days, and the panels earned a 4-plus hour fire rating, an R-Value of 14.25, and a sound transmission coefficient of 54.

CASE STUDY: MUNGER GRADUATE RESIDENCE, UNIVERSITY OF MICHIGAN

In 2013, when philanthropist and University of Michigan alumnus Charles T. Munger presented the university with its largest donation in history, the gift's goal was to create a "transdisciplinary environment," allowing graduate students to interact and connect at a new level. "[Munger] believed that changing the living arrangement for graduate students could create great things," says Paul Stachowiak, president and principal in charge at Integrated Design Solutions. "By creating networks among the individual silos in which most graduate students work, we have an opportunity to create collaboration and interdisciplinary learning."

While funds were received in 2013, the project called for the eight-story, 96-suite hall to be ready for occupancy by 630 graduate students in Fall 2015. Munger also stipulated that modularization be used in a significant way.

The combined need for speed and modularization led the team to a precast concrete design. "The biggest reason for specifying the precast structure was the tight schedule," says Stachowiak. "Just behind that was the combination of durability and the ability to work with our other prefabricated components smoothly."

The contractor opted to build the necessary 730 modular bathroom units off-site. While this prefabrication saved on time and maintained quality, it required essential coordination with the precasters to ensure penetrations through walls and floors were carefully plotted. "This is a total precast structure," says Greg Kerkstra with Kerkstra Precast. "The floor system is hollowcore, bearing on the structural precast on both the interior and exterior walls behind the brick, using design assist. I can't say enough good things about our collaborative partners working with our PM John Ciulis, Walbridge, Integrated Design Solutions, and Hartman Cox." This coordination up front paid dividends on-site, allowing for quick, error-free installation. The precast frame also established a strong base on which to secure modular units.

The system saved an estimated four to six months over conventional construction, Mark Corey, senior project manager at Walbridge, estimates. The project also had savings of roughly 15 percent in materials over a project built on-site. Precast and modular elements were delivered on a just-in-time basis, keeping the site free from clutter.

Photo courtesy Cipher Imaging/Brian J. Rotert

Mixed design elements combine effortlessly on the precast facade of Jackrabbit Grove.

either modern or traditional design, with few voicing support for funky or eclectic styles.[11]

Three trends appear from data evaluating college student preferences. All students are concerned with quality of life, life safety, and healthful amenities. Making these attributes a priority through housing design pays off for universities in both enrollment and longevity, and additionally brings benefits to the student body.

Students spend more than two-thirds (70 percent) of their time at college outside of the classroom.[12] A yearlong study of 14 colleges researched on-campus involvement and sense of community among students. It found that "students who are actively involved in academic and out-of-class activities are better integrated into the academic and social life of the institution. Students are also more satisfied and more likely to graduate."

Housing is ultimately where the bulk of student time will be spent, making it a vital place to encourage student development. "The ability of residence hall students to interact with other students is also one of the most important factors in predicting their overall satisfaction in residence halls."[13] Incorporating a mix of private and public areas, along with desired amenities, allows housing to make a powerful statement for the university and its mission.

Thoughtful Amenities Aid Student Satisfaction and Well-Being

While security and housing cost are important considerations for students, the "Longwood University Student Housing Survey" revealed the following top 10 amenities that are either "very important" or "somewhat important" to students.[4]

1. Private bedroom (95.5%)
2. On-site parking (92%)
3. Double beds (91.3%)
4. On-site laundry facilities (90.3%)
5. Internet access (88.8%)
6. Proximity to campus (73.3%)
7. Fitness center (73.3%)
8. Private bathroom (73%)
9. Cable TV (56.4%)
10. Satellite dining (50%)

J Turner Research recorded fitness centers as topping the list of common areas students report using, followed by study areas and computer labs. Other popular amenities included coffee shops/cyber cafés and theaters. Space for game rooms and bike storage ranked last.

Fitness centers again topped the list of most important community features, according to J Turner Research. Parking spaces and a pool or spa also were indicated as important amenities. Large dwelling units, in-unit washers and dryers, and storage space ranked as top considerations when choosing housing. Students also indicated the importance of walkability, with the majority surveyed, 37 percent, stating that "walking is the ideal mode of transport to and from campus."[11]

Continues at ce.architecturalrecord.com

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

Green Globes Certification Overview

Enabling sustainability for all building types

Sponsored by The Green Building Initiative

Buildings in the United States account for nearly half of our national energy use and greenhouse gas emissions. They also contribute 65 percent of the waste our nation produces and consume 12 percent of our potable water. In response to this reality, more and more building owners and operators are using third-party green building certification programs to optimize and assess the environmental attributes and performance of new construction and existing buildings. The benefits associated with green building certification are not only to minimize environmental impacts but also to reduce operating costs, improve tenant retention, optimize occupant comfort, and enhance employee performance, while increasing the property's value.

GREEN BUILDING AUTHORITIES ADD VALUE TO OWNERS

The Green Building Initiative (GBI), a nonprofit organization founded in 2004 to accelerate adoption of green building best practices, provides third-party green building certifications and tools that act as roadmaps for architects, builders, and property owners so that sustainability goals are identifiable, achievable, and measurable throughout the entire life cycle of the building.

Walton Lofts in Seattle achieved three Green Globes for New Construction.

