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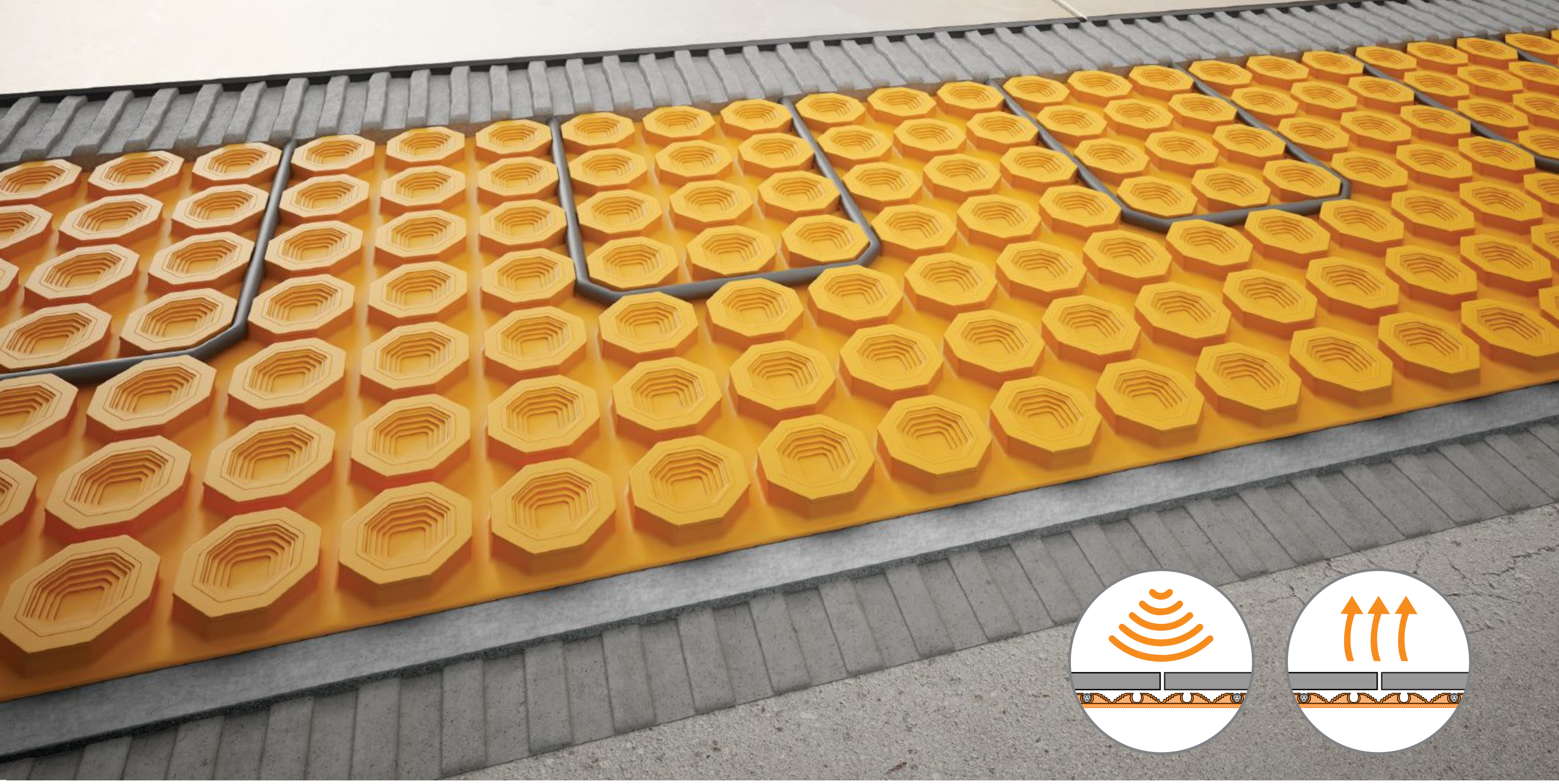

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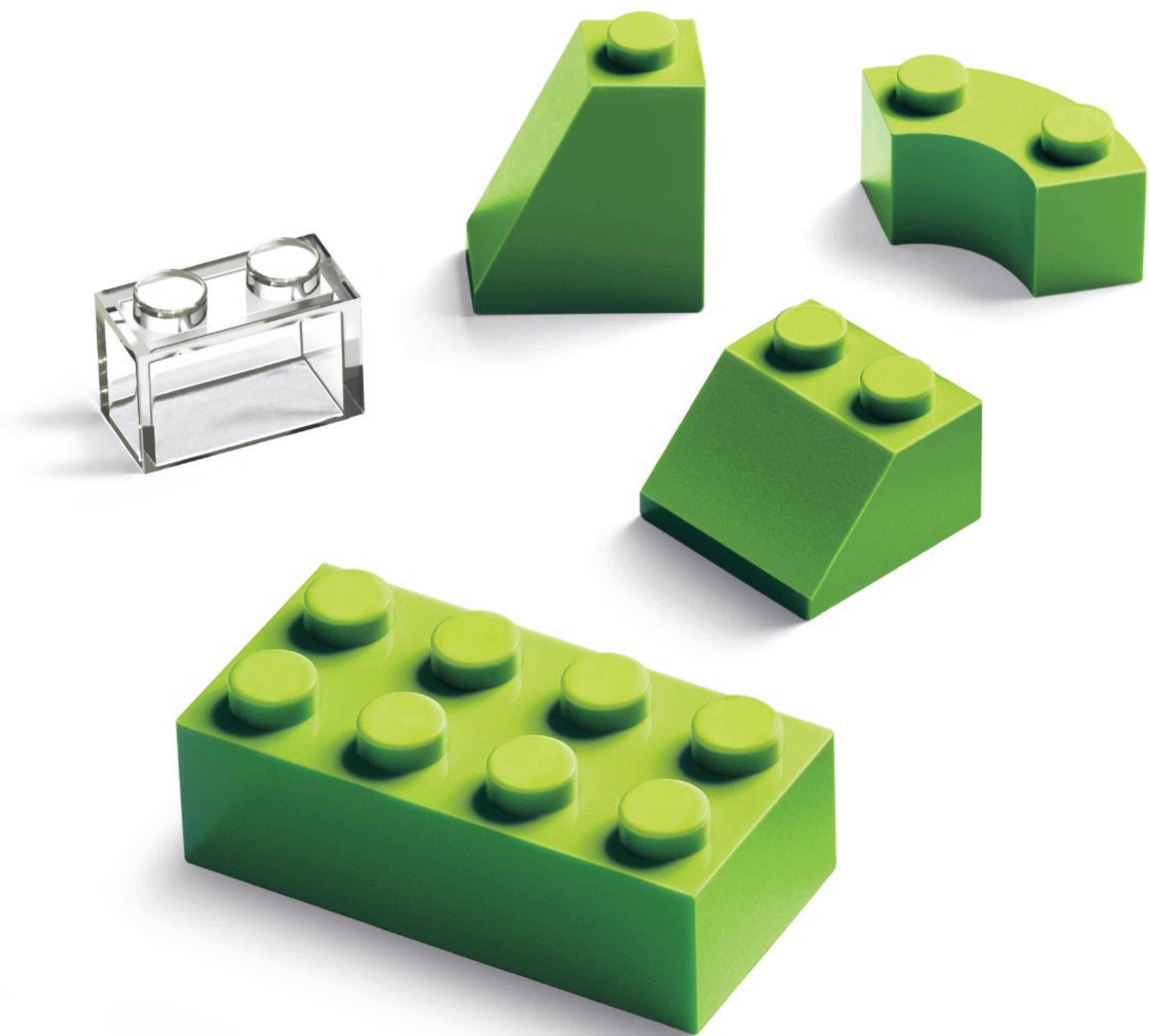


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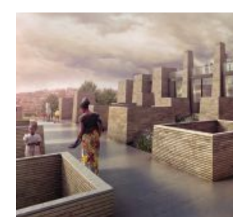
On the cover: GHESKIO Tuberculosis Hospital in Port-au-Prince, Haiti, by Mass Design Group. Photo by Iwan Baan



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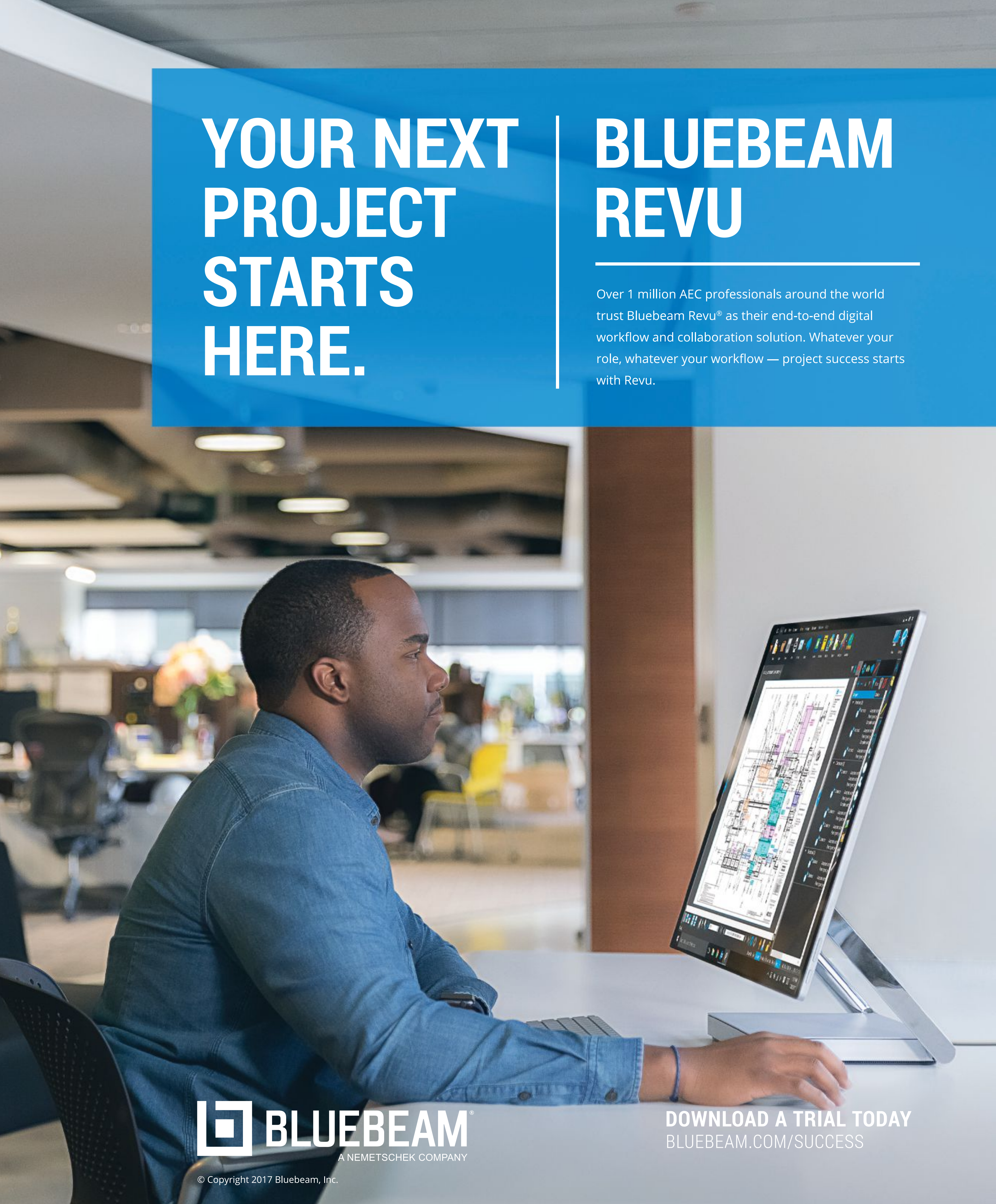
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The latest interdisciplinary contribution to the cannon of biomimicry comes to us from the Institute for Computational Design and Construction (ICD) and Institute of Building Structure and Structural Design (ITKE) at the University of Stuttgart in Germany. Professors Achim Menges and Jan Knippers led a group that studied the silk "hammocks" created by the larvae of leaf miner moths and programmed a drone to pass roughly 144 miles of resin-filled glass and carbon fiber between two stationary industrial robotic arms to weave this roughly 39-foot-long cantilevered pavilion. —KATHARINE KEANE

> *To read more about the ICD/ITKE Research Pavilion 2016–17, visit bit.ly/LarvaeSilkPavilion.*

JIAXI & ZHE

Resting in Peace

More than 200 grave sites of late designers are alphabetically listed and illustrated across 152 pages in Henry Kuehn's *Architects' Gravesites: A Serendipitous Guide* (MIT Press, 2017). While Kuehn expected to find glorious monuments dedicated to the men and women who shaped urban landscapes around the world, he was surprised to discover that the vast majority are remembered by modest markers and that many chose cremation over interment. Each entry in the book has a photograph and a short note about the individual's resting place, such as Michael Graves' utterly fitting postmodern tombstone (above). —SELIN ASHABOGLU

> *To see a batch of Henry Kuehn's photos and read more about his book, visit bit.ly/ArchitectsGraves.*

FABRICE DALL'ANESE

Calculating a Grotto

Architect Michael Hansmeyer believes computational design will change architecture as we know it. His *Grotto II*, a 7-metric-ton stalactite-and-stalagmite-esque work so complex it boasts 1.3 billion individual surfaces, was fabricated for Paris' Centre Pompidou on a sandstone 3D printer using a subdivision-based algorithm that created details as small as a grain of sand. He and fellow programmer Benjamin Dillenburger used a supercomputer at ETH Zurich to process the design in pieces and then assembled them in Photoshop. The extreme detail meant they couldn't be sure what *Grotto II* would look like until it was finished. —CHELSEA BLAHUT

> *Read more about Michael Hansmeyer's* Grotto II *and its predecessor,* Grotto I*, at bit.ly/DigitalGrotesque.*

JOSHUA WHITE

(De)Constructing PoMo

We are deep into a Postmodernism revival, one that, to this point, has played out mostly in drawings, models, and photographs. But "The Duck and the Document: True Stories of Postmodern Procedures," on view at SCI-Arc until May 28, salvages other kinds of artifacts from the dustbin of history. Curated by UCLA professor Sylvia Lavin, the exhibition includes actual building fragments and reproduced construction correspondence—thick binders of letters, invoices, and assorted memorandums from the offices of Venturi & Rauch (the duck originators), Charles Moore (Sea Ranch utopian), and Mike Reynolds (Earthship pilot), among others. —MIMI ZEIGER

> Read a full review of the exhibition at bit.ly/DuckandtheDocument.


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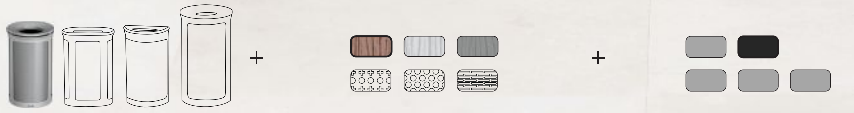

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Best Practices: Preventing Employee Burnout

TEXT BY SARAH RAFSON

The cutthroat culture of design that has architecture students working the longest hours of any major in college often continues into practice. While workloads—and work habits—are hard to change, architects are less likely to burn out when they feel a sense of competence, control, support, flexibility, and humor in their day-to-day. Here are tips for building a healthy, successful firm culture from practitioners and psychologists alike.

Reward Hard Work

Everyone's capacity for stress is unique, but clinical psychologist Stevan Hobfoll's Conservation of Resources theory proposes one common characteristic: Stress occurs when an individual's "resources" are taxed without a feeling of reward. A canceled project can be demoralizing after long hours of work and zero payback. Sarah May Bates, host of the *Help Me Be Me* podcast, suggests that in these cases, showing the project and lessons learned to someone who will value that work—peers or family—can promote resilience and confidence. "The key to everything we do is a sense of purpose," May Bates says. "It's a stronger motivator than money." Thus, managers can help "create a sense of accomplishment" in their teams by displaying canceled projects internally as "ideas that shouldn't die," repurposing them as training material, or even recycling concepts in future work.

> "The onus *has* to be with the individual, but companies can help."
>
> —Nigel Marsh, author and TED Talk speaker

Better Breaks

Recovery time is also essential. After stressful bouts of work, a long vacation might seem like the ideal way to recharge, but research shows that the quality of time off matters more than quantity. Charlotte Fritz, associate professor of psychology at Portland State University, in Portland, Ore., has found that the effects of longer vacations wear off quickly, but shorter, more frequent vacations have a greater positive impact.

Fritz's research also shows that weekends are vital to long-term well-being. Inevitably, weekends will contain non-work-related stressors—housework, car troubles—which can drain energy needed for the workweek. However, spending quality time with loved ones and reflecting positively on work correlate directly to increased happiness and productivity. In the end, promoting better breaks can reap dividends for employers: In addition to fostering a happier, more effective staff, it also helps the bottom line. "Turnover is expensive and demoralizing for the rest of the team," Fritz says.

Personal Choices or Policy?

How much of the responsibility for employee burnout prevention is on the employer? The notion of overwork is particularly idealized and widespread in architecture, Fritz notes. Though this is not easy to change, "the role of the team leader is very important to working against that image" by modeling positive behavior, lending support, and setting reasonable expectations. "Small changes in an organization can make a big difference," she says.

However, author Nigel Marsh suggests in his widely viewed 2010 TED Talk, "How to Make Work-life Balance Work," that employers—even the well-meaning ones—should never be trusted to ensure employee wellness. "The onus *has* to be with the individual," he tells ARCHITECT, "but governments and companies can help."

For example, Robert A.M. Stern Architects (RAMSA) promotes a healthy work environment starting "on the most basic level, by ensuring that all our projects are appropriately staffed," says chief operating officer Lisa Matkovic.

In addition to aligning work with employees' interests, the New York firm provides staff lunches and dinners as deadlines approach, and comp days and celebratory dinners after deadlines are met. RAMSA also prioritizes professional development and social interactions at work with "class trips, drawing outings, sports teams, as well as lectures and happy hours," Matkovic says. "We want people to know they're among friends."

> *To learn more about strategies for avoiding employee burnout, visit bit.ly/AREmployeeBurnout.*


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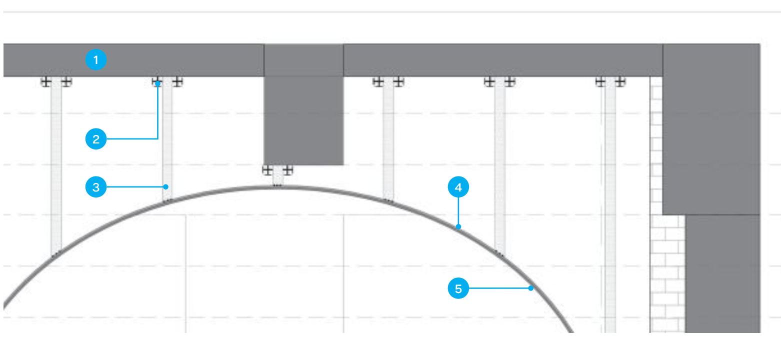
Detail:
Anil Drapes Retail Vault

TEXT BY TIMOTHY A. SCHULER



A far cry from the multifamily housing projects that fill the portfolio of the Bengaluru, India–based Purple Ink Studio, Anil Drapes (AD) Retail is a local wholesale textile showroom tucked completely inside an old warehouse with no access to daylight. "It completely contradicted our approach and the openness that we love," says principal architect Akshay Heranjal.