© Benjamin Benschneider Photography

There are several third-party certification programs in the United States market that overlap in their goals of promoting adoption of sustainable technologies and practices, and this course strives to support understanding of how key factors, such as flexibility and support services, can contribute to deciding which program will best match with the building or project.

GBI'S GREEN GLOBES IS A NATIONALLY RECOGNIZED CERTIFICATION PROGRAM

Among the leading national programs is the GBI's Green Globes, North America's first interactive design guidance, environmental assessment, and certification program. Green Globes assists in the design and evaluation of sustainable, high-performance buildings by:

- Increasing awareness of environmental issues with owners, designers, and operators
- Incentivizing achievement of energy, water and other performance objectives
- Providing third-party assessment of design, construction, and operations practices, which keeps teams on track in achieving goals
- Recording actionable suggestions for improvement at varying stages of project delivery through customized assessment reports
- Maximizing owner and investor value through achievement of a certified building

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Learning Objectives

After reading this article, you should be able to:

1. Recognize the environmental and occupant/tenant benefits of green building certification.
2. Identify the attributes of green building certification programs that make them applicable to all building types.
3. Explain how GBI's predesign, schematic design, and construction documents survey tools facilitate Green Globes certification.
4. Describe the Green Globes assessment process and locate additional user support.

To receive AIA credit, you are required to read the entire article and pass the test. Go to **ce.architecturalrecord.com** for complete text and to take the test for free.

AIA COURSE #K1611J

GBI acquired the rights to bring Green Globes to the United States in 2004. The United States version evolved from the Canadian Green Globes program, a web-based, interactive green building tool based on Building Research Establishment Environment Assessment Method (BREEAM). BREEAM, which was developed in the United Kingdom in 1990 and was the world's first sustainability assessment method for buildings, has achieved global recognition. Today, there are Green Globes certified buildings throughout the United States and Canada.

Since its launch in the United States, Green Globes has grown in relevance and impact. In 2012, a study commissioned by the federal General Services Administration (GSA) determined that GBI's Green Globes met the requirements of the federal government. As a result, GSA and DOE issued statements recognizing Green Globes as well as the U.S. Green Building Council's LEED rating system as the only two systems approved for use for federal buildings. Today, GBI's public sector clients include federal government agencies, such as Veterans Affairs, DHHS, DOE, NASA, NIH, and the Forest Service. Also, various state, county, and city governments include Green Globes in their incentive programs and have used Green Globes to

Image courtesy of Green Building Initiative

GREEN GLOBES®

certify their own buildings. Private sector users of Green Globes include Fidelity Investments, Jones Lang LaSalle, Whole Foods Market, Internap, and Drexel University.

GREEN GLOBES IS APPLICABLE TO ALL BUILDING TYPES

Green Globes programs are available for New Construction, Existing Buildings, and Sustainable Interiors (tenant improvements). Green Globes has been used on a myriad of building types and portfolios, including offices, warehouses, data centers, hospitals, laboratories, hospitality/multifamily, grocery stores, and mixed-use retail.

As a credible, practical, and cost-effective green building rating system, Green Globes has several unique features to allow building owners and managers to focus on addressing those aspects of sustainability most suited to achieving their operational goals.

GREEN GLOBES PROVIDES

- Online, interactive survey tool that acts as a user-friendly roadmap
- Weighted 1,000-point based system in lieu of prerequisites
- Non-applicable options that increase the flexibility of the rating system
- Collaborative approach throughout the assessment process
- Reliable and tested criteria, pathways, and references

GREEN GLOBES PROVIDES

- **Collaborative approach throughout the assessment process:** Collaboration with a green building authority is important, and Green Globes is unique because it promotes sustainable thinking throughout planning and delivery, while fostering an interactive process. Each building is assigned a GBI staff person as project manager and a third-party assessor as a technical expert.
- **Weighted 1,000-point based system in lieu of prerequisites:** Instead of requiring that teams use one specific approach, which can eliminate some buildings from even considering green certification, Green Globes assigns high point values to incentivize achievement of criteria deemed most critical to high-performing, green buildings. The point system incentivizes teams to apply green building best practices to every building, regardless of size, type, or budget.
- **Non-applicable options that increase the flexibility of the rating system:** Green Globes offers increased flexibility with the ability to enter a Not Applicable designation when appropriate. Assessment criteria can be noted as non-applicable when local codes conflict or a criterion addresses a technology that is not appropriate for the building (e.g., cooling systems if the climate or building type doesn't require their use).
- **Online, interactive survey tool that acts as a user-friendly roadmap:** The surveys generate discussion on how to achieve optimal energy conservation, water use efficiencies, responsible materials use, occupant comfort, and project team efficiencies.

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Mitsubishi Electric's business headquarters and warehouse in Suwanee, Georgia, earned two Green Globes for New Construction.

Image courtesy of Sefaira

The Benefits of a Performance-Based Design Process

New collaborative tools are helping designers consistently deliver high-performance design solutions

Sponsored by Sefaira and SketchUp

When it comes to designing new buildings and major retrofits, architects are increasingly expected to create structures that are aesthetically pleasing and functional, as well as energy efficient and environmentally sustainable. The green building market has been growing steadily over the past decade, and it is estimated to now exceed 50 percent of total construction in the nonresidential market. Between this trend, and changes to energy codes and their associated requirements, architects must reach increased performance targets. Practitioners need to be able to adapt to these changes and think differently about building design. While the building performance goals have changed, many architects are still using a traditional design process. As a result, they are finding the task of meeting requirements focused on building performance related to resource use, occupant experience, and environmental impact to be challenging.