Inspired by the histories of drapery and arched windows, Heranjal and his team designed a freestanding wooden arcade and vault at the center of the store's concrete shell. The 24-foot-long, 9-foot-tall structure partitions the store into reception and meeting areas while preserving wall space to display racks and shelves of fabrics.

The designers drew the vault, which includes a series of double-curved arches, first by hand and then in Trimble SketchUp. The contractor, Mumbai-based MM Interiors, then created a series of physical mock-ups. The vault is supported by eight wood-framed columns that form a central aisle flanked by a series of three arches.

Each component of the arcade was manually measured, cut, and installed. Even power sanders were eschewed in favor of sandpaper. "It was completely handcrafted," Heranjal says.

Heranjal's team worked with MM Interiors to form the curved profiles of the support ribs first in 0.5-inch plywood. Once the framework was satisfactory, the team duplicated the ribs in teak and attached them to teak battens nailed into the concrete slab ceiling. The team then fitted and nailed a layer of Flexi Ply to the teak rib profiles, and then adhered and nailed a teak veneer to the Flexi Ply.

Despite its obscure location, AD Retail is garnering foot traffic. The owner previously had to travel to his clients, taking fabric samples with him. Now, buyers from hotels and other companies are visiting his showroom, Heranjal says. "It's a place that they want to experience."

1. Existing concrete structure
2. 1" teak batten (typ.)
3. 0.5" teak rib, cut to curved profile (typ.)
4. 6mm Flexi Ply, cut to form vault surface and nailed to ribs
5. 4mm teak veneer, glued and nailed to Flexi Ply

SHAMANTH PATIL

> *Learn more about the Purple Ink Studio's design and construction process for AD Retail at bit.ly/ARADRetail.*

Next Progressives: Nomi

EDITED BY KATHARINE KEANE

Location:
Lexington and Louisville, Ky.

Founded:
2015

Leadership:
Matthew Brooks, AIA

Education:
B.Arch., University of Kentucky

Experience:
Beckhard Richlan Szerbaty & Associates and Omni Architects

Matthew Brooks

Firm size:
15

Mission:
Nomi is an architecture, design, and fabrication studio that works on a variety of project types at multiple scales, from high school campuses to an individual table. The diversity of our work strengthens our practice by challenging us to continue learning, problem-solving, and collaborating with new people.

Ultimately, we want to improve the lives of people using our buildings and products. So, whatever the type or scale, we apply the same research-based intensity to develop smart designs that are specific to each project.

Memorable learning experience:
When I was living in New York, I found a job building models through an ad placed in the newspaper by Acconci Studio. Vito Acconci does these amazing installations that blur the line between art and architecture. But of course, he is also well known for his, shall we say, unconventional performance art. Those were two interesting weeks.

Origin of firm name:
Just like our approach to design, choosing a name was a collaborative effort. Everyone was invited to add names and ideas to a shared document, which ended up being about nine pages long. We narrowed that list down to a few names and ultimately Nomi was chosen. In Italian, it means "names." In Japanese, it refers to a type of wood chisel. We all agreed the duality of the meaning was perfect.

Favorite project:
In 2014, we won the York Street Challenge, an affordable-housing design competition organized by a local community development nonprofit. We loved everything about the competition; it had the potential to change the way we think about residential construction.

Inspired by open-source projects, we proposed to build the York Street Maker Spaces project ourselves, using CNC fabrication. Ultimately, the wood structure for the houses became an assembly of milled pieces that fit together like a puzzle. The pre-cut parts were delivered on pallets and constructed on site using only rubber mallets, screw guns, and a little elbow grease. The idea that an affordable house can be assembled by its owner on site is really exciting to us.

Second favorite project:
Our Louisville office space is special because it was the first time we translated a purely conceptual idea into a built form. I sketched out an idea of plywood that would be bent and manipulated to form workstations. We were able to research and develop a way of making those pieces that was very close to the original vision.

Design tool of choice:
A block of wood—it holds so many possibilities. It can be drawn on, carved into, or cut through; it can be joined with other materials or stand alone.

Superstitions:
Plenty. But I'm too superstitious to name them.

Vice:
Kentucky bourbon.

COURTESY NOMI

> To read more about Nomi's projects and inspirations, visit bit.ly/ARNomi.

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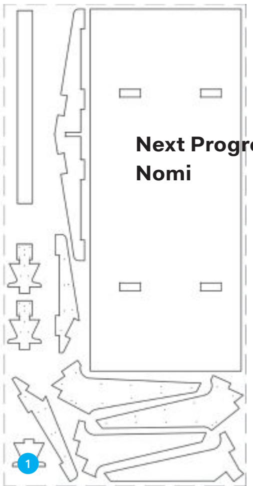

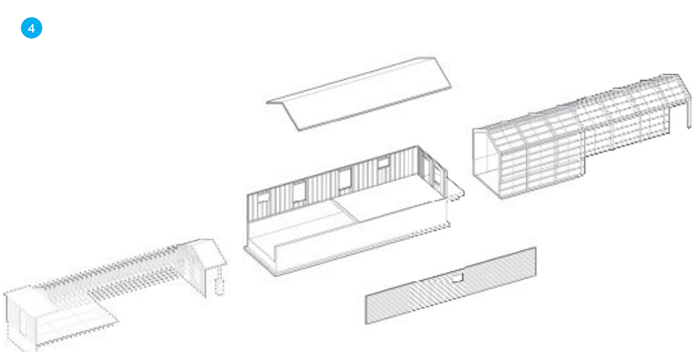

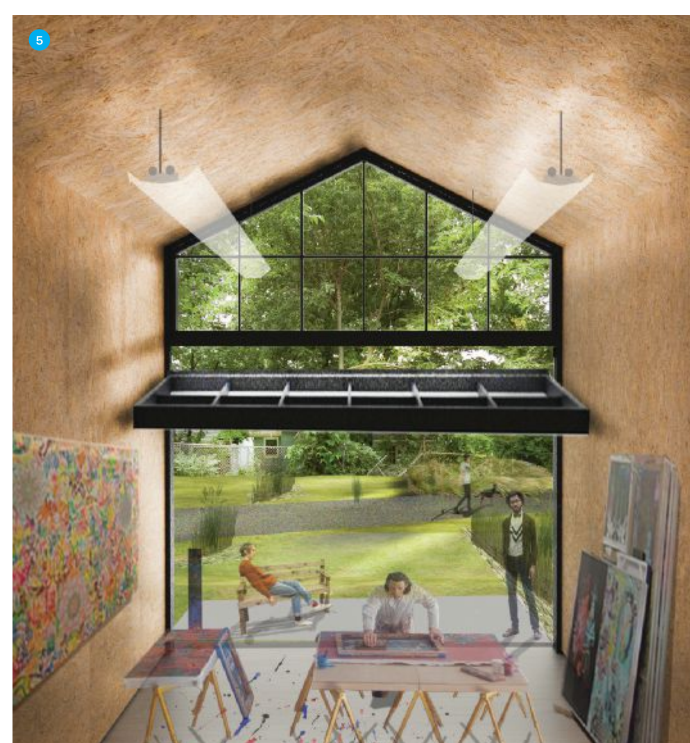

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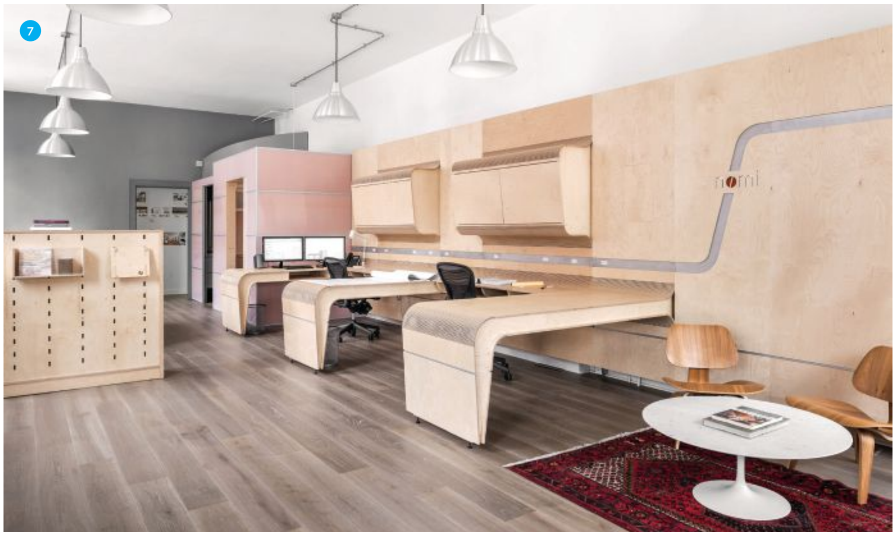

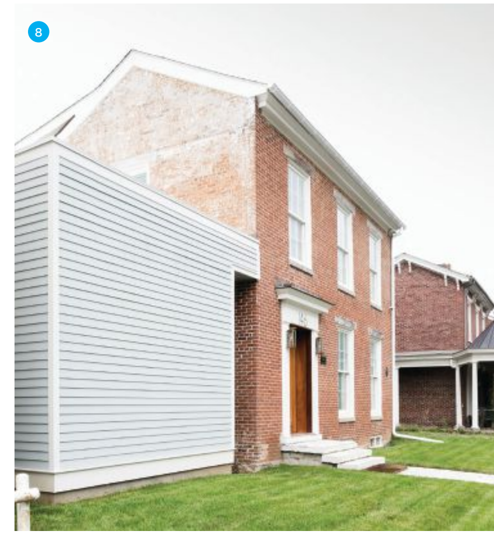

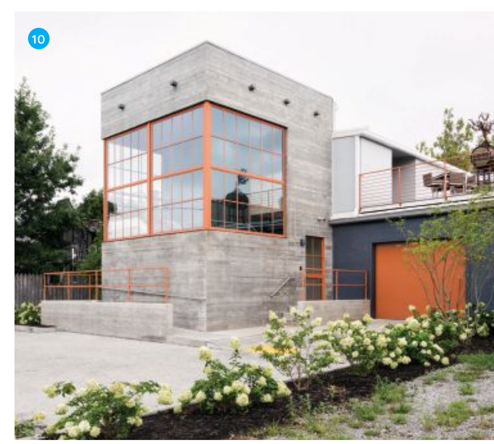

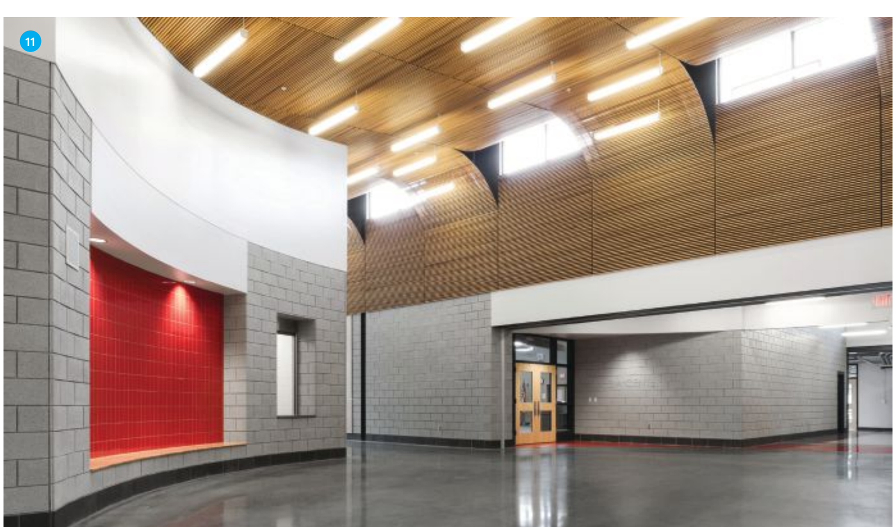

1, 2. The Plantory is a multi-tenant nonprofit center located in a former bread factory in Lexington, Ky. Nomi repurposed the remnants of CNC-milled plywood—used to make desk frames—as screen walls for the conference room. **3.** A renovated kitchen featuring a red painted structural beam is part of an open-concept living space in this Fayette Park residence in Lexington. **4, 5.** Organized by the North Limestone Community Development Corp., in Lexington, the York Street Challenge asked for innovative design ideas to repurpose 20th-century shotgun houses into live–work spaces. Nomi proposed building a new structural frame that incorporated salvaged lumber and extending the floor plan to include the original porch area. **6.** This model depicts a lounge-kiosk concept for an office. **7.** Custom shelving, desks, wall panels, and a movable wall system made of plywood create a contiguous and raw look in Nomi's office. **8, 10.** The adaptive reuse of a Federal-style former residence into an office included the construction of a board-formed concrete-and-glass stair and elevator tower in the rear as well as a contrasting modern addition next to the entrance. **9, 11.** Nomi worked with the Fairview school district to renovate the local high school. The project included an 11,170-square-foot addition and the use of curved wood panels on the interior.

2, 3, 7, 8, 9, 10, 11: GLINT STUDIOS

Architects' Choice: Commercial Seating

TEXT BY SELIN ASHABOGLU

Striad Lounge Chair, Herman Miller

Application: Lounge

Description: By German designers Markus Jehs and Jürgen Laub, Striad was inspired by the construction of a high-end ski boot. The chair has a hard outer and inner shell made from a natural composite, with a soft interior lining made of dual-density foam cushions that absorb and disperse impact. Offered in low-, mid-, and high-back (shown) options with a four-star or wire base (shown). *hermanmiller.com*

Finishes: Striad can be upholstered in more than 500 of the company's textiles. The outer shell comes in white, warm gray neutral, and black, and the base options are each offered in three finishes.

"We were drawn to the chair because … it's a modern remake of a classic design. It's also a flexible piece—the options for the height and base allow us to tailor it to the project aesthetic with different applications."

—Kelly Preston, interiors II, SmithGroupJJR, Washington, D.C.

Fern Task Chair, Haworth

Application: Office

Description: Inspired by the humble fern, the ergonomic back of this task chair uses the company's Wave Suspension System, which comprises three layers: cradle, fronds, and stem. Cradle is a soft frame that works as an overlay for stem and fronds, which respectively function as the spine and provide support for the user's upper and lower back. *haworth.com*

Finishes: Fern's mesh back is available in 11 colors, including cornflower, peat moss, and mushroom. Its plastic trim comes in black, fog, and snow, and its aluminum base comes in four finishes, including pitch black and metallic champagne.

"[Fern's] adjustment controls and structural components are selectively concealed, creating a more elegant aesthetic. Because it doesn't have a rigid frame, Fern continually adjusts to [its user's] body movements."

—David Little, AIA, associate vice president and interior designer, HGA Architects and Engineers, Minneapolis

Reflect, Allsteel

Application: Lounge

Description: Part of Allsteel's Gather Collection, this versatile lounge chair gives users the option to work individually or in a group through a semi-private, cove-like shell, which can be upholstered or covered with a hard veneer. Its 360-degree swivel base enhances user flexibility while its wide armrests can accommodate a laptop. *allsteeloffice.com*

Finishes: The chair's veneer shell and base come in clear maple, light cherry, burnished cherry, and dark rift oak. Reflect's seat and shell can be customized in more than 2,000 upholstery collections.

"This personal workspace enables people to escape from daily distractions and do concentrated work or take a personal call. A large, enveloping back reduces visual and audible distractions and communicates unavailability."

—Christine Vandover, senior project interior designer, HOK, New York

> To discover more commercial seating recommendations, visit bit.ly/CommercialSeating.

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USING THE AWI QUALITY CERTIFICATION PROGRAM

Presented by:

To help support quality construction goals with modern woodwork, architects and builders can turn to the *Architectural Woodwork Standards* (AWS), the guide for the specification, construction, and installation of interior architectural woodwork Country Club Pavilion House, Forsyth Country Club by Rowland Woodworking, Inc., Photo Courtesy of Deborah Hall.

LEARNING OBJECTIVES

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

1. Describe the *AWS* and how it is applied to woodwork.
2. Explain how to specify architectural woodwork using the *AWS*.
3. Discuss how third-party certification programs that support the *AWS* operate.
4. List the benefits of utilizing third-party *AWS* certification programs.

CONTINUING EDUCATION

AIA CREDIT: 1 LU
AIA COURSE NUMBER: AR052017-4

Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR052017-4 and complete the quiz for free as you read this article. If you are new to Hanley Wood University, create a free learner account; returning users log in as usual.

By Andrew Hunt

Ensuring quality construction begins with specifying and installing quality materials, and wood is one of the most versatile and functional. To help support quality construction goals with modern woodwork, architects and builders can turn to the *Architectural Woodwork Standards* (*AWS*), the guide for the specification, construction, and installation of interior architectural woodwork. The *AWS* is a definitive reference manual designed to simplify and clarify guidelines, information, and principles required for fabrication, finishing, and installation of architectural woodwork.

While the *AWS* is a useful tool, complying with the standards can be a challenge for architects and builders. In support of this, several organizations have been created to help guide builders and architects through the certification of their woodwork craft to satisfy the *AWS*. Third-party programs such as the Quality Certification Program, which was founded by AWI, are specifically designed for builders and architects hoping to achieve *AWS* compliance. This article will discuss how these programs work and how they can be leveraged to better achieve QCP certification and protect all stakeholders in the process.

HISTORY OF AWI AND *AWS*

The Architectural Woodwork Institute (AWI) was founded in 1953 in Chicago, Ill., as a not-for-profit organization. Its mission was to improve industry standards and provide education to woodworkers and design professionals. At that time, half of the organization's members were manufacturers of wood windows; today, wood window manufacturers comprise less than 5 percent.

Third-party programs such as the Quality Certification Program, which was founded by AWI, are specifically designed for builders and architects hoping to achieve AWS compliance.

In 1961, AWI published the first edition of what was then called the *Quality Standards of Architectural Woodwork, later called the Quality Standards Illustrated*. The *QSI* evolved over the years, serving as the authoritative resource for specifying interior architectural woodwork. AWI and the Architectural Woodwork Manufacturers Association of Canada (AWMAC) first combined their standards in 1996, and in 2009, a new unified standard replaced the *QSI*. Jointly published by AWI, AWMAC and the Woodwork Institute (WI), the *Architectural Woodwork Standards* (*AWS*) superseded both the *QSI* and WI's *Manual of Millwork* (MM). A second edition of the *AWS* was published in the fall of 2014.

The *AWS* contains centuries of combined knowledge and industry experience. Like the *QSI*, the *AWS* includes technical and design illustrations and addresses all facets of architectural woodwork, from raw lumber and veneer to factory finishing and installation.

A diverse group of people contribute to updates of the *AWS*. Every idea submitted is carefully reviewed and explored by the AWI Technical Committee. This committee welcomes input from professionals in the field, and the Standards includes a form on the back inside cover for submitting ideas.

AWI is currently developing the next generation of a broad-based consensus industry standards for architectural woodwork through its ANSI-approved process. AWI firmly supports an open, informed, and transparent process of standards development that involves input from subject experts, design professionals, manufacturers, project owners, and other stakeholders. To aid specifiers and design professionals, AWI will coordinate its new ANSI standard with CSI's Master Format sections. Until the new Standard is approved by industry vote, AWI will continue to support and utilize the jointly developed *Architectural Woodwork Standards*, Edition Two.

The Standards, as in both previous publications, encompass three grades of quality: Economy, Custom, and Premium. Following the Introduction, Users Guide, and Preface, the *AWS* is divided into twelve sections detailing every aspect of fabrication and installation of interior architectural wood products—from Submittals, Care and Storage, and Lumber to Casework, Countertops, and Historic Restoration Work. Each of these twelve sections consists of two main parts. The Introductory Information section includes educational resources, general recommendations, and specification requirements. The Compliance Requirements section includes basic considerations, product (manufacturing) requirements, installation requirements, and a test section, which provides information for verifying compliance, although not all sections include the installation and test sub-sections.
A Glossary and Design Ideas section at the end of the Standards are provided for reference.

The *AWS* includes compliance criteria to ensure that all millwork manufacturers are competing equally when bidding on projects and they are obligated to perform work of equal quality.

COMMON ISSUES WITH ARCHITECTURAL WOODWORK

Architectural woodwork is often one of the most visible and appealing features in a project. As a building professional, you have no doubt encountered issues with architectural woodwork in the field. The following typical scenarios illustrate how adhering to *AWS* can ensure quality fabrication and installation.

As mentioned earlier, the Standards include specifications for three different grades: Economy, Custom, and Premium. Section 10-4.2.1.2 of the standards states that, for Premium and Custom grades, the grain direction for cabinet surfaces must run vertically, unless otherwise specified. This applies to both wood and plastic laminate. A number of cross references in the *AWS* support this standard, such as Face Veneer grades found in Section 4. Consequently, having a full copy of the *AWS* is vital to Contract Document enforcement.

One of the most common issues in architectural woodwork is the movement of installed woodwork in response to changing relative humidity levels. *AWS* addresses this issue in Section 2.4.4 Basic Rules: Installation, stating that relative humidity should be maintained between 25 and 55 percent for most areas of the US. Of course, the woodworker often can't control humidity levels on the job once they have installed their products; to counter this problem, the design and engineer of products for wood movement is essential. In many cases, woodworkers will also place humidification logging devices on site to monitor humidity levels and to track readings that fall outside the recommended range.

In some cases, not complying to *AWS* can have serious and potentially dangerous consequences. For example, Section 10.6.1 Basic Rules: Casework Wall Anchorage requires casework to be installed with surface-bearing screw heads.

THE ROLE OF THIRD-PARTY PROGRAMS

As we have just seen, the *AWS* can help ensure quality fabrication and installation. But the execution of an architect's designs depends entirely on builders and subcontractors, leaving them with a dilemma: How can they guarantee that the woodworker approved to fabricate the millwork is versed in the Standards?

Building professionals can make that determination, which requires dedicating staff time and billable hours to vetting the woodworker, but most do not have the time or money to perform a thorough examination of each subcontractor and the products they supply.

As an alternative, they can take advantage of a third-party program which does all of this legwork for them. These programs include the AWI Quality Certification Program, known as the QCP, and programs hosted by the

Woodwork Institute (WI) and Architectural Woodwork Association of Canada. For a small cost, these programs can provide specification review, shop drawings review, and inspection of the fabrication and installation of woodwork on a project. Specifying the QCP or other third-party program and registering the project will ensure that the spec is held through the bidding and award process.

First, here is a little background on the QCP and its parent organization, the AWI Quality Certification Corporation (QCC). Incorporated in early 2007, QCC is an autonomous organization that administers the QCP. QCC is a 501(c)6 trade association headquartered in Northern Virginia, just outside of Washington, DC.

The QCC board of directors is comprised of industry representatives from the architectural woodworking, construction, and architectural professions. The board sets corporate policies as it pertains to governance and fiduciary responsibility. Through its oversight of operations, it verifies compliance with federal and local laws, and with the credentialing industry's best practices.

It is the mission of the QCC to verify, inspect, and report compliance with published woodwork industry standards. It is the vision of the QCP to be the recognized compliance assurance process for the architectural woodwork industry.

WOODWORKER ACCREDITATION AND AFFILIATION

In most cases, the third-party program does not certify the woodwork, but rather licenses woodworking firms to certify that their work complies with the specifications and the referenced standards. The programs verify compliance through the inspection process.

While each of the third-party programs has different requirements, each has measures to ensure affiliated or accredited woodworkers meet the highest standards.

Woodworking firms earn specific QCP licenses through a process of written testing and evaluation of samples and actual projects demonstrating the ability to fabricate, finish, and/or install various categories of millwork per quality grade criteria set forth in the Standards. To become accredited, a woodworker must submit the application fee of between $2,000 and $3,500, along with ten references from architects, general contractors, and/or owners. In addition, he/she must pass the *AWS* and QCP tests.

Wintrust Financial Incorporated by Bernhard Woodwork LTD, Photo Courtesy of Tom Harris

The woodworker must undergo plant inspections and a qualification visit, and must submit examples of work for each *AWS* Section and Grade. In addition, he/she must undergo a review of completed projects and shop drawings. Further, companies must own or lease a facility and woodworking equipment, and they must employ and supervise the people who manufacture architectural woodwork.

The accreditation process typically takes 45 to 90 days. Firms that succeed are required to have their first two certified projects inspected during fabrication and installation. Finally, all licensed firms must successfully complete the written test every three years and undergo triennial project inspections.

INSPECTORS

Each third-party program maintains a team of representatives, usually drawn from former woodworkers and designers. QCP inspectors are held to high standards. They must possess a minimum of 15 years in the industry including time at the bench, in the field, and in management positions. All inspectors must pass the written test and attend annual orientations and training. In addition, inspectors are periodically accompanied by their peers (for training purposes) and evaluated by the Program Director.

PROGRAM COST

Of course, one of the first questions building professionals ask is about the added cost of using third-party certification programs in their projects. Some have been "scared off" from the program after hearing—inaccurately—that it can add $20,000, $40,000, or even more to a project.

The reality is these programs cost much less. For example, the QCP only costs one-half of 1 percent of the woodwork contract amount, or $500, whichever is greater. Or, for a woodwork contract of $100,000, QCP adds .005 x $100,000, or $500. This is not a large expense, especially considering that any project carrying the correct specification language and registered with QCP prior to fabrication is technically eligible for project inspection and evaluation by a third-party QCP.

The WI programs are somewhat more expensive and have a tiered fee structure. For example, the basic fee for certification of shop drawings through the CCP is $300; the basic fee for certification of shop drawing, product, and installation starts at $1,600 for millwork contracts of $10,000 or less. Currently WI has approximately 80 licensed firms, primarily in California, while QCP has over 540 licensed firms throughout the US and abroad.

In general, the woodworker pays for the cost of the third-party program and includes it in the millwork bid.

REGISTERING A PROJECT

Any project stakeholder can register a QCP-specified project, but it must be registered

before fabrication begins. Often the architect registers a project during the design phase. If this step has not been completed when a woodworking company is awarded the contract, that woodworker is required to complete the registration.

Registration puts the project on QCP's radar, generates a control number for all parties to use throughout the project, and creates a single location in the QCP database to post documents, reports, and correspondence. Staff are available to answer any administrative or technical question related to a QCP project.

Specific verbiage should be input into specifications if the project is to be certified. The QCP language clearly indicates where the project number is to be inserted into the contract documents. Once the number is obtained, it states clearly that the project is registered and it allows all parties to track the progress of the project:

Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.

Provide AWI Quality Certification Program [labels] and [certificates] indicating that woodwork, [including installation] complies with requirements of grades specified.

This project has been registered as AWI/QCP Number xxxxxxx.

This article continues on http://go.hw.net/AR052017-4.
Go online to read the rest of the article and complete the corresponding quiz for credit.

QUIZ

1. In what year did the Architectural Woodworking Standards replace the Quality Standards Illustrated?
   a. 1954 b. 1972
   c. 1980 d. 2009

2. Which of the following grades do the Standards not include specifications for?
   a. Entry Level b. Economy
   c. Custom d. Premium

3. How long does the woodworker accreditation process typically take?
   a. 1–2 days b. 45–90 days
   c. 1–2 months d. 3–6 months

4. What position does an inspector not need to hold over their minimum 15 years in the industry?
   a. Bench b. Field
   c. Deputy inspector d. Management

5. Where are the WI firms primarily located?
   a. Wisconsin b. California
   c. Florida d. Colorado

6. Which of the following websites is correct in searching for QCP participant firms?
   a. findawoodworker.com b. awiwoodworking.com
   c. qcp.com d. awiqcp.org

7. Which project component can certification be requested for?
   a. Fabrication b. Finishing
   c. Installation d. All of the above

8. What is the preferred option for a licensee that has non-conforming items?
   a. Make corrections b. Obtain a Letter Accepting Variations
   c. Consult the GC and accept their advice d. Do nothing

9. Where are proof of certification labels placed?
   a. In the Northern Virginia offices b. Attached to the product
   c. With the homeowner d. In the contractor's files

10. Who was protected by using the QCP process in the case study for the Abu Dhabi National Oil Company?
    a. The owner b. The government
    c. The subcontractor d. The installer

SPONSOR INFORMATION

UNDERSTANDING THE VALUE OF PROPER HVLS FAN SPECIFICATIONS TO A PROJECT

Presented by:

ENTREMATIC

Origin Climbing And Fitness, Las Vegas. Photographer: Jeremy Enlow.

LEARNING OBJECTIVES

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

1. Identify the proper fan for an application.
2. Determine appropriate fan size and mounting location.
3. Examine the importance of fan speed and direction.
4. Understand optimal fan controls and user experience.

CONTINUING EDUCATION

CREDIT: 1 LU/HSW

COURSE NUMBER: AR052017-2

Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR052017-2 and complete the quiz for free as you read this article. If you are new to Hanley Wood University, create a free learner account; returning users log in as usual.

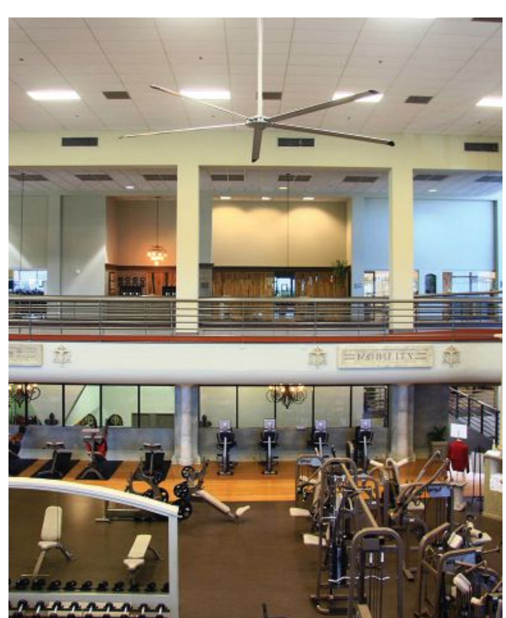
By Aphrodite Knoop

SECTION 1: FIT THE APPROPRIATE HVLS FAN TO AN APPLICATION

More than just supporting mechanical equipment, an HVLS fan system is an often underestimated, yet integral part of a building's efficiency and occupant experience. By helping reduce the burden on HVAC systems, HVLS (high volume, low speed) fans play a critical role in both building performance and overall occupant comfort and well-being.

Unlike their smaller residential counterparts, HVLS fans are large mechanical fans, with a diameter exceeding 5 feet. These state-of-the-art fans are engineered to move large volumes of air at a low rotational speed for better thermal, acoustic, and energy performance.

HVLS fans create a healthier space by supporting the existing ventilation system to make climate control more effective and reduce the monthly operating costs for all types of industrial and commercial facilities. Although both commercial and industrial HVLS fans are designed based on the same principles of physics and function, there are important differences, as we will see.



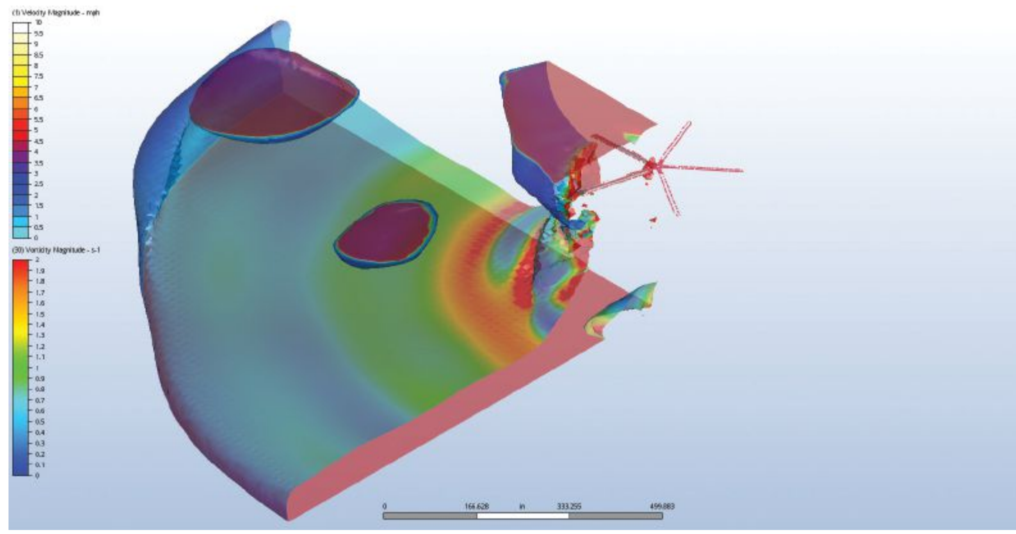
Commercial fan used in multilevel sports club for ventilation and destratification.

Industrial fan used in a warehouse for ventilation and condensation control

Industrial Applications

Industrial applications include farms and ranches, aviation facilities, sports facilities and arenas, food and pharmaceutical facilities, manufacturing and distribution centers, and service centers (e.g., ground transportation, machinery, aircraft).

Commercial fan used in sports bar to complement interior décor while enhancing comfort.



Using fluid dynamic software the 3D cut-out section of the fan showing the airflow moving through a section of the fan which simulates the path of air coming through the fan.

Industrial spaces can be huge energy drains and are not necessarily designed with comfort in mind. In these applications, where the financial stakes are particularly high, HVLS fans are tasked with meeting multiple needs. They need to regulate room temperature for human comfort and circulate air to keep sensitive products like food, produce, cosmetics, and pharmaceuticals from spoiling.

With their ability to move massive amounts of air, industrial HVLS fans help reduce air stagnation, alleviate hot and cold spots, and create a significant reduction in perceived temperature. By easing the load on the HVAC system, industrial HVLS fan applications can also lead to substantial energy savings throughout the year.

Commercial Applications

Commercial applications encompass municipal and education facilities, restaurants and bars, retail and public spaces, sports centers and outdoor spaces, health centers, and fitness facilities. Commercial HVLS fans are engineered to deliver efficiency, comfort, and design flexibility.

A single commercial HVLS fan is powerful enough to replace the equivalent of six residential fans. HVLS fans produce a consistent airflow at any speed setting for more effective cooling, energy efficiency, and sound control for acoustically sensitive spaces such as offices and libraries.

Many commercial HVLS fans allow design flexibility with sleek, low-profile designs. Depending on your vendor, you can choose from an array of colors or customize your fan with your own patterns, designs, and color options.

The key difference between commercial and industrial HVLS fans is in application. Commercial fans are designed for conditioned spaces that have specific acoustic requirements and high occupancy loads during certain hours. In these cases, the RPM of the fan is lower than that of an industrial fan, and the sound level is 35 dBA or less (depending on the ceiling and other variables). In addition, a commercial fan has a smaller chord length and lower RPM, which leads to less airflow.

HVLS Fan Technology

HVLS fans are designed according to the principles of physics and aerodynamics and use airfoil technology for greater efficiency in air movement. These powerful fans move air slowly and evenly throughout a space to eliminate the wind chill effect because too much indoor air movement is a waste of energy and uncomfortable—even in warmer climates. HVLS fans create a large column of air that travels farther than that of a smaller fan.

Smaller high-speed fans (such as residential fans or directional fans) produce a high velocity jet of air that is turbulent and quicker to dissipate. HVLS fans, on the other hand, can move a large mass of air and take advantage of the air's inertia. Air takes up a great deal of volume in a space, so less power is required to keep an air mass moving than to start that volume moving in the first place.

In addition to keeping workers cool during hot weather, HVLS industrial fans also improve workplace safety by drying wet floors and protecting perishables.

Fan Design, Including Blades and Winglets

The profile of a blade, the spacing between the blade, and the RPM of the fan dictate how much airflow the fan can push. HVLS fan blades have a large airfoil shape, so fans need only 5 to 6 blades to increase airflow without increasing energy use or causing undue stress to a building. The 5-blade design is an improvement over the 6-blade design and is optimized for low-speed rotary airfoil applications.

Airfoils are a critical evolution of HVLS fan engineering. They produce a massive cylindrical column of air that flows down to the floor and disperses outward in all directions. The horizontal floor jet then pushes air out a great distance away from the center of the fan before the air is drawn back vertically toward the blades where the airfoils increase lift and the interior vertical support increases strength.

Winglets are yet another engineering innovation, extending a blade's efficiency. The downward oriented winglets increase a blade's effectiveness by reducing the induced drag. They further generate vortices below the airfoil to direct turbulence away from the trailing blade.

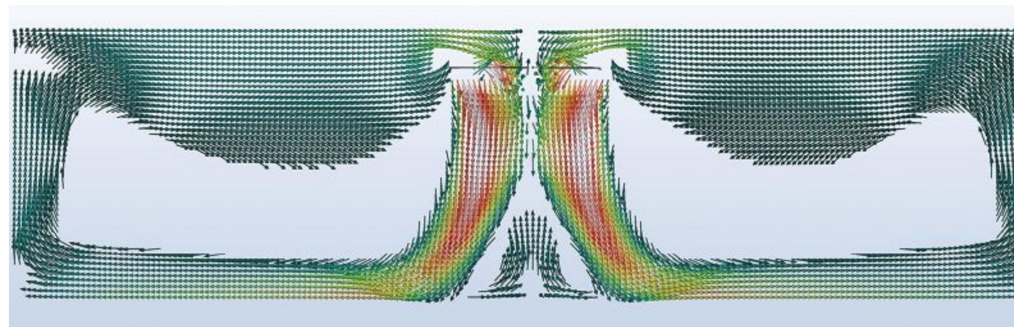
Performance Measures

HVLS fans are increasingly used in warehouse, manufacturing, and distribution facilities to improve air quality and human performance while reducing energy use and costs. Therefore, it's important to understand the type of airflow measurement that demonstrates a fans ability to push air.