Some of the more common problems with applying a traditional design process to achieve rigorous performance targets stem from the fragmented nature of the building industry. Indeed,

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Learning Objectives

After reading this article, you should be able to:

1. Describe the concept of performance-based design and how it impacts the energy efficiency of a project.
2. Explain how to implement a performance-based design process to support the health, safety, and welfare of building occupants.
3. List the benefits of collaboration within the design team to achieve performance goals through the design process.
4. Identify financial and environmental advantages of a performance-based design process.

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the disjointed nature of today's project-delivery methods works against achieving high-performance design. Complex projects often have so many stakeholders with different responsibilities that information is not shared early enough for informed decision making. The traditional design process puts most performance criteria, including energy efficiency, thermal comfort, and daylighting, into the hands of engineers and specialists, who are often not involved until after the architect has already established the fundamentals of the design. At this point, it may be too late to change suboptimal design decisions.

The rapid and fluid nature of modern design requires instant feedback and collaboration between architects, specialists, and engineers; however, neither architects nor engineers have historically had access to software tools that analyze designs quickly enough to keep pace with their ever-changing design needs. Traditional tools typically support only later-stage work: providing very precise, very detailed data based upon a fully fleshed-out and highly detailed design.

New buildings are complex systems, and designers often find that meeting growing performance expectations can be challenging, especially if they rely on a traditional linear and sequential design process. In essence, building design—especially for high-performance buildings—requires a new approach. Achieving performance demands an iterative and analytical approach now known as performance-based design.

WHAT IS PERFORMANCE-BASED DESIGN?

Performance-based design (PBD) is a goal-oriented design approach that specifically addresses performance-related criteria, such as energy use, operating cost, occupant comfort, daylighting, and HVAC size and cost, among others. At the heart of PBD is the intent to create an open and collaborative building process that includes architects, specialists, and engineers from the very beginning of a project.

Unlike the traditional design process, PBD requires architects and designers to set project performance goals early in the design phase so that they can understand and influence the elements that are impacting the design's performance. Once goals are set, analysis is used from the very start of the design process to assess the impact that various design decisions will have on performance goals.

It is important to note that PBD is an approach to building design that uses iterative analysis to inform decisions, supporting optimum occupant experience, lowered resource use, and minimal negative environmental impact. PBD is an approach that works to meaningfully inform building design in a way that can impact everything from energy consumption and operating costs to occupant comfort and environmental impact, and it is used from schematics and conceptual design through to the construction phase. This holistic approach is what PBD is all about, and it can empower the architect in ways that were previously not possible.

Image courtesy of Sefaira

Expectations for higher-performing buildings have prompted many architects to search for an improved and smarter way to meet design and energy-efficiency goals in projects.

PBD can help architects understand:

- Opportunities to impact performance
- Building/project constraints
- How their design compares to other buildings, to an ASHRAE 90.1 baseline, or to 2030 Challenge goals

When using PBD in their practices, architects obtain continuous feedback throughout the design process. This iterative, analytical approach is beneficial to designers and projects because this feedback helps them better understand the spaces they are designing, see how design options will impact these spaces, and make more informed decisions about their design. As a result, architects can address performance issues as part of their creative process, all while improving building design and performance.

UNDERSTANDING THE IMPORTANCE OF PERFORMANCE-BASED DESIGN

The energy performance of a building is impacted significantly by internal systems, like HVAC systems and lighting systems, and by the building envelope. While the environmental and financial benefits of a PBD approach are discussed later in the course, it is important to understand how and why design decisions can impact certain systems. When it comes to designing high-performance buildings, energy use is one of the most important considerations, and the decisions surrounding it can impact occupant comfort as well as operational costs. For example, when a PBD approach is used for a project, architects and designers can quickly and iteratively explore the energy and comfort impacts of different glazing and shading strategies for a building's windows, and this can directly impact HVAC and electrical system needs. By comparing the tradeoffs between desired daylighting levels, energy use, and comfort needs, architects can make sure they include properly sized mechanical systems, appropriate window materials and glazing, and alternative electrical systems if needed. For example, the capital cost of installing photovoltaic cells may be offset by the lifetime operating costs of electricity. PBD can help designers understand this tradeoff at the start of the project.

Because of the complexity of modern design, the various aspects of building performance, comfort, health, and safety are interrelated and can't be considered in isolation.