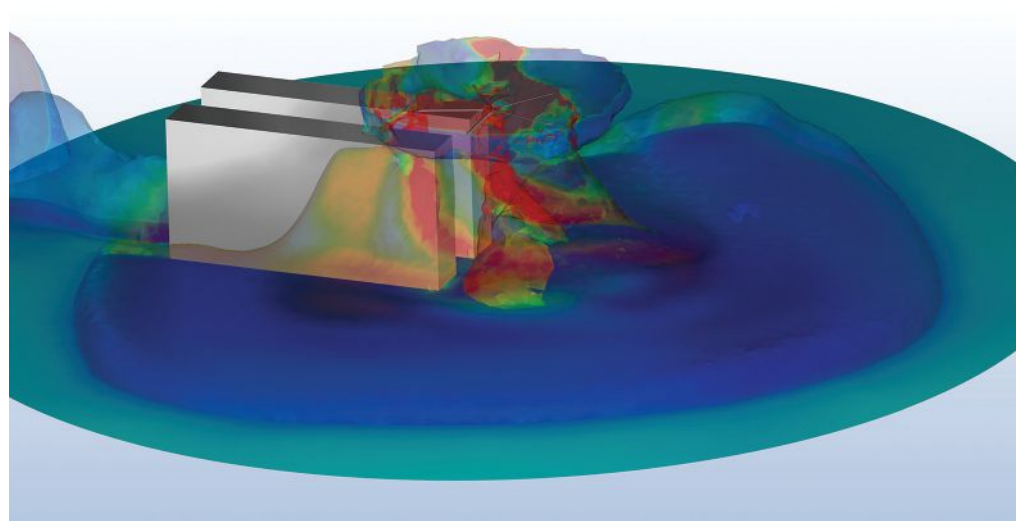
Fan speed is measured using cubic feet per minute (CFM). CFM is the volume of air being pushed through a fan each minute. A higher CFM means a higher capacity to push a larger volume of air, which translates to higher efficiency.

However, another way to measure a fan's efficiency is to look at air velocity, as measured in miles per hour (MPH) and fan speed settings. Consider also that a fan's efficiency depends on a space's parameters and user settings. Because not all users want to run a fan at maximum, fan manufacturers have derived airflow tests and simulations to demonstrate how well fans can operate at a range of lower settings.

Airflow moving across the ground level (shown bottom of image) represents the floor jet. As the velocity dissipates, the air moves beyond until it circulates back up into the top of the ceiling (shown top of image) and is then drawn back into the fan.]



This vector pattern shows with arrows how the fan pulls air and pushes the air down to ground level.



Airflow simulation of an industrial fan in a warehouse shows how the airflow moves down through racks or objects on the ground floor.

SECTION 2: FAN SIZING AND INSTALLATION BEST PRACTICES

All facilities have different designs, are made of different building materials and systems, and have certain floor and ceiling obstructions that can change airflow patterns, thus dictating where fans can be located. These various constraints and considerations affect the size and number of fans that facility requires.

Therefore, installation of an HVLS fan system for optimal comfort and building performance entails more than figuring out standard measurements and square footage. It takes a more holistic planning and engineering approach. Here are some basic guidelines:

Understand the project from the ground up and account for all factors unique to that environment, including how it is used currently and how it may evolve over time. Environments often change, depending on the business, efficiency needs, innovation, and the economy at large. For example, a space that's currently serving solely as storage may, somewhere down the road, house office space alongside production. Such a shift in use would require a significant change in cooling patterns.

Identify the project's primary goal (e.g., warehousing, entertainment, education, or material versus occupant focus). Aside from the basics such as facility size, location, and fan size, you need to dig deeper and understand what a building owner or operator expects in terms of fan function.

Asses the climate concerns that an HVLS fan system will have to address. For example, problems with floor sweating or moisture build-up require a consistent velocity of air movement at floor level, which is different than environments that don't have those condensation issues. If a facility prioritizes cooling for human comfort, that same velocity at ground level isn't as important because, there, the air just needs to reach the people being cooled.

Determine the right size of fan designed for the specific environment; and plan for room shape, ceiling heights, and user traffic patterns. For example, you can't put a 24-foot fan in a room that's 26 square feet and expect good results.

Provide a comprehensive site layout plan to optimize each fan location for efficient air movement. For added air velocity, you would space fans closer. To avoid airflow disruption or to decrease air velocity in certain areas, you would space fans farther apart. Doing so would save on costs for the total number of fans required. Also, use the plan to verify there is nothing about the installation that might infringe on a manufacturer's exclusion zones.

Account for all potential obstacles to the path of a fans' airflow because airflow can make a big difference in the fan system's efficiency. Any number of objects can block airflow, including solid walls, pallets, machinery, HVAC ductwork, product inventory, pipes and conduits, counters, and lighting. In industrial spaces, larger elements such as bridges, gantry cranes, conveyors, and hanging signage can also impede airflow from your HVLS fans and affect the size and quantity of fans the space needs. Since obstructions are so disruptive to airflow, careful planning will help you with laying out the proper placement of fans and to install only as many fans as a space requires.

It is critical to address these issues before installing and operating the HVLS fans to avoid the very high expenses of reconfiguring an HVLS fan layout after the fact—especially in spaces with a networked system of multiple fans. Just consider how expensive HVAC ductwork can be. For new facility planning, incorporating HVLS fans up front minimizes the ductwork needed while meeting desired temperature goals.

Function Informs Implementation

HVLS fan implementation should also reflect the story behind a space. Whether it is a library, a warehouse, a concert hall or an aviation facility; or whether it is new construction, a renovation or fit-out, each space presents unique challenges and opportunities. Let's look at some scenarios…

In a retail environment, the focus is on the merchandise. In a sports arena or theater, the focus is on the event. In such cases, fans should ideally be in the background, providing comfort without distracting from the intended focus.

We discussed physical obstructions, but don't forget about visual obstructions, as those can affect occupant well-being. For example, if you have an office environment where the ceiling grid incorporates both HVLS fans and lighting systems, plan the system layouts simultaneously so you don't inadvertently incur strobe effects, which may affect individuals differently.

Then there are acoustic and thermal considerations. In office spaces, HVLS fans can promote productivity by reducing noise and balancing temperatures so occupants are not experiencing drafts or extremes in heat or cold. Libraries, schools, courts, and other such facilities typically need quiet zones and have spaces that can range from the small and intimate to the large capacity. These facilities have greater need for zoned and balanced air movement and noise reduction, so you need to take great care in specifying and placing HVLS fans to accommodate the variance in functions.

From an aesthetic perspective, public environments can provide good opportunities to showcase a fan system and incorporate it as a design element. Additional applications where HVLS fans can serve as feature elements include bars, restaurants, lobbies, community centers, health clubs, and other spaces where design reflects a convergence of form and function.

By contrast, industrial and warehousing environments place greater emphasis on storing sensitive products such as food and pharmaceuticals or housing machinery and industrial functions. For example, vehicle maintenance centers and manufacturing facilities, to name a few, tend to be large open spaces with high ceilings. Such spaces may not even have a mechanical air conditioning system and a series of HVLS fans will need to perform multiple functions, including cooling, evaporation, and destratification. In these cases, incorporating HVLS fans properly would be a priority both for protecting merchandise and machinery and for keeping personnel comfortable to ensure staff retention.

QUIZ

1. HVLS fans are designed to do which of the following?
   - a. Make air feel cooler by leveraging wind chill effect
   - b. Move large volumes of air at slow speed
   - c. Provide a standard solution for ventilation issues
   - d. Move air quickly through spaces
2. True or False: Besides aesthetics, there is no significant difference between industrial and commercial HVLS fans.
3. Fan manufacturers use air flow tests to simulate which of the following?
   - a. The speed at which condensation is dried
   - b. The difference between a 5-blade and 6-blade fan profile
   - c. A fan's effectiveness at settings below maximum
   - d. Destratification
4. HVLS fans create healthier, safer environments by doing which of the following?
   - a. Support a building's existing HVAC system
   - b. Circulate air to prevent stagnation
   - c. Help dry condensation buildup on floors
   - d. All of the above
5. How do HVLS fans destratify air?
   - a. By pushing a column of air higher across the ceiling
   - b. By mixing the air and pushing it down to occupant level
   - c. By reversing cold air upward in summer
   - d. By causing a building's furnace to run more frequently
6. Which of the following can be considered an industrial application?
   - a. Warehouse
   - b. Dairy farm
   - c. Sports arena
   - d. All of the above
7. True or False: Air flow simulations can help identify obstructions before fan implementation.
8. Which of the following is not a function of industrial fans?
   - a. Move air down and outward
   - b. Circulate air where air conditioning is lacking
   - c. Control noise levels throughout
   - d. Move air over obstructions
9. What is the role of winglets?
   - a. To extend a blade's efficiency
   - b. To produce a column of air that speeds a blade's movement
   - c. To push air horizontally away from the blades
   - d. To tighten the column of air around the fan
10. What is the maximum number of fans that can be networked in a facility?
    - a. 5–150
    - b. 2–50
    - c. 3–25
    - d. 2–200

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This article continues on http://go.hw.net/AR052017-2. Go online to read the rest of the article and complete the corresponding quiz for credit.

Presented by:

reTHINK WOOD®

MASS TIMBER IN NORTH AMERICA

EXPANDING THE POSSIBILITIES OF WOOD BUILDING DESIGN

Albina Yard
Location: Portland, Oregon
Architect: LEVER Architecture
Structural Engineer: KPFF Consulting Engineers
Developer: reworks

Photo courtesy of LEVER Architecture

LEARNING OBJECTIVES

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

1. Examine the trend toward mass timber buildings in the context of carbon footprint, construction efficiency, fire and life safety, occupant well-being, and other potential advantages.
2. Identify a range of mass timber products available to North American building designers.
3. Discuss research and resources related to the structural performance and fire/life safety of mass timber products.
4. Based on examples of mass timber buildings either built or under construction, describe how all-wood and hybrid systems are expanding the options for wood design.

CONTINUING EDUCATION

AIA CREDIT: 1.5 LU/HSW
GBCI CREDIT: 1.5 CE HOURS

AIA COURSE NUMBER: AR032017.2
GBCI COURSE NUMBER: 0920012088

Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR032017-2 and complete the quiz for free as you read this article. If you are new to Hanley Wood University, create a free learner account; returning users log in as usual.

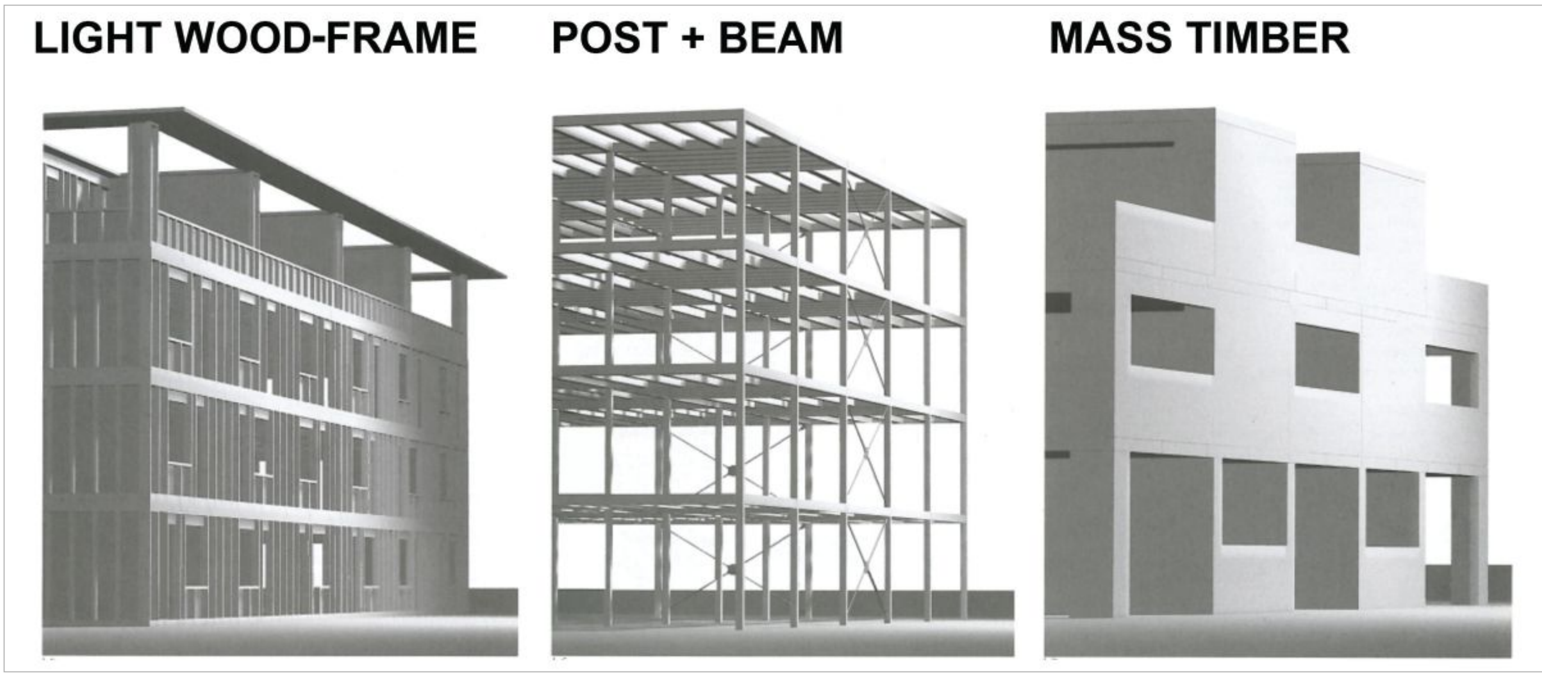
It's been a while since a major category of building materials inspired the kind of widespread enthusiasm currently being shown for mass timber. Around the world, designers are leveraging the strength, stability, and design flexibility of products such as cross-laminated timber (CLT) to push beyond wood's perceived boundaries, achieving building heights and spans that would have once required concrete, steel, or masonry for structural support.

For many, it's the combination of aesthetics, structural performance, and opportunity for innovation that have proven irresistible. But mass timber also offers a host of other advantages:

Lighter carbon footprint: Mass timber products allow the use of a renewable and sustainable resource as an alternative to more fossil fuel-intensive materials. Designers of 'tall wood' buildings have been especially focused on the reduced carbon footprint achieved by using wood, which aligns with the goals of Architecture 2030. Reducing carbon is also a priority for many public buildings and schools.

Construction efficiency: Mass timber construction is fast, and speed correlates to revenue, whether the project is an office, school, student residence, condominium, or hotel. Bernhard Gafner of structural engineering firm Fast + Epp, says that, in his firm's experience, a mass timber project is approximately 25 percent faster to construct than a similar project in concrete. Noting the advantages for urban infill sites in particular, he says it also offers 90 percent less construction traffic (trucks delivering materials) and requires 75 percent fewer workers on the active deck, making for a much quieter job site.

The fact that mass timber weighs less than other materials also has a number of potential benefits, including smaller foundation requirements and lower forces for seismic resistance. Discussing the new Design Building at the University of Massachusetts, for example, structural engineer Robert Malczyk of



Mass timber systems are a complement to light wood-frame and post-and-beam construction. Image courtesy of Fast + Epp

Equilibrium Consulting, says, "The seismic force is proportionate to the weight of the building. If this building were designed in concrete, which was considered, the weight would be six times more than the mass timber design."

Fire and life safety: Structurally, mass timber offers the kind of proven performance—including fire protection and seismic resistance—that allows its use in larger buildings. It also expands the options for exposed wood structure in smaller projects.

Occupant well-being: An increasing number of studies focused on wood's biophilic aspects have linked the use of exposed wood in buildings with improved occupant health and well-being.[1,2]

This course is intended for architects and engineers seeking current information on mass timber, including products, research related to structural performance and life safety, and available resources. It answers common questions regarding strength, fire protection, and durability, and highlights examples of mass timber buildings in different occupancy groups to illustrate both design trends and the extent to which mass timber has captured the imagination of North American building designers.

WHAT IS MASS TIMBER?

Mass timber is a category of framing styles typically characterized by the use of large solid wood panels for wall, floor, and roof construction. It also includes innovative forms of sculptural buildings, and non-building structures formed from solid wood panel or framing systems of six feet or more in width or depth. Products in the mass timber family include:

Cross-Laminated Timber (CLT)

CLT consists of layers of dimension lumber (typically three, five, or seven) oriented at right angles to one another and then glued to form structural panels with exceptional strength, dimensional stability, and rigidity.

Panels are particularly cost effective for multistory and large building applications. Some designers view CLT as both a standalone system and product that can be used together with other wood products; it can also be used in hybrid and composite applications. CLT is well-suited to floors, walls, and roofs, and may be left exposed on the interior for aesthetics. Because of the cross-lamination, CLT also offers two-way span capabilities.

CLT can be manufactured in custom dimensions, with panel sizes varying by manufacturer. There are several CLT suppliers in North America, with more anticipated. The species of wood used depends on the manufacturing plant location.

The 2015 International Building Code (IBC) and 2015 International Residential Code recognize CLT products manufactured according to the ANSI/APA PRG-320: Standard for Performance Rated Cross-Laminated Timber. Under the 2015 IBC, CLT at the required size is specifically stated for prescribed use in Type IV buildings. However, CLT can be used in all types of combustible construction—i.e., wherever combustible framing or heavy timber materials are allowed. The National Design Specification® (NDS®) for Wood Construction is referenced throughout the IBC as the standard for structural wood design, including CLT. The 2012 IBC does not explicitly recognize CLT, but the 2015 IBC provisions for CLT can be a basis for its use under alternative method provisions.

For more information on CLT, the U.S. CLT Handbook is available as a free download at www.rethinkwood.com.

Nail-Laminated Timber (NLT or Nail-lam)

NLT is created from individual dimension lumber members (2-by-4, 2-by-6, 2-by-8, etc.), stacked on edge, and fastened with nails or screws to create a larger structural element.

NLT is far from new—it's been used for more than a century—but is undergoing a resurgence as part of the modern mass timber movement. Commonly used in floors, decks, and roofs, it offers the potential for a variety of textured appearances in exposed applications, and wood structural panels can be added to provide a structural diaphragm. NLT has also been used to create elevator and stair shafts in midrise wood-frame buildings.

NLT naturally lends itself to the creation of unique roof forms. Because panels are comprised of individual boards spanning in a single direction, both singly curved and freeform panels can be created by slightly offsetting and rotating each board relative to the others. This allows the complex geometry of curved roof and canopy structures to be realized with a simple system.

Advantages of NLT include the ability to use locally available wood species and the fact that specialized equipment generally isn't necessary. An NLT system can be created via good on-site carpentry, though some suppliers do offer prefabrication, and this can have benefits depending on the scale and complexity of the project. Prefabricated NLT panels typically come in sizes up to 10 feet wide and 60 feet long, with wood sheathing preinstalled. When detailing NLT systems, designers need to account for moisture movement.