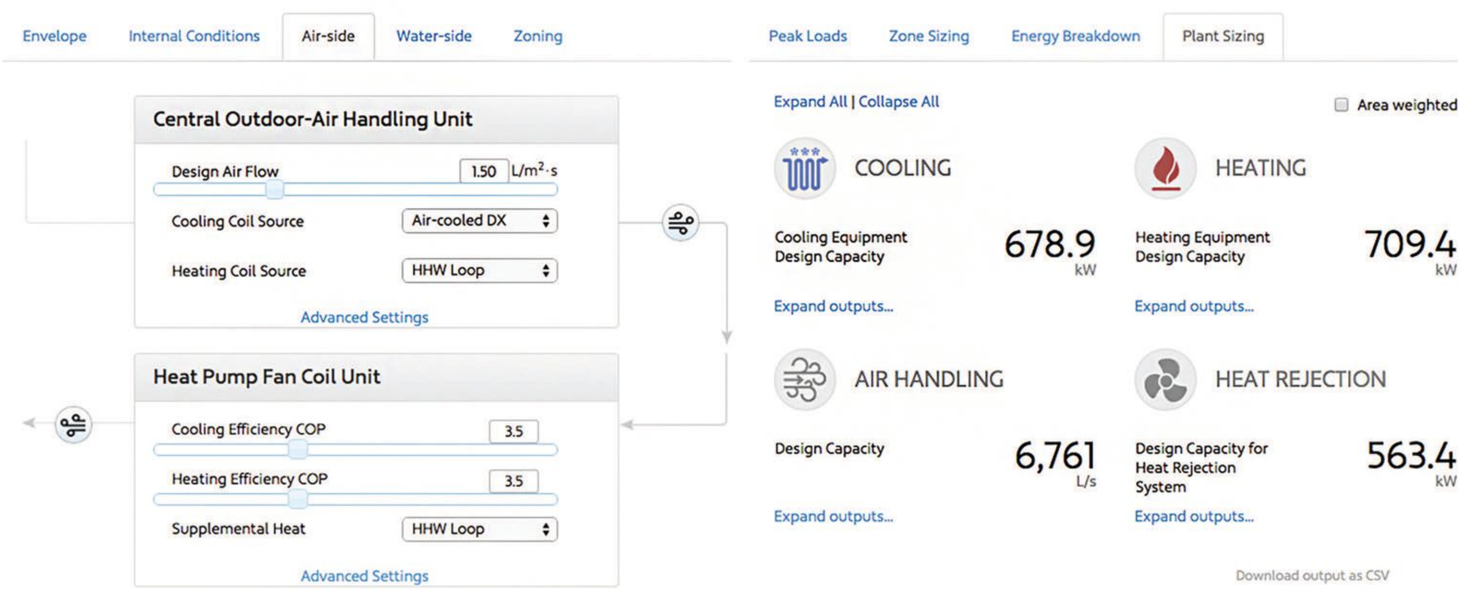
Windows are a prime example of this. Adjusting the size, glazing, and thermal performance of the window affects more than just the quantity of light entering the building. Window performance has a cascading impact on the comfort of the occupants and the overall energy use of the building. Window performance determines how much solar gain gets into the space, which affects the cooling load. Windows also impact heat loss by conduction through the glass, which affects the heating load. In turn, expected heating and cooling loads should determine the size and type of the HVAC system, which then impacts capital costs and operational energy costs. The traditional design approach often has HVAC and envelope decisions, like windows, made independently rather than considering their impacts together. With a PBD approach, if an architect reduces glazing area or adds shading to a project, the PBD tool would incorporate this potential reduction in cooling load and, in response, reduce the size of the system or suggest a different system type altogether.

To better understand the impact of PBD, let's examine some of the potential benefits to this new design philosophy when attempting to create more sustainable, comfortable, and safe buildings.

Construction Resource and Energy Use

Green building has become mainstream, to such an extent that every phase of construction—from resource extraction, processing, and transportation to physically constructing the building—must now be taken into account when evaluating a project's sustainability. And the ability to understand and evaluate all of these interrelated inputs early in the design phase—by using a PBD process—can help optimize the performance of the design.

Image courtesy of Sefaira



Properly sizing the HVAC system is critical not only for both occupant comfort and energy costs, but also for capital costs.

Post-Construction Energy Costs

Post-construction energy costs are just as important, if not more so, than the energy costs incurred during construction. The operational costs associated with machinery and HVAC equipment, electrical systems, as well as ongoing maintenance costs all contribute to the lifetime cost of the building.

Projects that use a PBD approach in their design process can better estimate the ongoing energy needs of the building before it is even created. Operational costs are a direct result of design decisions and will impact the energy use and maintenance costs of the building over the course of its entire functional lifetime. The PBD approach helps designers minimize these costs by setting performance goals and metrics, and determining the best way to meet those goals through the decisions they make early in design.

Proper Sizing of HVAC Equipment

Architects and builders need to understand how to size their HVAC systems to match the actual needs of a project in order to maximize the project's efficiency, and they need to make sure that the system is properly installed in order to maintain energy efficiency, particularly in a high-performance building.

When it comes to HVAC systems, more often than not, architects rely on engineers to properly size equipment. Engineers, wanting to avoid costly mistakes, build redundancy into their systems, which often means "bigger is better." But with high-performance, energy-efficient buildings, "bigger" may simply mean more costly and energy intensive, and may result in over-heated and over-cooled buildings, which ultimately negatively affect occupant comfort. A system that is much too small for the space will fail to meet occupants' comfort needs. However, a slightly undersized HVAC system—roughly 10 percent or less—has been found to operate more efficiently than a perfectly sized system. Moreover, a system that has been designed for continuous operation can provide more uniform heating and cooling, as well as help maintain proper air humidity levels.

A properly sized HVAC system paired with a carefully designed and operated building can reduce the capital costs of a project when compared to an oversized system, and can improve occupant comfort, all while reducing utility costs and improving overall operating efficiency. The PBD process considers heating and cooling loads early enough that they can still be meaningfully changed by adjusting the design, whereas the traditional design process takes heating and cooling loads as a given, then designs an often oversized HVAC system to meet those needs. The PBD approach allows for a much more comprehensive evaluation that includes all the known parameters before committing to an HVAC system for the project.

Daylighting

As noted earlier, daylighting (i.e., using natural light to illuminate a building's interior) is one of the more important elements to consider when designing for occupant comfort. The challenge, however, is that too much natural light can be too bright for occupants, and it can increase cooling loads and energy use. A beautiful view that brings in sunlight for a good part of the day may be great for the occupant experience, but not if it means that the space is too bright or too warm, especially in already warm environments. Moreover, the stress that too much daylight can have on the HVAC system (i.e., cooling) can affect both the capital and operational costs of the building, as the system may need to be replaced sooner and may be required to run more often

As a way of avoiding some of these problems, a building designed with the PBD approach can introduce, analyze, and ultimately balance the many interrelated factors that can affect daylighting performance. From the very start of the project, architects and designers can consider window glazing ratios, glazing locations, and glazing materials, as well as how different shading strategies may impact building design, occupant comfort, energy use, and HVAC size.

Implementing a PBD approach on a project can help architects and designers better understand the impact of daylight and direct sunlight. They can thus improve their designs and find the balance between aesthetics, occupant comfort, and overall performance. Some of the common design questions that architects can deal with more effectively using a PBD process include: detailed shading design, passive solar design, exterior solar access, sunlight prevention to light-sensitive spaces, and how to meet certification requirements.

IMPLEMENTING PERFORMANCE-BASED DESIGN

Once an organization or project team has decided to incorporate a PBD approach, initiating the process can be relatively simple, but it requires a thoughtful review of the current methods and design tools used. The critical milestones in the PBD process includes: setting relevant performance goals for a project, performing an analysis of those goals, and evaluating the results. At each of these milestones, it is important the design team be able to easily communicate with all the key players in the process and then "course correct" as needed to achieve project goals.

Setting Goals

Let's look at the first step: setting measurable project goals. Goals are critical to the process because they do three key things. First, they let the team link client values to measurable performance metrics. If a client is interested in achieving net-zero energy in a project, for example, an obvious and measurable goal would be optimizing energy use and energy generation such that the net energy use of the building is zero. Second, setting goals focuses the team on asking relevant questions for the project. Again, this links to the goals and to the client requests, and the questions help narrow the focus to a measurable metric. For example, a client may wish to emphasize annual energy efficiency in the building design, but is unable to pinpoint what specific level of energy performance he or she is seeking. With precise, measurable goals, the team can work through iterative analysis to achieve the desired level. Finally, setting project goals is useful for clear communication both within the design team and with the client. When the team sets up a clear structure for its goal setting and has a clear plan for iterative analysis, it can present its findings and progress very clearly to the client over the course of the project.

As an example, consider a common goal in modern design—the request for "good daylighting." The design team might translate this into a daylight autonomy target based on best practices or specific guidelines, such as LEED daylight credits. Clearly established project goals set the design limitations and needs for the entire project. This "eye on the prize" approach helps focus the entire design and construction team on achieving measurable performance criteria and requires that every part of the building process be aligned with these criteria.

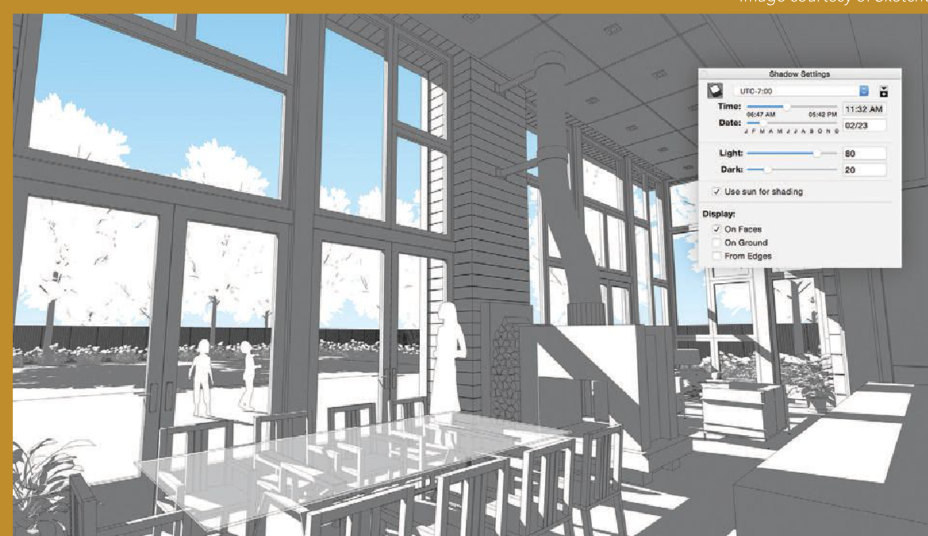
IMPORTANCE OF DAYLIGHT

The benefits of incorporating natural light into projects to both enhance the occupant experience and as part of a performance-based design process are significant. Natural lighting is both a sustainable and energy-saving feature and a health and wellness feature for occupants.

As architects strive to balance aesthetic design with meeting the 2030 Challenge energy targets, they often must make tradeoffs between energy use and daylighting. Metrics such as glare, or annual sunlight exposure, need to be compared with energy use and cooling load to help make sure that both daylight and energy goals are met. In multistory buildings, these tradeoffs may need to be done on a floor-by-floor basis, which makes the process even more complicated.