The IBC recognizes NLT and provides guidance for structural and fire design. No product-specific ANSI standard is required, as the structural design of each element is covered by the NDS and applicable grading rules. NLT can be used in all types of combustible construction.

Glued-Laminated Timber (glulam)

Glulam is composed of individual wood laminations (dimension lumber), selected and positioned based on their performance characteristics, and then bonded together with durable, moisture-resistant adhesives. The grain of all laminations runs parallel with the length of the member.

Glulam has excellent strength and stiffness properties, and is available in a range of appearance grades for structural or architectural applications. While typically used as beams and columns, designers can use glulam in the plank orientation for floor or roof decking. With careful specification and design that considers the flatwise structural properties (see APA reference below), deep glulam sections can be placed flatwise as decking similar to NLT. With the flexibility of glulam manufacturing, glulam 'panels' can be used to create complex curvature and unique geometry. When used in such innovative floor and roof panel configurations, glulam is seen as an extension of the mass timber product family and sometimes referred to as GLT.

The IBC recognizes glulam products manufactured in conformance with ANSI Standard A190.1-2012: Standard for Wood Products—Structural Glued Laminated Timber. For more information, consult the Glulam Product Guide available at www. apawood.org/glulam.

Dowel-Laminated Timber (DLT)

Dowel-laminated timber panels are a next-generation mass timber product commonly used in Europe. Panels are made from softwood lumber boards (2-by-4, 2-by-6, 2-by-8, etc.) stacked like the boards of NLT and friction-fit together with dowels. Typically made from hardwood lumber, the dowels hold each board side-by-side, similar to how nails work in an NLT panel, and the friction fit lends some dimensional stability to the panel.

CASE STUDY #1
ALBINA YARD & FRAMEWORK

Location: Portland, Oregon

Architect: LEVER Architecture

Structural Engineer: KPFF Consulting Engineers

Design Assist + Build (Framework): StructureCraft

Developer (Albina Yard): reworks

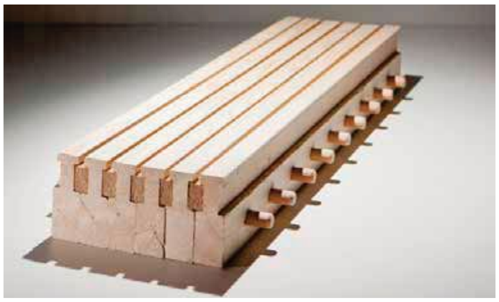
The four-story, 16,000-square-foot Albina Yard is noteworthy for being the first commercial building in the United States to use domestically fabricated CLT as a structural element. A Type III project designed under the 2014 Oregon Structural Specialty Code, it is also interesting as a precursor to another LEVER-designed office project—Framework, the 12-story winner of the U.S. Tall Wood Building Prize Competition.

"We were very interested in exploring a mass timber/CLT project on a smaller scale prior to building the larger high-rise project, so it was a very fortunate coincidence," says Design Principal Thomas Robinson. Asked about lessons learned, he emphasized the need for early collaboration between architectural, structural, mechanical, and installation. "Each discipline had a role to play; input and problem solving needed to happen together. As the building was essentially prefabricated off-site, the coordination and problem solving that often occurs in the field needed to be accounted for beforehand. After we were off the ground-floor slab, Albina Yard was built to a 1/8 tolerance, and it went together perfectly."

Currently in design, Framework will consist of ground-floor retail, five levels of office space, five levels of housing, and a rooftop community space. It is expected to include CLT floor panels as well as a new system of post-tensioned rocking wall panels.

Developed for use in high seismic regions, rocking mass timber shear walls were tested by the Network for Earthquake Engineering (NEES) as part of its CLT Planning Project. Seismic activity was simulated by cyclic loading that pushed and pulled the top of a 16-by-4-foot CLT panel with an embedded vertical pre-tensioned rod into a rocking motion. The wall was able to reach 18 inches of displacement, while maintaining its ability to self-center back to a vertical position.

Framework, which is scheduled for completion in 2018, is expected to be the first application of a rocking mass timber shear wall system in the United States.



Pictured is a dowel-laminated timber panel with an acoustic profile integrated into the exposed surface. Photo courtesy of StructureCraft

There isn't a prescriptive code path for the use of DLT under the current IBC, and the NDS doesn't provide published design values or equations for calculating capacities of wood dowel joints. To calculate capacities, the Timber Framers Guild provides some information. However, because nothing is referenced in the code, the use of DLT would require approval by the Authority Having Jurisdiction on a case-by-case basis.

Among the advantages of DLT, acoustic strips can be integrated directly into the bottom surface of a panel. This can help a designer achieve acoustic objectives, while keeping the wood exposed and allowing for a wide variety of surface finishes.

With growing interest in DLT, continued product innovation is likely, along with increased availability to U.S. building designers.

Structural Composite Lumber (SCL)

SCL is a family of wood products created by layering dried and graded wood veneers, strands, or flakes with moisture-resistant adhesive into blocks of material, which are subsequently re-sawn into specified sizes. Two SCL products—laminated veneer lumber (LVL) and laminated strand lumber (LSL)—are relevant to the mass timber category, as they can be manufactured as panels in sizes up to 8 feet wide, with varying thicknesses and lengths, depending on the product and manufacturer. Parallel strand lumber (PSL) columns are also commonly used in conjunction with other mass timber products.

The manufacture of SCL is standardized. However, while SCL is included in the NDS, design values are provided by the manufacturers. International Code Council Evaluation Service (ICC-ES) evaluation reports and APA product reports are available to assist with structural design capacities and specifications.

This article continues on http://go.hw.net/AR032017-2. Go online to read the rest of the article and complete the corresponding quiz for credit.

QUIZ

1. Which of the following is NOT true of cross-laminated timber (CLT)?
   a. CLT panels are particularly cost effective for multistory and large building applications.
   b. CLT is well-suited to floors, walls, and roofs, and may be left exposed on the interior for aesthetics.
   c. CLT offers two-way span capabilities.
   d. CLT can only be purchased in Europe.

2. Which building project is expected to be the first application of a rocking mass timber shear wall system in the United States?
   a. Albina Yard
   b. Framework
   c. T3
   d. Brock Commons Tallwood House

3. Which of the following is an advantage of nail-laminated timber?
   a. It naturally lends itself to the creation of complex roof forms.
   b. It is sold in a wide range of colors.
   c. It is connected with wood dowels.
   d. It typically has three, five, or seven layers of cross-lamination.

4. True or False: With careful specification and design that considers the flatwise structural properties, deep glulam sections can be placed flatwise as decking.

5. Which of the following contributes to the efficiency of mass timber?
   a. Speed of construction
   b. Less construction traffic
   c. Fewer workers on the active deck
   d. Integration of services into prefabricated elements
   e. All of the above

6. Which statement is NOT true of the seven-story T3 building in Minneapolis, Minnesota?
   a. The project has no exposed wood because of building code limitations.
   b. It took an average of nine days to erect per 30,000-square-foot floor.
   c. More than 100 truckloads of glulam and NLT panels arrived as they were needed on the job site, with steel connections preinstalled.
   d. The project is an estimated 30 percent lighter than a comparable steel design and 60 percent lighter than post-tension concrete.

7. True or False: Because of its strength and dimensional stability, mass timber offers a low-carbon alternative to steel, concrete, and masonry for many applications.

8. Which of the following is cited as a reason to use mass timber in schools?
   a. Lighter carbon footprint
   b. Ability to construct an entire project over the summer while the students are off campus
   c. Potential efficiencies of replicable modular designs
   d. Positive impacts of exposed wood on student wellbeing
   e. All of the above

9. Wood buildings over ____ stories are not currently within the prescriptive height limits of the International Building Code, meaning that designers of taller projects must follow an alternative means process.
   a. two
   b. three
   c. four
   d. six

10. Which test by the American Wood Council contributed to the recognition of CLT in the 2015 International Building Code?
    a. Full-scale compartment test comparing the performance of light-gauge steel, light-frame wood, and CLT
    b. Static and cyclical testing of self-tapping screws
    c. ASTM E119 fire endurance test of a five-ply CLT wall system
    d. Testing of CLT rocking walls

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Presented by:

Kingspan

INNOVATIVE INSULATION TECHNOLOGIES AND THEIR FITNESS FOR USE

Titanic Belfast, Belfast, Northern Ireland. Photo courtesy of Kingspan Insulation LLC.

LEARNING OBJECTIVES

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

1. Describe the three methods of heat transfer and how insulation addresses each one.
2. Describe several types of rigid insulation board technologies and their "fitness for use" in different applications.
3. Discuss strategies for designing thinner walls while maintaining or increasing thermal performance.
4. Identify the fire performance characteristics of different rigid insulation board technologies.

CONTINUING EDUCATION

CREDIT: 1 LU/HSW

COURSE NUMBER: AR052017-3

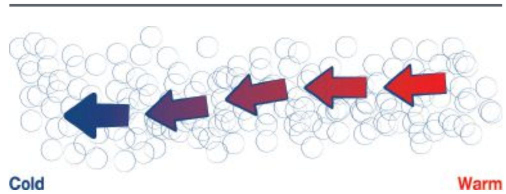
Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR052017-3 and complete the quiz for free as you read this article. If you are new to Hanley Wood University, create a free learner account; returning users log in as usual.

Insulation is an essential component of every building project, whether commercial or residential, new construction or renovation. To meet today's requirements for energy efficiency and occupant comfort, architects need to design insulation into every part of a structure, from the foundation to the roof.

In the past, bulky foams and fiberglass or mineral fiber batts were the primary insulation options available. They could provide the energy efficiency performance needed, but at the cost of thicker walls and roof assemblies. Recent advances in rigid insulation board technologies have changed this landscape significantly. Architects can now get the same R-value from thinner walls and roofs. That can mean greater design flexibility and, for commercial projects, more internal floor area within the same building footprint, which can increase leasable space and Return on Investment (ROI).

Insulation is no longer a "one technology fits all" proposition. Modern insulation board technologies offer a range of characteristics that can determine their fitness for use in different parts of a project. These include long-term durability, moisture resistance and fire performance. By understanding these characteristics, architects can select the best type of insulation for each application.

HOW INSULATION WORKS



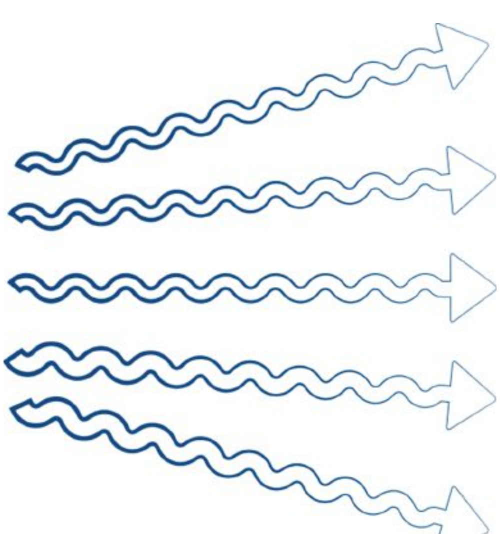
Different materials have different thermal conductivity properties; the lower the thermal conductivity, the better the ability of the material to resist heat transfer through conduction, convection and/or radiation.

Before we discuss the different types of insulation and their applications, let's get a better understanding of how insulation works. Thermal insulation is used to prevent heat loss/gain in buildings and thereby reduce energy usage. Heat naturally flows from warmer areas to colder areas, unless a barrier prevents the flow. In cold weather, heat leaks out of a building into the colder environment. In warm weather, heat from the environment moves into the cooler building. Heat transfer occurs in three ways: conduction, convection and radiation. Thermal insulation can resist each of these flows. You should also understand the difference between closed-cell and open-cell insulation.

Conduction is the movement of heat within a material from one molecule to another and it can take place in solids, liquids and gases. Different materials have different thermal conductivity properties (k or lambda λ values). For example, tiled/stone floors feel cold whereas a wood floor feels warm. This is because tiles and stone have a high conductivity whereas wood has a lower conductivity. Tiles allow heat to flow better and thus when your feet touch the tile, it feels cold. Insulation materials with low thermal conductivity resist conduction. The lower the thermal conductivity, the better the ability of the material to resist heat transfer through conduction. Using a low conductivity gas in insulation rather than just air further helps to reduce conduction.

A convection cell is the circular pattern of a gas in which warm air expands and moves upward, balanced by the downward movement of cooler air. Insulation can resist convection by preventing the flow of air, such as with a closed cell material that impedes air movement.

Convection is a flow of heat within liquids or gases. It does not occur in solids or a vacuum. As a liquid or gas heats up, its molecules become less dense. For example, warm air rises and transfers heat upwards. Insulation can resist convection by preventing the flow of air, such as with a closed cell material that impedes air movement. Materials can affect or manipulate convection in different ways. With open products (fiber/wool), convection cells can be set up but the fibers act as baffles to retard the air (and heat) flow. Closed cell product convection cells can be set up but are limited to the size of the cell. The smaller the cell the more difficult it is for the convection cell to start and the less efficient it is. In addition, the more convection cells that heat has to pass through to get from the warm to the cold side of the material, the harder it is for heat to flow.



Emissivity is the ratio of the energy radiated from a material's surface to the radiation from a perfect black body, and is affected by how emissive a surface is. A material with low emissivity, such as the "shiny" foil facing on an insulation board, reflects radiation and reduces the transfer of radiant heat.

The precise edges of insulation boards minimize air gaps when installed and minimize air leakage. This is also known as "convective bypass" which is the movement of heat-carrying air around insulation products.

Radiation is the transfer of heat as energy across space from one body to another. It does not need gases, liquids or solids to take place and can occur in a vacuum. The heat from the sun that we feel on our skin is a form of radiation. The rate of heat transfer as radiation depends on the difference in temperature between the radiating surface and the receiving surface, the distance between the surfaces, and the emissivity of the surfaces. Emissivity is the ratio of the energy radiated from a material's surface to the radiation from a perfect black body, and is affected by how emissive a surface is. A material with low emissivity, such as the "shiny" foil facing on an insulation board, reflects a large proportion of radiation (about 95%) and reduces the transfer of radiant heat in the proper configuration where the foil and an air space are on the warm side of the insulation. Radiation happens within insulation products as well; the fibers in fiber materials radiate heat as do the cell walls in foam materials.

MEASURING INSULATION PERFORMANCE

Three inter-related measures are commonly used to evaluate how well insulation performs.

- **Lambda value (k-value)** measures the thermal conductivity of a material, which reflects its inherent ability to conduct, convect and internally radiate heat. Insulation materials have low thermal conductivity.
- **R-value** measures the thermal resistance of a material at a given thickness. R-value is calculated by dividing the thickness of the material by its thermal conductivity. Materials with higher R-values are better at resisting heat loss or gain.
- **U-value** measures thermal transmittance of an entire building element, such as a wall or roof. It adds up the thermal resistances of all the layers in the element and corrects for air gaps and thermal bridges. U-value is expressed as an inverse of thermal resistance, so the lower the U-value, the better insulated the building is. Calculating U-values is a complex process, but leading insulation suppliers can provide technical assistance for these calculations.

The best way to compare the relative performance of different insulation materials is to look at their R-values per inch of thickness, which is essentially the reciprocal of thermal conductivity —the higher the better.

OPTIMIZING INSULATION PERFORMANCE

Several other factors within a structure also affect heat transfer and insulation performance.

Thermal bridges, also called cold bridges or heat bridges, are pathways through which heat can escape. For example, wooden studs allow greater conduction of heat than the insulation that surrounds them, so each stud is a pathway of least resistance for heat to move from the inside to the outside of a wall or ceiling. Window frames and brackets in rainscreen cladding systems are other common thermal bridges.

There are several types of thermal bridges. Repeating thermal bridges are a regular pattern of heat loss pathways, for example from wood studs in the walls. Non–repeating thermal bridges do not follow a regular pattern and are often caused by fasteners and gaps in the insulation around window frames. Geometrical thermal bridges are found at junctions between building elements, for example where the wall meets the floor. Use of continuous insulation, cavity closers and good workmanship during construction can significantly reduce thermal bridges. Cavity closers are insulated extrusions for closing wall cavities at openings such as window reveals and door reveals.

As heat transfer can take place by bulk movements of warm air from the inside of a building to outside (called air-leakage), it is important to control air movement through the building envelope. This can be done through air tightness and ventilation. **Air tightness** of a structure determines how much heat transfer occurs as air leaks through the building envelope. Both good construction and use of building wraps and other insulation materials that block air flow improve the tightness of the building.

Apart from true convection described previously, there are two other phenomena labelled as convection to be aware of. **Forced**

convection is where the effects of air pressure force heat-carrying air through an insulating material; "wind washing" of open cell materials would be an example. **Convective bypass** is the other; this is where air-pressure forces heat-carrying air around insulating materials.

CONTROLLING MOISTURE

The dew point temperature is normally lower than the air temperature and describes the point at which moisture in the air will condense. This depends on the amount of moisture in the air. If it is very humid, the dew point temperature will be higher. The amount of insulation you use and how you place it is key to keeping materials above their dew point temperature, and so avoiding condensation. You can use a vapor control layer on the warm side of insulation to reduce water vapor from passing from warm to cold sides of the construction and condensing. Leading insulation suppliers can provide technical assistance for this process.

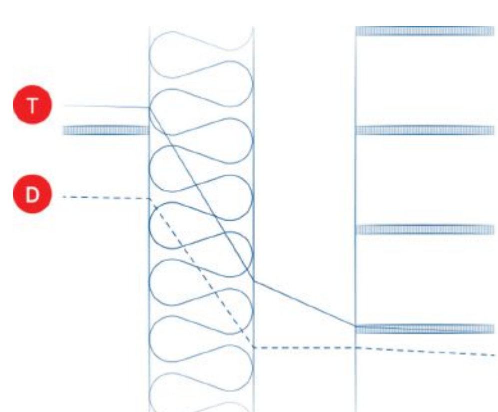
Moisture and condensation within the building envelope can reduce the performance, and even damage, some types of insulation. If trapped within walls or ceilings, moisture can lead to the growth of harmful molds. When the temperature drops below the dew point for a given level of humidity, moisture will condense from a vapor to a liquid both on internal surfaces and between layers inside a wall, roof or floor.

There are two types of condensation, surface and interstitial. Surface condensation takes place on the visible surfaces of a building. Indoors, this can increase the risk of mold, which can reduce air quality and can cause staining. Thermal bridges can cause surface condensation as heat is drawn out, leaving the inside surfaces cold. Interstitial condensation happens between the layers in a construction, i.e. inside the roof, wall or floor. It can damage these elements or even cause them to fail completely. Building elements can be designed to avoid the formation of interstitial condensation, or ventilation can be used to remove any condensation that forms before it causes any damage.