A performance-based design process that incorporates modern software can ease this challenge by providing designers with information about surfaces (e.g., reflectivity, specularity, roughness), the surrounding surface area (e.g., cement vs. grass), and data about the local weather and typical sky conditions. The combined information includes both energy and daylight analysis so that designers can make informed tradeoffs on the amount and type of glazing to include in a project, while maximizing the amount of daylight.

Image courtesy of SketchUp



Modern software applications can provide visual simulations of expected daylighting, including shadows specific to site location and time of day.

Analysis

Once these goals are set, a PBD approach implements a phase of iterative analysis. This phase links directly to the project goals, and can help the team identify its design direction. The iterations may include performance comparisons across a variety of alternative options or optimized performance for a single design, and they can be done very early in the design process. After the initial performance goals are set, the design team should plan to:

- Ask specific questions about the design.
- Undertake a lot of small analyses.
- Focus on the deliverable and the output.

By asking questions about the design—both internally and with the client—the design team can better narrow down its own analyses and perhaps think differently about ways to approach design problems in the project.

Traditional design is a more isolated and independent approach that separates architects from engineers and specialists until specific questions need to be addressed. PBD, on the other hand, requires ongoing collaboration, where each design decision is evaluated for its impact on the overall goals of the project. Fortunately, new tools have been developed to enable PBD and the collaboration it requires.

The Power of Advanced Software

Analysis of the building as a whole can be done almost instantaneously and in an open and collaborative context thanks to new software applications.

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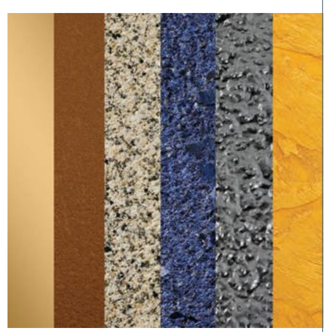

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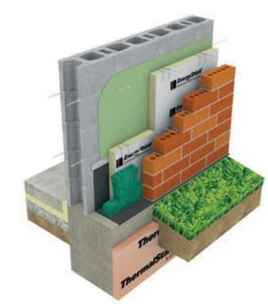

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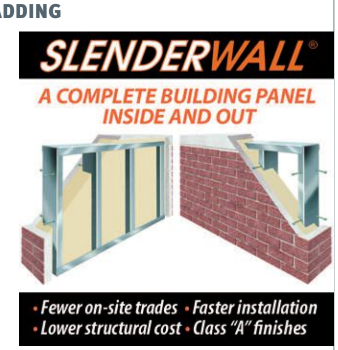

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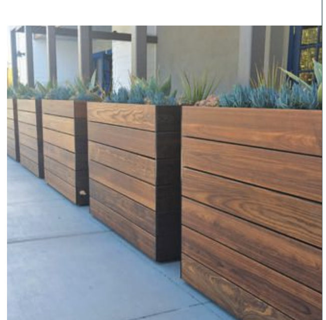

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The Department of Architecture in the College of Architecture, Art, and Planning at Cornell University invites applications for the position of ***Department Chairperson****.*

Situated at Cornell University, the department includes two top-ranked, internationally renowned professional programs — the B.Arch and M.Arch degrees — as well as research-focused post-professional degrees and a Ph.D. in the history of architecture/urban development. The department's faculty includes emerging and established practitioners, scholars, and an array of internationally distinguished visiting faculty. In addition to the Ithaca, NY campus, the department also has semester-long programs in New York City and Rome.

Qualifications for this position include a record of distinction in professional practice and/or research, scholarship, and teaching; experience in academic administration; and a demonstrated commitment to excellence in teaching and research.

Interested individuals should send a letter of application that indicates how their skills and experiences align with the stated qualifications for the position along with a resume that reflects notable achievements and a 10 page (maximum) summary portfolio of creative work.

Review of applications begin November, 2016, and will be accepted until the position is filled. The new department chair appointment will begin July 2017.

Please apply using the university's online application tool at:
https://academicjobsonline.org/ajo/jobs/8130

Additional information:
Architecture Chair Search Committee - Department of Architecture
College of Architecture, Art, and Planning
139 East Sibley Hall, Cornell University, Ithaca, NY 14853-7301
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Ⓡ Regional AD

New and Upcoming Exhibitions

Question the Wall Itself
Minneapolis
November 20, 2016–May 21, 2017
Question the Wall Itself examines ways that interior spaces and décor can be fundamental to the understanding of cultural identity. This multimedia exhibition at the Walker Art Center showcases work by 23 international, multigenerational artists who explore the political and social dimensions of interior architecture as well as its complicated relationship to history and their own backgrounds. The show presents a breadth of pieces conceived as rooms—from the anteroom, prison cell, and living room to the library, showroom, and garden. Through the artists' examinations of such spaces, both public and private, the contexts of these environments are revealed. For more information, visit walkerart.org.