Effective moisture control can be challenging because many different factors affect it, including specific climate conditions and wall assembly design. **Ventilation** of interior spaces is very important because it helps to remove moisture before it can condense. Within the wall assembly, ventilation and drainage strategies can prevent damage caused by moisture that can degrade insulation performance over time. Ventilation is used to help the movement of air through air gaps in the cavities of the building envelope. This movement assists the drying behind the cladding of the wall system and will significantly reduce the chances of condensation forming. Drainage can prevent damage by allowing a pathway for water that penetrates the exterior cladding.

The proper installation of insulation also has a significant impact on moisture control. Placing a **vapor control layer** on the warm face of insulation boards or batts prevents water vapor from moving from the warm side to the cold side of the construction, where it is more likely to condense. Whether that vapor control layer should be on the exterior or interior side of the insulation depends on the climate and specific wall assembly. In general, buildings in warmer climates have vapor control layers on the exterior side of insulation and buildings in colder climates have vapor control layers on the interior side. (Note: placing vapor control layers on both sides of the insulation is not recommended because it can trap moisture in the insulation material.) With so many factors in play, these common strategies are not always the best for a particular building's location and design.

A good practice is to conduct a **hygrothermal analysis** or **condensation risk analysis** (CRA) of the building design to guide the selection and installation of insulation. A CRA assesses the risk of condensation forming once insulation is installed. As you can see in this diagram, the top line (T) shows the temperature and the bottom line (D) represents the material's predicted dew point temperature.



The top line (T) shows the temperature and the bottom line (D) represents the material's predicted dew point temperature. The amount of insulation you use and how you place it is key to keeping materials above their dew point temperature, and so avoiding condensation.

MODERN RIGID INSULATION BOARD TECHNOLOGIES

Today's rigid insulation boards can offer a higher R-value per inch and long-term durability. They are also lightweight and easy to install. Some types are very moisture resistant and don't provide food sources for mold and pests. Modern rigid insulation board technologies include foams (phenolic, polyiso, XPS and EPS), mineral fiber/wool and VIPs.

Rigid foam insulation boards can be manufactured using either a thermoset or a thermoplastic material. Thermoset insulation products, such as polyiso and phenolic insulation, retain their shape when exposed to heat or fire. They typically are bonded to facers or foils. Thermoplastic products, such as EPS and XPS insulation, are manufactured in an extrusion or expansion process.

Closed cell insulation has a compact and dense structure, which decreases the ingress of moisture. Insulation with a closed cell structure can also be more resistant to flood damage. Because of its low water uptake, closed cell insulation panels can recover from immersion in flood water more quickly than mineral fiber insulations, for example. Open cell insulation, on the other hand, has a structure that allows moisture and vapor to permeate through it.

A blowing agent is a substance used during the manufacture of closed cell foam insulation products. These agents are typically used to enhance the thermal performance of the finished product by filling the cells within the insulation with a low thermal conductivity gas. When choosing a manufacturer, look for one that uses blowing agents with zero Ozone Depletion Potential and low GWP.

TYPES OF INSULATION

Now let's discuss six rigid insulation board technologies that all have different properties and advantages:

Expanded Polystyrene (EPS)

Expanded Polystyrene (EPS) is a lightweight, rigid, closed cell insulation. EPS insulation is most commonly used in structural insulated panels (SIPs) and insulating concrete forms (ICFs), and can also be used in floors, walls, ceilings, below grade foundations (high-density EPS) and roofing systems. It has the lowest average R-value per inch of thickness of all rigid foam insulation, at R-4. EPS is the least expensive and most vapor-permeable type of rigid foam insulation material discussed here.

EPS is manufactured in a 2-stage process. Raw thermoplastic polymer beads are expanded by using steam, which are then dried, aged and cured before being placed into a mold. In the mold the beads are vacuumed and steamed again. Further expansion of the beads causes their surfaces to fuse together to create a solid block or beadboard.

Extruded Polystyrene (XPS)

Extruded polystyrene (XPS) has a uniform, closed cell structure which provides high resistance to water penetration damage and a good R-value of 5 per inch of thickness. Rigid extruded polystyrene insulation is lightweight, fiber free and available with various levels of compressive strength ranging from 25 to 100 PSI. The high compressive strength of XPS insulation board makes it suitable for high-load applications, including under slab, below grade foundation exteriors, inside basement walls, on exterior walls over wood sheathing, and on green roofs and plaza decks. It can also be used as continuous insulation for walls. XPS is also excellent for low-temperature freezer floors, cold storage facility floors, ice rinks and parking decks requiring a minimum compressive strength of 40 psi.

XPS insulation is manufactured through an extrusion process that involves melting together the thermoplastic polymer and other ingredients. The liquid formed is then continuously extruded through a die and expands during the cooling process. This produces a closed cell rigid foam insulation.

Phenolic

Phenolic insulation is a rigid thermoset material with a high compressive strength and a closed cell structure that resists air, moisture and water vapor penetration. Phenolic insulation has the highest R-value per inch of thickness of all rigid foam insulation materials discussed here at 8 to 8.5. It is lightweight, fiber-free and uses a low Global Warming Potential (GWP) blowing agent.

Phenolic is thinner than most commonly used insulation products for any specific R-value. Due to its light weight and high R-value per inch of thickness, phenolic insulation is primarily used in walls, floors, soffits, rainscreen and concrete sandwich wall systems (precast and tilt-up).

The closed cells in the core of phenolic insulation are enclosed in a solid polymer matrix. To produce phenolic insulation, a liquid polymer-forming mixture, including the blowing agent, is deposited onto the bottom layer of facing; it then expands to meet the top layer of facing. During this expansion, the polymer reaches a tacky/adhesive phase that bonds itself to the facing. It then goes through a heated conveyor with a fixed width gap to control board thickness. It is then kept at an elevated temperature to cure and set the polymer.

Polyisocyanurate (polyiso, PIR or ISO)

Polyisocyanurate foam (PIR) is a rigid thermoset insulation that has a high R-value of 6 per inch of thickness. It is closed cell, so it resists air, moisture and water vapor penetration. It is lightweight, fiber free, and uses a low Global Warming Potential blowing agent. Though PIR has a lower R-value per inch than phenolic insulation, it offers another option for walls, attics, and roofing.

To produce PIR, a liquid polymer-forming mixture including the blowing agent is deposited onto

QUIZ

1. __________ is the movement of heat within a material from one molecule to another.
   a. Conduction   b. Convection
   c. Radiation   d. Emissivity

2. What does R-value measure?
   a. Thermal transmittance of an entire building element   b. The inherent thermal conductivity of a material
   c. Thermal resistance of a material at a given thickness   d. Moisture resistance of an insulation material

3. Which rigid insulation board technology has the highest R-value per inch of thickness?
   a. Mineral Wool   b. Extruded Polystyrene (XPS)
   c. Phenolic   d. Vacuum Insulation Panels (VIP)

4. Which rigid insulation board technology has the lowest R-value per inch of thickness?
   a. Mineral Wool   b. Extruded Polystyrene (XPS)
   c. Phenolic   d. Vacuum Insulation Panels (VIP)

5. In general, where should a vapor control layer be installed in warmer climates?
   a. On the interior side of the insulation   b. On the exterior side of the insulation
   c. On both sides of the insulation   d. A vapor barrier is not needed in warmer climates

6. The ASTM E84 test measures:
   a. Full scale fire performance of exterior, non-load bearing wall assemblies   b. Smoke and flame spread performance of materials
   c. Compressive strength of materials   d. Moisture resistance performance of materials

7. How can selecting phenolic rigid insulation board increase a project's Return on Investment (ROI)?
   a. Automated installation reduces labor costs   b. Increased window size improves daylighting
   c. Finished surfaces eliminate cost for painting   d. Thinner walls increase rentable floor area

8. What characteristic of Extruded Polystyrene (XPS) insulation makes it suitable for exterior below grade applications?
   a. Low cost per square foot   b. Better R-value per inch of thickness
   c. High compressive strength and low water absorption   d. Ease of installation

9. Which rigid insulation board technology is best suited for soffits if thinness is required?
   a. Phenolic   b. Mineral Wool
   c. Spray Foam   d. Expanded Polystyrene (EPS)

10. Which rigid insulation board technology, first used in refrigerators and freezers, is now being selected for building projects where a lack of construction space is an issue?
   a. Mineral Wool   b. Extruded Polystyrene (XPS)
   c. Phenolic   d. Vacuum Insulation Panels (VIP)

This article continues on http://go.hw.net/AR052017-3. Go online to read the rest of the article and complete the corresponding quiz for credit.

GREEN QUALITIES OF SPRAY FOAM INSULATION

Presented by:

LEARNING OBJECTIVES

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

1. Discuss the importance of air barriers and insulation for reducing energy consumption and potential health and safety hazards in residential and commercial buildings.
2. Describe open-cell and closed-cell spray foams and explain applications of each.
3. Explain how spray foams work as a green and sustainable form of insulation.
4. Identify uses of spray foam insulation to reduce fuel consumption.
5. Discuss green features of spray foam insulation as opposed to traditional insulation materials and methods.

CONTINUING EDUCATION

AIA CREDIT: 1 LU/HSW
AIA COURSE NUMBER: AR032017.1

Use the learning objectives above to focus your study as you read this article. To earn credit and obtain a certificate of completion, visit http://go.hw.net/AR032017-1 and complete the quiz for free as you read this article. If you are new to Hanley Wood University, create a free learner account; returning users log in as usual.

By Lisa Jo Rudy

Building insulation is a tool for keeping heat in or out of structures. Insulation makes it possible for buildings to stay warm in winter, cool in summer, and relatively moisture free year-round. Different types of insulation and air barriers have been used over the centuries with varying results.

Today, new materials and technologies make it possible to create and apply extremely effective insulation and air barriers. The result is buildings that can maintain a safe, comfortable temperature while using very little energy for heating or cooling. This translates to greener buildings that create very low "carbon footprints" and meet LEED and other energy efficiency guidelines.

Spray foam is a newer material that combines the benefits of insulation and air barriers. Because of its unique formulation and application, it consistently out-performs older, more traditional forms of insulation. Recycled and environmentally-friendly products are available to make spray foam an exceptionally "green" choice.

HOW HEAT MOVES IN BUILDINGS

Heat is a form of energy which causes the molecules in gases or solids to move more rapidly. Heat tends to flow to cooler areas until all areas are at the same temperature. It moves from the warmest to the coolest parts of any structure through three mechanisms: conduction, convection, and radiation.

- Conduction describes the transfer of heat through materials. An example is the heat that is transferred from a stove to a pot, or from a hot liquid to a spoon. Heat and cold can both be conducted through materials in a building, with the result that warmth is conducted to cooler areas. Some materials are better conductors than others; metal, for example, is a good conductor while wool is a poor conductor.

- Convection is the process by which warmer gas or liquid rises, cools, sinks, heats, and rises again. Convection can be seen in a boiling pot, or felt in a poorly insulated building. During winter, convection is the process that moves warm air from lower floors to the roof. In many cases, warm air then escapes through gaps in the building.
- Radiation is heat that comes from a single source and moves in a straight line. The sun produces radiant heat, as does an electric heater.

Insulation is simply a tool used to manage the flow of heat. In construction, it may be used to keep heat in or out of a building or to maintain a constant temperature. In most cases, its purpose is to slow down the process of convection and conduction, or to reflect radiant heat.

In a building without insulation, heated and cooled air move through the building and are lost to the outside environment. As a result, the heater or air conditioner must work constantly to keep the building at a comfortable temperature. Proper insulation, however, can keep the building at a consistent temperature for long periods of time. This means less energy spent on heating or cooling air—which leads to lower environmental impacts and lower fuel costs.

To maintain comfort, the heat lost in the winter must be replaced by your heating system and the heat gained in the summer must be removed by your cooling system. Properly insulating your home will decrease this heat flow by providing an effective resistance to the flow of heat.

HOW TRADITIONAL INSULATION WORKS

The purpose of insulation is to stop the flow of heat from warmer to cooler areas. Natural materials have been used for thousands of years to insulate homes and maintain comfort. Rock and wood can literally stop the flow of air by putting an impermeable barrier in its way. Thick, fibrous material such as wool, horse hair, or thatch can trap heat in gaps between the fibers. While these materials were somewhat effective, they left plenty of room for improvement. With new technologies, more effective materials were developed.

Sweaters are like insulation, while wind breakers are like air barriers. Both are necessary for proper building envelope performance.

In the 20th and early 21st centuries, foam board and fiberglass became very popular insulation materials. Foam boards physically block the movement of air while also slowing conduction. Spun fiberglass can be stuffed between floors and into gaps in construction, and its many layers of fibers do a good job of trapping warm air.

The job of any insulating material is to stop heat from moving from one location to another. The ability of any individual material to stop this flow is measured by its R-value. A high R-value means that a material is a very effective insulator, while a low R-value means the material is a poor insulator. Paper, for example, has a low R-value while thick fiberglass insulation has a much higher R-value.

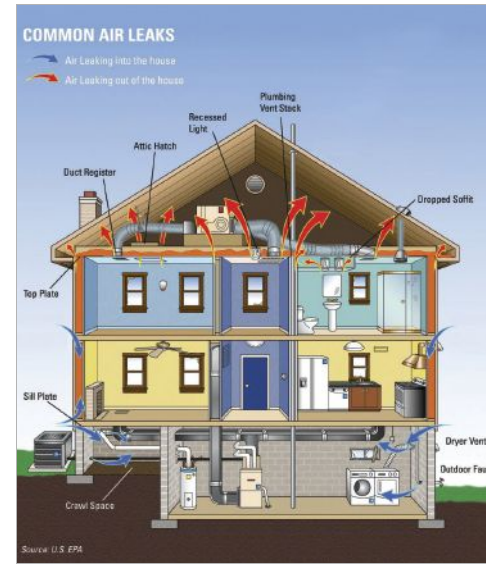
The R-value of an insulating material is also based on the degree to which the material is properly installed. An inch of fiberglass material in a five-inch gap will do little to stop the flow of heat. Fiberglass that completely fills a gap will do a far better job of stopping the flow of heat, and thus produces a higher R-value.

THE LIMITS OF TRADITIONAL INSULATION

Standard insulation works in very much the same way as a sweater. Like a sweater, it is made up of layers of fibers which trap heat. In the case of clothing, however, heat is generated by the human body rather than by a furnace.

A sweater is perfect for cool autumn days when the sun is shining. Not only is it a thick, barrier between your warm skin and the colder air, but gaps between the fibers do a good job of trapping warm air. But what happens when rain falls or cold winds blow? Because it does not provide an impermeable barrier, the sweater provides only minimal insulation from stormy weather.

A windbreaker is an external covering that helps stop wind and water. Put on a windbreaker over a sweater, and the sweater can do its job better. Together, the windbreaker



and sweater provide an ideal climate control system.

The sweater is a good analogy for standard insulation. Insulation is any material used to prevent transmission of heat or cold. Typically, structural insulation is made of fiberglass. In buildings, insulation is used to keep indoor environments separate from outdoor environments. No matter what the weather outside, insulation acts like a sweater—keeping warm air inside and helping to keep cold and heat outside.

When the weather becomes very cold, hot, wet, or windy, however, gaps in fiberglass insulation let in the cold and drafts. That's when an air barrier becomes important. Traditional air barriers are self-adhered sheets, membranes, films, or board stock that are attached to the outside of structures to stop wind and air leakage from occurring.

CAUSES OF AIR LEAKAGE

Air leakage is a result of pressure differences caused by the "stack effect," wind loading, flues, and ventilation systems. While some air leakage is unavoidable, it can be minimized through the use of high-quality insulation and/or air barriers. Causes of air leakage relate to basic physics, and to the way in which structures are insulated.

The Stack Effect: Hot air is lighter than cold air. Because of this, hot air rises to the top floors of a building. Positive pressure inside the building builds toward the roof as more air is forced into the same space. This pressure pushes air out through gaps in the ceiling and upper story windows.

Meanwhile, on the lower floors, air pressure is lower inside the building than outside. Higher pressure outside pulls cold air in through openings in windows, walls, and the building foundation. As the cold air warms, it rises—building pressure toward the ceiling and starting the process all over again.

The stack effect, also called convection, is always in process. It's an unavoidable reality of physics. But it can be mitigated if buildings are sealed to the degree possible.

OTHER CAUSES OF AIR LEAKAGE:

The stack effect describes one process by which air moves in and out of structures. There are also two other major reasons for air leakage.

Wind loading describes the outcome that occurs when the wind blows most often on one side of the building. As the wind blows, cold air enters through gaps in insulation, building up pressure on the windward side of the building. This leads to negative pressure on the down-wind side of the building. This phenomenon results in wind being pulled through the building—creating drafts and adding to leakage issues.

Flues and ventilation systems are openings in the building structure. They are used to expel air from the building when furnaces and hot water heaters are operating. When air is pushed out, it is replaced by outside air that leaks in through other openings.

Air leakage resulting from wind loading, flues, and ventilation systems is unavoidable. No one can stop the wind from blowing, and flues and ventilation are absolutely essential. But there are methods for minimizing air leakage and the problems associated with it.

PROBLEMS ASSOCIATED WITH AIR LEAKAGE

Why is air leakage such a serious issue? To go back to the sweater analogy, air leakage is similar to holes in a sweater. Cold air and rain can readily enter through any gaps in a sweater, allowing heat to escape and moisture to increase discomfort.

Air leakage can create a range of problems for home and building owners. It can impact health and safety, durability, occupant comfort, and heat and cooling costs. It can also lead to environmental issues as owners crank up the heat or air conditioning.

In structures, air leakage is a major concern. There are numerous problems associated with air leakage, including:

- Health and Safety Risks
- Durability Issues
- Loss of Occupant Comfort
- Increased Energy Costs

Health and Safety Risks: Air leaks carry moisture—and damage from airborne moisture from air leaks can cause a variety of safety problems. For example:

- When warm moist air leaves a building, and interacts with cold air, icicles form. In some cases, falling icicles can become serious safety hazards.
- When water freezes, it expands. Warm, moist air can freeze on the inside of building facades, pushing bricks or stones out of alignment and causing damage to the façade or masonry cladding. When the frozen water melts and refreezes, it pushes the bricks, stone, or other materials further out of alignment and even more damage is done.
- Warm, moist, dark environments are ideal for mold and mildew. Mold and mildew can cause long-term structural damage to the building. Some kinds of mold can also cause serious health risks, especially to people with allergies or asthma.

Durability Issues: Airborne moisture can negatively impact the durability of a building. When warm, moist air condenses on cold steel, the steel can rust and corrode. In addition, moisture condensing on a roof deck of an attic can lead to mold, mildew, rot, and corrosion.

Occupant Comfort: Air leakage creates cold drafts in winter. It also creates uncomfortable heat and humidity in summer. Even when air is cooled or heated, air leakage can bring in outdoor pollutants such as dust, pollen, and chemicals. These materials are difficult to remove, and can build up over time.

Heating and Cooling Costs: In summer, air leakage means more work for air conditioners as warm, moist air enters through gaps in insulation and air barriers. In winter, heating systems work overtime to warm up cold air. In both cases, costs and energy use are higher than they need to be for the same outcome. In fact, according to the Department of Energy, unwanted air leakage can account for nearly one-third of the heating and cooling energy costs of a typical home. Fortunately, it's possible to reduce air leakage by as much as 80 percent through the use of air barriers.

WHAT IS SPRAY POLYURETHANE FOAM?

Spray Polyurethane Foam (SPF) is a modern polymer produced as the result of a two-component chemical reaction between a polyalcohol and a polyisocyanate. Polyurethane is an extremely popular material, as it provides a huge range of benefits. It is used in a wide range of ordinary products, including:

- Footwear (Shoe Soles/Cushion)
- Sofas
- Mattresses
- Paint
- Bowling balls
- Insulation
- Roller blades wheels
- Golf balls

When it is used as an insulator/air barrier, Spray Polyurethane Foam (SPF) is applied as a liquid. The liquid quickly expands into a foam which surrounds and seals gaps. Over the course ofseconds, the foam hardens and becomes an extremely effective insulator and air barrier.

OVERVIEW OF SPRAY POLYURETHANE FOAM INSULATION

Spray Foam Insulation has become the insulation of choice for builders, architects, and homeowners because of the myriad of benefits it provides, all stemming from its ability to provide a seal against air, moisture, and thermal fluctuations, all in one application. Spray foam is applied as a liquid, which allows it to flow into potentially leaky areas such as cracks, gaps, and penetrations. The foam quickly expands, seals, and hardens.

Fiberglass, in batt and blown forms, has traditionally been used in vented attics, walls, and crawlspaces. These traditional insulations act like loose blankets for a home, and much like blankets, only work when air is not moving over, under, or through the blanket. Spray foam

Spray foam flows, expands, seals, and hardens. As a result, it's ideal for insulating small and oddly-shaped openings.

insulation is a significant improvement over fiberglass options. It expands to fills cracks and corners of attic roofs, walls, and crawlspace joists, sealing conditioned air in and keeping unconditioned air out.

The benefits of this multi-barrier insulation are numerous and include: lower energy bills due to better HVAC performance and smaller size, longer HVAC system life, less dust and air pollutants in the home, equalized room temperatures, cooler and cleaner attics, lower carbon footprint, increased structural strength, added sound abatement, increased value of home, and lower home insurance, all of which lead to happier homeowners.

TYPES OF SPRAY FOAM INSULATION

Closed-cell (ccSPF) and open-cell (ocSPF) Spray Polyurethane Foams serve as effective air barriers and insulation but have different properties.

There are two types of spray foam insulation: closed and open cell. These foams, while made of similar materials, are quite different—both in their properties and in their uses.

QUIZ

1. Which of the following actions can be described as "the movement of heat through solid surfaces?"
   a. Conduction — b. Convection
   c. Refraction — d. Reflection

2. Which type of material is most often used in traditional insulation?
   a. Film membrane — b. Natural fibers such as wool
   c. Fiberglass — d. Drywall boards

3. When warm air rises, it increases pressure toward the top of a structure. This forces warm out through gaps in or near the roof. This phenomenon is known as:
   a. R-value — b. Conduction
   c. An air barrier — d. The stack effect

4. A wind breaker is a good analogy for which of the following?
   a. Traditional insulation — b. An insulation/air barrier system
   c. Spray foam insulation — d. An air barrier

5. Which of the following is an advantage of spray foam as opposed to traditional insulation methods?
   a. Spray foam is both an insulator and an air barrier — b. Spray foam can be used to heat buildings
   c. Spray foam can be applied by non-professionals — d. Spray foam comes in a variety of colors

6. Which of the following problems can be solved with the use of spray foam?
   a. Mold and mildew caused by moisture — b. High fuel costs caused by poor insulation
   c. A and B — d. Only B

7. True or False: It is possible to find and use spray foam which made up largely of recycled materials?

8. Which of the following is an advantage of closed cell spray foam?
   a. It can improve structural integrity — b. It provides better insulation than open cell spray foam
   c. It can be used to improve ventilation — d. It is easier to apply than open cell spray foam

9. Which of the following is true of both open and closed cell spray foam?
   a. Both are appropriate for exteriors as well as interiors — b. Both can deaden sound between walls and floors
   c. Both are more commonly used than fiberglass — d. Both expand to the same degree when applied in liquid form

10. True or False: Spray foam does not perform as well as a system composed of fiberglass insulation and insulated sheathing

Open cell spray foam is low density, non-structural, and water vapor permeable. Its expansion rate is about 140 to 1, meaning that the foam, once applied, will expand by 140 percent. Open cell foam chambers are interconnected, so gas (air) can pass through multiple cells. Because it is water vapor permeable, it is used in interiors. Some examples of its use include:

- **Exterior walls**—ocSPF insulation can seal cracks and provide in-house noise reduction.
- **Partition Walls**—ocSPF can provide a sound barrier between rooms to ensure that noise stays in one area a building.
- **Attics**—ocSPF can provide effective insulation in the tradition vented attic or high performing unvented attic.

This article continues on http://go.hw.net/AR032017-1. Go online to read the rest of the article and complete the corresponding quiz for credit.

AIA Architect

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PHOTOGRAPHY: CARL BOWER

Across the Great Divide

Four decades in the air and abroad.

James Wright, FAIA, a senior principal at Page in Washington, D.C., is the 2016–17 president of the AIA International Region, which was formed in 2012. In his 37 years of working on projects outside of the United States, he has been responsible for over $3 billion worth of construction in more than 40 countries, including 25 U.S. embassies and consular compounds. "If you're going to work abroad, you have to do your homework," he says, "and the metric system is just the beginning."

As told to William Richards

One trend I don't see diminishing is the number of foreign nationals who want to study architecture in the U.S.—and it's fueling the growth of the AIA International Region. After foreign nationals attend American architecture schools, sometimes they'll stay to get licensed and sometimes they won't, but many of them return to their home regions to practice. Their association with the AIA is helpful to them in those regions and as they begin to practice globally—and then, one day, partner with their American counterparts.

Our best contribution at Page, as a U.S.-based firm, is at the front end of the entire process, with services like architectural programming or conceptual thought leadership prior to the design phase. I am a strong advocate of the positive chemistry between U.S. firms and local firms in a given country. It's not only philosophically important, but it's critical when it comes to things like fees, for instance. Cash flow can be an issue for projects abroad—since you're billing at the end of a long phase, instead of on progress or on a monthly calendar cycle, as we do in the U.S.—and a local partner can sometimes help finance you with interim payments. At a minimum, your partnering firm is in a better geographic and cultural position to help you collect. Local partners can also cover the performance bond that foreign projects often require you to post.

The AIA International Committee and International Region have been doing international practice workshops for years, and we've seen an increase in international opportunities for American architects, despite the wild swings in the global economy. I've seen many cycles in my lifetime when oil is king one year and then bust the next—and petroleum-based economies are hit particularly hard during those down cycles.

American firms have the skillsets to tackle projects that have any degree of complexity—higher-education facilities, research and development facilities, healthcare facilities, and so on. Sure, we have a lot of competition from Europe and Japan, but we have held our own for the last few decades in terms of expertise. I don't see that diminishing. AIA


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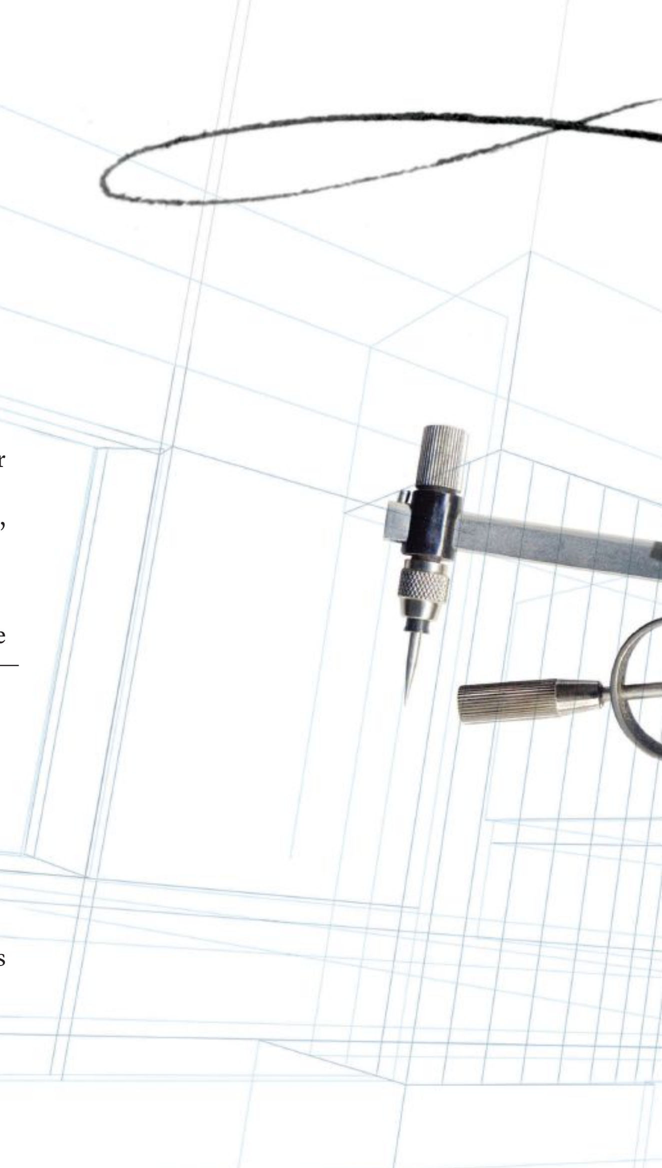
Contractual considerations for American architects working abroad.



In terms of the reach of its influence, architecture has always been a global profession. As communications and building technology make the world ever smaller and more accessible, however, recent years have seen an explosion of interest in international practice. Although working abroad is cause for special consideration in many areas, none may be more important than contracts, the formal agreement between the architect and owner/client that deals with the scope of work, schedule, payments, liability, and other matters.

As many U.S. architects have learned, the benefits of international practice are many, including access to untapped markets, the development of multicultural expertise, and increased branding and name recognition. In addition to established architectural markets in Europe, Asia (especially Japan), and the Middle East, emerging markets can be found in South America, Africa, and elsewhere. Although the AIA's Contract Documents are used for most contractual agreements in the United States, overseas architects are more likely to work with FIDIC contracts, published by the International Federation of Consulting Engineers, based in Geneva. (Sometimes clients draw up their own unique contracts, and certain countries have their own, but FIDIC and AIA contract documents are widely used.)

The first consideration for American architects working abroad is to nail down their own employment contracts, says Tiffany Melançon, INT'L. ASSOC. AIA, current president of AIA Continental Europe. Architects are likely to initially be employed by an existing architecture firm before opening their own practice, which in Europe would provide some legal cover and a relatively safe learning opportunity for professionals working in a new land. "I did exactly this when I moved to Switzerland many years ago to work for a Basel-based international company," says Melançon, who now runs her own Basel-based practice, Melancon & Co.

Once overseas, architects would do well to learn the local language, applicable building codes and laws, and general contractual requirements for doing business there, she says. If most projects use a certain kind of contract, it is probably the safest bet for architects new to the region to follow that lead until their practice is more established. Melançon, for her part, works primarily with contracts issued by the Swiss Society of Engineers and Architects (SIA).

To help architects understand contractual concerns, the AIA recently published the *AIA Global Practice Primer,* which outlines the major areas of concern that architects should include in their contracts. These include liability issues, payment schedules, roles and responsibilities, intellectual property rights, dispute resolution, and collateral warranties, which are used to extend recovery rights to a third party. All these areas must be carefully studied and negotiated—preferably with the help of legal counsel, a tax adviser, or an insurance broker—before architects sign on the dotted line.

In terms of liability, for example, some countries (such as France and parts of the Middle East) impose strict liability clauses—often called "decennial liability" because it dates to 10 years after project completion—for defects that affect the stability or safety of a structure. Contracts should address limitations of liability, which might include stated fees or the amount of required insurance. Even so, in some countries liability limitations are unenforceable.

Working in Japan, Indonesia, and China, George T. Kunihiro, FAIA, director of the AIA International Region, says that he employs a combination of local and AIA contracts, depending on the situation. He says that AIA contracts can serve as an important reference from which he can create bespoke agreements that suit a particular project or place. In China, for example, where his role has often been as a consulting partner or subcontractor, he has tended to go along with whatever Chinese agreements the project leads are using (although he makes sure to vet them against his own needs and requirements).

For architects working elsewhere, however, developing a custom contract might go against local practice or laws. In those cases, learning about FIDIC contracts would be not just worthwhile but a necessity.

Generally speaking, FIDIC contracts tend to be more detailed than AIA contracts and favor the owner/client, with strict standards, definitions, and clauses that can cause headaches for architects unaware of their pitfalls. "FIDIC is the king of the hill here," says Thierry Paret, FAIA, first vice president of the AIA International Region, who is currently based in Jeddah, Saudi Arabia. "The AIA contracts are well-tested and proven in the U.S., but legally one would have to be cautious using them [in the Middle East], because it doesn't work as well in the legal framework of this region."

A few years ago, Paret was negotiating a contract with a major client in Qatar that began with boilerplate language from FIDIC but was then compounded by additional clauses that were difficult to swallow—such as a requirement that the designer forfeit a portion of his fee for delays ("liquidated damages"). Delays can be caused by a number of complex factors, and it is problematic for the architect to automatically assume fiscal responsibility for them. FIDIC and AIA contracts differ slightly, too, in terms of the kinds of entitlements to delay the project that are allowed; AIA documents generally give contractors more leeway. Architects might also be expected to include some kind of performance bond, to help protect clients from U.S. architects who decide to pull up stakes and head home.

"Generally, my experience with FIDIC is that you have standard boilerplate, and then

ILLUSTRATION: VIKTOR KOEN

the client will add their specific requirements, which tend to be rather client-friendly and onerous for the architect and contractor," Paret says. "Sometimes you almost are afraid to sign the contract because you are responsible for everything under the sun."

In the Middle East, Paret says, project schedules tend to be aggressive, and clients often expect design work to be performed very quickly. He notes that architects should understand the differences in expectations from region to region. For example, in the United States, when construction documents are drafted, they are usually considered a final workable product. In the Middle East, construction documents are at about 80 percent completion compared to what would be produced in the United States, with more back-end detailing expected from contractors through shop drawings, which are then approved by the architects and engineers. These are all things that need to be spelled out contractually so that the architect is covered and doesn't waste effort.

As one architect working abroad said in an interview, the AIA contract documents are among the Institute's most highly valued offerings, but opportunities exist for the AIA to gain even more global market share through greater education about its contract documents and advocacy for their global use. To this end, AIAU, the AIA's continuing education portal, offers several courses related to global practice, such as its "When Change Means Going International" series, which often deals with contractual issues.

"Architecture students are not usually taught how to negotiate contracts in school," says Robyn Baker, associate general counsel of CallisonRTKL and co-author (with CallisonRTKL general counsel Robyn Miller) of the "Legal issues" chapter of the *AIA Global Practice Primer.* "The best risk-management tool you have is a good contract. Architects need to put in the time and energy to get appropriate terms." **AIA**

By Kim O'Connell

AIAFeature

Aboard the New Urban Agenda

A dispatch from Kibera, Nairobi's largest slum, reveals the urgency—and the promise—of Habitat III.

By Thomas Vonier, FAIA

PHOTOGRAPHY: ©TROCAIRE

ABOVE: Kibera in Nairobi—the capital city of Kenya—is one of Africa's largest slums. Kibera lacks sanitation, trash removal, drainage, safe drinking water, electricity, roads, and other public services, and it is bisected by a Uganda Railway line and a dedicated railway station. OPPOSITE: Kibera is one of nearly a dozen slums in the metro Nairobi area and contains nine established neighborhoods.

Nairobi astounds—a place of nonstop incongruities, countless contrasts. Deep squalor is adjacent to great opulence. Crude implements work alongside new technologies. Islands of cool and luxe offer havens from dust and swelter. Donkey-drawn carts run with Mercedes sedans. The stark juxtapositions are everywhere, and everywhere people are moving.

Unmistakably, this is Africa, and Nairobi is the capital of Kenya, an "emerging country" on a huge and sometimes turbulent continent. Nairobi is also global urbanization manifest. When Habitat I launched in 1976, 8,900 miles away in Vancouver, a little more than a third of the planet's population was in cities. Twenty years later that figure reached 45 percent. Today, in the waning glow of Habitat III last year in Quito, Ecuador, that number is above 54 percent and rising rapidly. In absolute terms, the number of urbanites is staggering.

In Nairobi, 60 percent of residents in a city of more than 4 million live in shantytowns—some 2.5 million people in all scattered across more than 200 separate sites. Some observers prefer the term "informal settlements," but Nairobi residents just call them "slums," as reflected by the names these places carry: Deep Sea Slum, Kiambui Slum, Suswa Slum, Huruma Slum.

Kibera, Nubian for "forest" or "jungle," was so named by its first settlers, Nubian soldiers who had served in the King's African Rifles and received plots but no land titles. It is now home to at least a quarter million people—with plausible estimates putting the actual population at two to three times that, but nobody really knows. Reliably, it is called Africa's largest slum. Quite possibly, it is the largest one in the world.

"Here we are," the driver said, smiling as we pulled alongside one of its rough and dirty edges, down steep hills adjacent to a sleek, almost new freeway. "Famous!"

And it is well-known: Kibera was the setting for the dramatic rendering of an exploited Africa in the film adaptation of John le Carré's *The Constant Gardener*. It is often used as a poster image for desolate shantytown poverty. It is famous simply because it is so vast and sprawling; its dwellings are indistinguishable from those found just about any place on the planet where poor people have to fend for themselves.

Kibera has thousands upon thousands of small shacks and shanties, most built from stick-and-mud walls, roofed with corrugated metal sheets. Cardboard is the common flooring. "Windows" are made of stretched plastic. Much of everything is scavenged. Dirt paths, usually wet and muddy, twist and turn among warrens of rough scabby enclosures.

Like most urban slums, Kibera is a densely packed, single-story development. Informal settlements cover just 6 percent of Nairobi's total land area, yet they account for as much as half of the city's population.

Nairobi's slums occupy lands that belong to the Kenyan state, but the shacks themselves are "owned" by people who rent them out. By some estimates, 90 percent of all Kibera residents are "tenants." A typical dwelling is a 12-foot-square rectangle sleeping eight people, often more. Roughly furnished, it commands a monthly rent of about $9, from people who get

PHOTOGRAPHY: ©TSCHREIBKRAFT

AIAFeature
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by on little more than $1 a day.

This city (also home to the U.N.-Habitat headquarters) is probably what many delegates to Habitat III had in mind when they adopted "The New Urban Agenda" last year, embracing these aims:

1. Basic services for all, including safe shelter, potable water, sanitation, food, healthcare, education, and access to communications.

2. Equality of opportunity, with attention to the needs of women, children, people with disabilities, the elderly, indigenous people, and marginalized groups.