Ongoing Exhibitions

Narcissus Garden at Johnson's Glass House
New Canaan, Connecticut
Through November 30, 2016
To celebrate the 110th anniversary of Philip Johnson's birth and the 10th anniversary of the Glass House's public opening, the house is hosting an installation by Japanese artist Yayoi Kusama. *Narcissus Garden*, initially created for the 33rd Venice Art Biennale in 1966, has been incorporated into the 49-acre site around the Glass House. The piece consists of 1,300 steel spheres floating on a newly restored pond, providing a dramatic view leading up to the house. Visit theglasshouse.org.

Michael Sorkin Studio and Terreform: Metrophysics
Los Angeles
Through December 4, 2016
Metrophysics foregrounds projects with meanings rooted in the urban, including buildings and sites designed with practical and polemical intent. On view at SCI-Arc, the work is from a team that operates as both a "traditional" architectural studio responding to clients and as a research practice that formulates its own agenda of investigation and intervention. For more information, visit sciarc.edu.

Oskar Hansen: Open Form
New Haven, Connecticut
Through December 17, 2016
Oskar Hansen: Open Form traces the evolution of Hansen's theory of open form from its origin in his own architectural projects to its application in film, visual games, and other artistic practices. Hansen was a member of Team 10, the architectural group that formed the first critical voice against the modernist orthodoxy of the Athens Charter and the followers of Le Corbusier. In his open-form theory, Hansen proposed parting with the model of the all-knowing expert to allow participation by viewers and a shifting hierarchy between artist and viewer. The exhibition, at the Yale School of Architecture, is divided into seven sections exploring Hansen's theories. For more information, visit architecture.yale.edu.

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

Lectures, Conferences, and Symposia

Solano Benítez & Gloria Cabral
New York City
November 7, 2016
The Architectural League's Current Work series features international figures who powerfully influence contemporary architectural practice and shape the future of the built environment. Solano Benítez & Gloria Cabral will present the work of their firm, Gabinete de Arquitectura, in this public lecture at Cooper Union. Gabinete de Arquitectura creates and constructs buildings made of vernacular materials that can withstand the nation's extreme heat and heavy rains, using the specialized knowledge of Paraguayan laborers. The architects rely on this expertise as a source of innovation in their designs and their construction. Visit archleague.org.

NeoCon East
Philadelphia
November 9–10, 2016
NeoCon East, a design expo and conference for commercial interiors on the East Coast, will return to Philadelphia for its 14th edition. This year's NeoCon East will feature partnerships with a host of regional design organizations, as

well as current products and services—ready to specify—across a spectrum of vertical markets. Visit neoconeast.com.

In Our Time: A Year of Architecture in a Day
New York City
November 12, 2016
In Our Time: A Year of Architecture in a Day presents some of 2016's most critical design projects in a daylong event organized and hosted by the Metropolitan Museum of Art. Architects, curators, theorists, photographers, and filmmakers construct a global view of contemporary architectural practice. Participants include Wolfgang Tillmans, Yves Behar, Malkit Shoshan, Ensamble Studio, and more. This program is free with museum admission, and seating is first come, first served. Visit metmuseum.org.

Daniel Libeskind | Steven Holl | Elizabeth Diller
New York City
November 14, 2016
The new book *Never Built New York* paints the picture of an alternative New York, with renderings, sketches, models, and stories of proposals for the city that never came to be. During this related lecture, at the New York Public Library, internationally acclaimed architects Daniel Libeskind (one of the book's authors), Steven Holl, and Elizabeth Diller come together to envision such an alternate city. Visit nypl.org.

World Architecture Festival 2016
Berlin
November 16–18, 2016
This year's festival, in addition to awarding prizes for both completed and proposed build-

Statement of Ownership, Management, and Circulation (Requester Publications Only)

Publication Detail

1	Publication Name	ARCHITECTURAL RECORD/BNP MEDIA II, LLC
1	Publication Number	132650
2	ISSN	0003858X
3	Filing Date	09/30/2016
4	Issue Frequency	MONTHLY
5	Number of Issues Published Annually	12
6	Annual Subscription Price	72.00
7	Complete Mailing Address of Known Office of Publication	2401 W. BIG BEAVER 700
7		TROY, OAKLAND, MI 48084
7	Contact Person	WAFAA KASHAT
7	Telephone	(248) 786-1631
8	Complete Mailing Address of Headquarter or General Business Office of Publisher	"2401 W. BIG BEAVER RD., STE. 700"
8		TROY
9	Publisher (Name and complete mailing address)	ALEX BACHRACH
9		350 5TH AVENUE
9		NEW YORK, NY 10118-0110
9	Editor (Name and complete mailing address)	CATHLEEN McGUIGAN
9		350 5TH AVENUE
9		NEW YORK, NY 10118-0110
9	Managing Editor (Name and complete mailing address)	BETH BROOME
9		350 5TH AVENUE
9		NEW YORK, NY 10118-0110

Owner

10	***Line***		***Full Name***	***Complete Mailing Address***
10		1	BNP MEDIA II, LLC	2401 W. BIG BEAVER RD., STE 700, TROY, MI 48084-3333
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10		3	HARPER T. HENDERSON	2401 W. BIG BEAVER RD., STE 700, TROY, MI 48084-3333
10		4	MITCHELL L. HENDERSON	2401 W. BIG BEAVER RD., STE 700, TROY, MI 48084-3333

Known Bondholders, Mortgagees, Other Security Holders

11	***Line***	***Full Name***	***Complete Mailing Address***

13	Publication Title	ARCHITECTURAL RECORD/BNP MEDIA II, LLC
14	Issue Date for Circulation Data Below	09/01/2016

15	***Extend and Nature of Circulation***	***Average No. Copies Each Issue During Preceding 12 Months***	***No. Copies of Single Issue Published Nearest to Filing Date***
15a	Total Number of Copies (net press run)	99783	98420
15b1	Outside County Paid/Requested Mail Subscriptions stated on PS Form 3541. (Include direc written request from recipient, telemarketing and Internet requests from recipient, paid subscriptions including nominal rate subscriptions, employer requests, advertiser's proof copies, and exchange copies.)	62239	63838
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15b3	Sales through Dealers and Carriers, Street Vendors, Counter Sales, and Other Paid c Requested Distribution Outside USPS	5380	5984
15b4	Requested Copies Distributed by Other Mail Classes Through the USPS (e.g. First-Class Mail)	5	17
15c	Total Paid and/or Requested Circulation	67624	69839
15d1	Outside County Nonrequested Copies stated on PS Form 3541 (include Sample copies, Requests Over 3 years old, Requests induced by a Premium, Bulk Sales and Requests including Association Requests, Names obtained from Business Directories, Lists, and other sources)	26219	24134
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15d4	Nonrequested Copies Distributed Outside the Mail (include Pickup Stands, Trade Shows Showrooms and Other Sources)	1315	788
15e	Total Nonrequested Distribution	27534	24922
15f	Total Distribution	95158	94761
15g	Copies not Distributed	4625	3659
15h	Total	99783	98420
15i	Percent Paid and/or Requested Circulation	71.06	73.70

16	***If total circulation includes***	***electronic copies, report that circulation on lines below***	
16a	Requested and Paid Electronic Copies	277	526
16b	Total Requested and Paid Print Copies (Line 15c) + Requested/Paid Electronic Copies	67901	70365
16c	Total Requested Copy Distribution (Line 15F) + Requested/Paid Electronic Copies	95435	95287
16d	Percent Paid and/or Requested Circulation (Both print & Electronic Copies)	71.15	73.85
	I Certify that 50% of all my	***distributed copies (Electronic & Print) are legitimate requests.***	

17	Publication of Statement of Ownership	Publication of this statement will be printed in the 11/01/2016 issue of this publication
18	Signature and Title of Editor, Publisher, Business Manager, or Owner	WAFAA S. KASHAT
18	Title	Audience Audit/Postal Specialist
18	Date	09/30/2016 02:15:05 PM
Version	PS Form 3526, September 2007	

dates&events

ings, will include a robust roster of seminar speakers, including Richard Rogers and Moshe Safdie, who will touch on topics relating to large-scale housing: for dense cities, for refugees, in relation to luxury, energy efficiency, and more. There will also be panels focused specifically on the revitalization of post-Wall Berlin and architecture tours of the area running on all three days of the festival Additionally, there will be on-site "live crits," where architects and designers can receive feedback on their project ideas in real time. Visit worldarchitecturefestival.com.

Realities and Realms
Cambridge, Massachusetts
November 18, 2016
This colloquium at Harvard University focuses on the role of computation and robotics in landscape architecture and the expanding sensorial field of the built environment. These hybrid grounds of operation merge anthropogenic perception and technological mediation. As sensing networks expand, data grow exponentially in quantity and ubiquity, building an increasingly abstract landscape of information. How such data are elucidated, curated, and augmented forms new realities for design. This colloquium will explore design methodologies that address concurrent physical and virtual realms and the realities in which they operate. Visit gsd.harvard.edu.

Competitions

Call for Applications: 2017 Carter Manny Award
Submission deadline: November 15, 2016
The Graham Foundation is accepting applications for the 2017 Carter Manny Award, the organization's annual award for Ph.D. students working on dissertation topics in architecture. Established in 1996, the award recognizes innovative and advanced scholarship on architecture's role in the arts, culture, and society. Two of these awards are given each year, one for writing and one for research. For more information, visit grahamfoundation.org.

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

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

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PROJECT **TANGENTIAL DREAMS**
LOCATION **BLACK ROCK DESERT, NEVADA**
DESIGNER **MAMOU-MANI**

AMONG THE dozens of temporary installations erected at this summer's weeklong Burning Man festival in the Nevada desert, *Tangential Dreams*—an undulant timber tower designed by French architect Arthur Mamou-Mani—was a celebration of mathematics, teamwork, and free spirit. The climbable 20-foot-high structure comprised a helicoid framework and 1,000 plywood "tangents," and was designed using a set of algorithmic rules, which Mamou-Mani tested with 3-D models in his London digital-fabrication lab. To realize the project—a winner of one of the festival's annual arts grants—the architect enlisted students and faculty from his graduate architecture studio at London's University of Westminster. The crew constructed three modules in a Reno art space before transporting them to the arid site, where they joined the pieces with wooden screws. "The toughest part was assembling in the middle of the desert—we couldn't go to Walmart for supplies," says Mamou-Mani. Strong winds and sandstorms posed more obstacles for the team, which worked in shifts to build the 70-mile-per-hour-wind-resistant structure. At night, the tower "became a huge party" as LEDs transformed it into a multicolor beacon of light. In line with Burning Man's climactic pyrotechnic tradition, the piece became engulfed in a spiraling blaze—"like a 3-D flame"—at the festival's close. *Alex Klimoski*

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