3. Cleaner air, by using renewable energy, greener public transport systems, and sustainable practices with natural resources.

4. More resilience and less risk of damage from disaster through better planning, stronger infrastructure, and improved response capabilities.

5. Safe and accessible green public space, including walkways, cycling lanes, squares, and parks.

All of that, and more, is much needed here. Along with the U.N., various charities, foundations, action groups, volunteers, and community organizations are working with the Kenyan government to electrify parts of Kibera and other Nairobi settlements. All of them lack outdoor lighting. Only a fifth of the city's shacks have any kind of electrical power.

The government and U.N.-Habitat tried a Kibera "cleansing" scheme to replace and upgrade the shanties, including plans for a series of new high-rises. That did not go very far. Crews encountered great difficulty bringing building supplies onto the site, which has no room for vehicles and is surrounded by relatively steep downward slopes.

Supplies that did make it into the complex quickly disappeared. Kibera is built on refuse; its unstable ground cannot accommodate foundations. Collapses during floods are common, and when shoddy buildings fall they damage good ones. And many residents didn't want any change at all.

Today potable water does run into Kibera via large main pipes, easing the risk of cholera and typhoid, but latrines are shared; when they're emptied, the waste often goes right into the Nairobi River. Teenage pregnancy is common, as are alcohol and drug dependency. Health remains a challenge for everyone. Most employment is menial and unskilled. More than half of the slum's inhabitants have no work at all.

Still, you can book guided tours of Kibera ("Come! Visit Our Slum!") and many tourists do. Day-trippers say it's a friendly enough place, and its residents are proud. It is a nearly unavoidable physical presence. Sections of it are within view of Nairobi's booming commercial center and its office towers.

A local architect friend said of Kibera, "It's important to meeting basic housing needs." He called it affordable, improving, and the only way into the city for the many people arriving daily from the countryside to seek opportunity. "It can be just a stop on the way to something better," he told me. "People actually leave; they actually do move up."

That was a hopeful thought. It spoke to basic human enterprise, which might actually be the only hope. We know the statistic—more than half of humanity now lives in cities. We know the numbers—there are more than five billion of us today, soon enough seven.

Nairobi is many things all at once—noisy, quiet, large, small, stifling, liberating, rural, urban, global, poor, rich, old, traditional, new, fun, sobering. Mostly, however, it is a place where many thousands of people invent, look for money, wander for work, seek solutions, and try to cope—mainly on their own, every day, all the time, in every way. AIA

PHOTOGRAPHY: © EOGHAN RICE / TRÓCAIRE

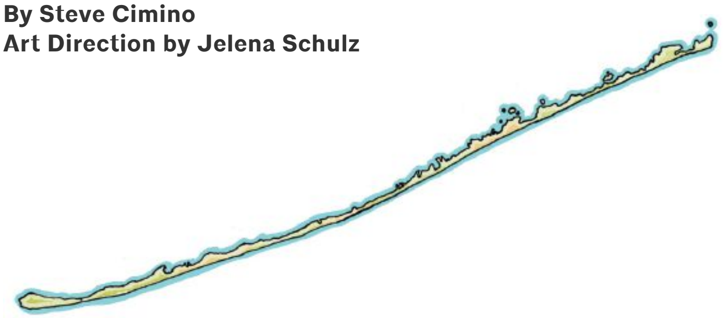
ABOVE: Kibera's main streets are defined by contiguous dwellings and served as the backdrop for much of the post-election violence of 2007.
TOP: A lack of proper sanitation challenges old and young in Kibera, home to at least a quarter million Kenyans (by some estimates).

AIANow

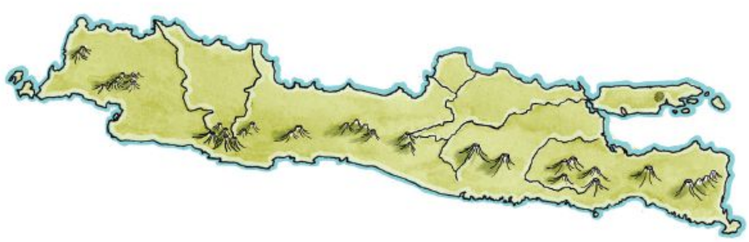
By Steve Cimino
Art Direction by Jelena Schulz

Design Your Own Island

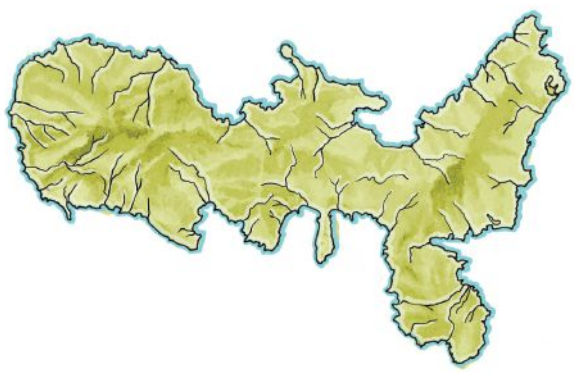
The University of Pennsylvania's *LA+* (Landscape Architecture Plus) journal has launched a $10,000 international ideas competition to design a hypothetical island. But before you start dreaming up your own land mass, consider these seven islands as inspiration.



Fire Island: The homes on this barrier island off the southern shore of New York's Long Island are a renowned group of nature-informed modern gems, built for its party-happy inhabitants in the 1960s and still embraced today.

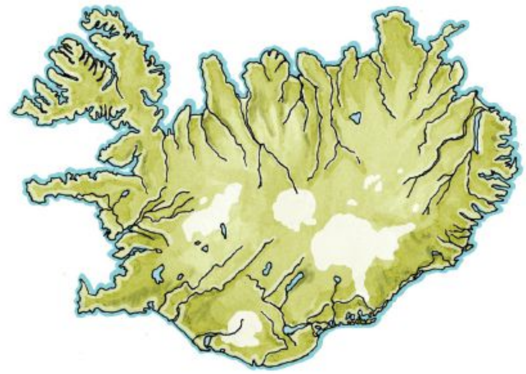


Java: The most populous island on Earth—with more than 141 million people—houses Indonesia's capital, Jakarta. Its name has served as a synonym for coffee since its beans became a chief export in the early 20th century.

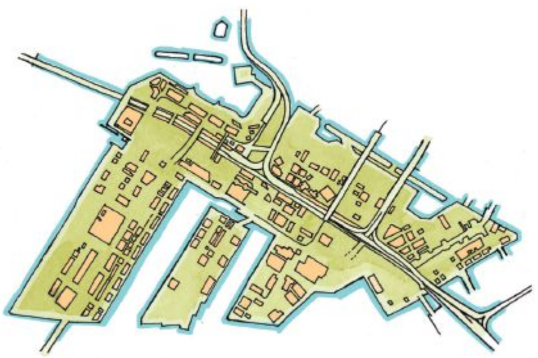


Elba: This Mediterranean island—now part of Italy—housed the exiled Napoleon Bonaparte for 300 days but has become just as well-known for tourism and wine.

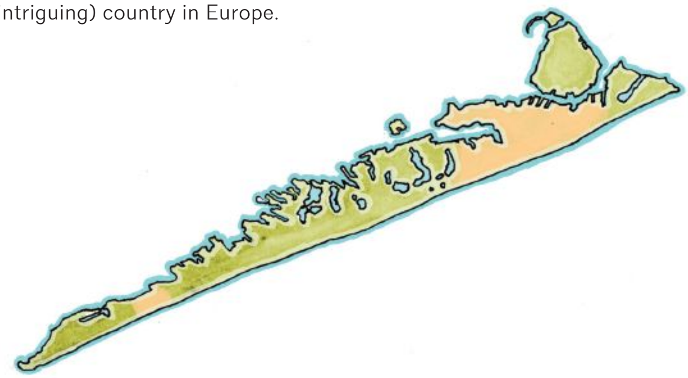
Tierra del Fuego: Home to Ushuaia, Argentina's southernmost city, the "Land of Fire" is really an archipelago named by Ferdinand Magellan in 1520.



Iceland: If you want sand, lava fields, mountains, glaciers, and rivers, look no further than the most sparsely populated (and most geographically intriguing) country in Europe.



Odaiba: Built by the Tokugawa shogunate nearly 170 years ago to defend Edo (now Tokyo) from seaborne threats, it has become a tourist destination and one of two places in the Tokyo area with an accessible shoreline.



Galveston Island: After a hurricane wiped out most of this Texas barrier island and its residents in 1900, the densely packed urban environment was rebuilt in a mixed style known as "Galveston vernacular."

ILLUSTRATION: LAUREN NASSEF

AIAKnowledge

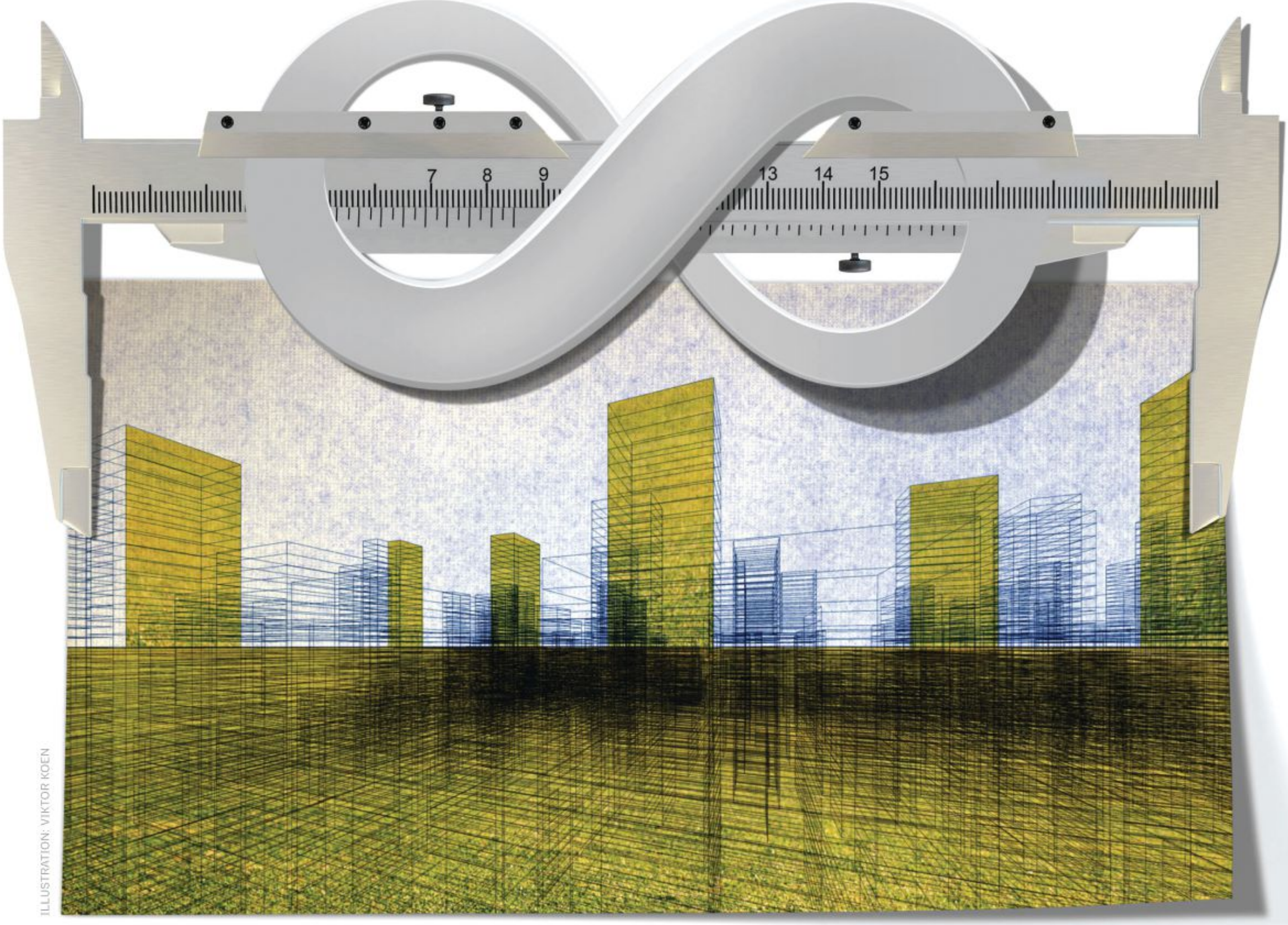


ILLUSTRATION: VIKTOR KOEN

Indexing Sustainability

Finding answers to large-scale questions on urban development.

In the latter half of the last decade, designers Joyce Hsiang, ASSOC. AIA, and Bimal Mendis began discussing a comprehensive sustainability metric for urban development. At the time, sustainability was a nascent ill-defined movement meant to measure certain performative aspects of the built environment—namely, the buildings themselves.

Hsiang and Mendis were thinking on a larger level. "How do you make sense of metrics that inform sustainability beyond the scale of buildings?" Hsiang asks, describing the initial impetus for what became their paper, "Indexing Sustainability: Defining, Measuring, and Managing the Performance of Urban Development." Their collaborative work (produced with Daniel Markiewicz, AIA, and Ryan Welch) was the 2009 recipient of the AIA Upjohn Research Initiative grant. The grant provides material support up to $30,000 for projects that "enhance the value of design and professional practice knowledge."

Hsiang and Mendis are currently faculty at the Yale School of Architecture, as well as partners at Plan B Architecture + Urbanism. Up until 2008, both had been working in Amsterdam at Rem Koolhaas' OMA.

"There was a lot of rapid development in the world from 2003 to 2008," Hsiang says. "We were working on all these large-scale projects that forced large-scale questions."

Hsiang and Mendis were part of master planning and project teams envisioning cities-within-cities, such as OMA's proposal for London's White City competition, intended to repair the frayed urban fabric from the city's core to Heathrow Airport. Approaching such projects required looking past "the problem of answering a project brief and normative design purview of an architect, and looking at the social, political, and economic context," Mendis says.

By 2009, now settled at Yale, the two leveraged a grant from the Hines Research Fund for Advanced Sustainability in Architecture to flesh out their question and began in earnest to build their gauge. Their research started with digging into the historical framework of sustainability, tracing the practice of resource management back to the 18th-century German bureaucrat Hans Carl von Carlowitz, who was focused on

AIAKnowledge

CONTINUED

maintaining an abundant supply of timber to power the mining industry.

The research followed the path of sustainability through the Industrial Revolution and into the modern age, looking to "deconstruct and create a language of sustainability," Hsiang says. To understand sustainability broadly, there was first the need to understand the syntax used to describe its indicators. Hsiang and Mendis also performed an audit of the existing sustainability indexes, from quasi-governmental United Nations and Organisation for Economic Co-operation and Development (OECD) indexes to more exacting corporate indicators that measured "the costs per infrastructure."

Over 670 indicators were analyzed to produce a composite index that synthesized the language of sustainability and the way in which it was being measured. "We wanted to create a methodology to address the balance between [this language] and systems that were descriptive or perspective," Mendis says.

"When everyone is measuring everything, it makes it impossible to measure anything," Hsiang adds. "What we drew were essentially standards."

They also created a spatial ordering of the data, a way to visually represent the interrelated characteristics of sustainability and how individual metrics fit into and inform large-scale systems design. "These are abstract issues that are difficult to see," Mendis says. "But by showing it spatially, the act of visualization is a way to realization and to influence policy."

Their work has taken numerous forms since the awarding of the Upjohn grant. The paper morphed into what became "City of 7 Billion," an exhibit that uses data to reveal the world as one vast dynamic interconnected place. It has been displayed in cities and programs, including the Hong Kong–Shenzhen Biennale of Urbanism, Chengdu Architecture Biennale in China, and 2011 Eye on Earth Summit in Abu Dhabi. Most prominently, the duo received the 2013 AIA Latrobe Prize for the exhibit, a $100,000 award to further realize the work behind their research.

Meanwhile, outside of their teaching and other professional commitments, Hsiang and Mendis use lessons learned from the project to lend expertise to governments facing increasing environmental threats. "The Upjohn," Hsiang says, "was the first phase of what has become, in many ways, a life project." AIA

Ben Schulman

AIAPerspective

Is Inclusive Design Achievable?

In the spirit of the "special relationship" between the U.S. and the U.K., I invited our friend and colleague Jane Duncan to take over this spot this month. She is president of the 40,000-member Royal Institute of British Architects (RIBA) and director of Jane Duncan Architects + Interiors, an award-winning practice in Buckinghamshire, England. Jane ran for office on pledges to improve pride, fees, and diversity within the architecture profession—and she is doing much to make good on all of them. —Thomas Vonier, FAIA

Do architects have the skills and attitude that we need to create truly inclusive environments? Is it even possible to design architecture for everyone?

It's normal to be different, and we are all different. I am 5 feet 1 inch tall and can't reach stuff. My creative solution was to marry someone 6 feet 3 inches tall, but I realize that this is a solution not open to everyone.

The Paralympics have been an eye-opener for me and for millions who watched people with a plethora of physical impairments become superhumans. There is no question that a major shift in perspective took place, that the world woke up and applauded people with disability.

"My disability exists not because I use a wheelchair, but because the broader environment isn't accessible," said disability activist Stella Young.

People are still uncomfortable and do not understand disability—and people fear what they don't understand. Architects are in pole position to reclaim environments for a wide range of user requirements. Isn't it about time we challenged the polarized separation of "able-bodied" and "disabled," and realized that we just need to design for people?

There is a huge range of ability within our population, from the helpless infant to the elderly person with dementia and everything in between, including chronic and temporary states of mental and physical impairment.

Good design is inclusive design, about designing for people and not about design for disabled people, and making places everyone can use. How they are designed affects our ability to move, see, hear, and communicate effectively. Removing barriers that create undue effort and separation enables everyone to participate equally, confidently, and independently in everyday activities.

This creates opportunities to deploy our creative and problem-solving skills for real people in all their variability, removing the frustrations and hardship experienced by many disabled people, older people, and families with small children.

While the needs of wheelchair users and mobility-impaired people are important, it is also necessary to understand the barriers experienced by people with learning difficulties, those with mental illnesses, and visual and hearing impairments. Considering a more diverse picture will often achieve superior solutions that benefit everyone, exceed minimum technical specifications, and help people use developments safely, with dignity, comfort, convenience, and confidence.

By challenging (or removing) the idea of normal, we can widen our capabilities beyond relying upon anthropometrics and ergonomic data. Employers are recognizing that it is smart business to have a diverse workforce, one in which many views are represented and everyone's talents are valued. Disability is part of diversity, and it's not just about fairness; it makes good business sense to create accessible spaces. A rigorous, inclusive design process mitigates business risk and ensures repeatable design success.

Main Street businesses could effectively be turning away one in five customers by not accommodating disabled people; households with a disabled person have a huge combined disposable income. Research shows that disabled people find shopping the most difficult experience in terms of accessibility, followed by going to the cinema, theater, or concerts. Drinking and eating out came third on the list.

We need to develop the skills to provide inclusive design: Let's grasp this one. AIA

Jane Duncan,
RIBA President

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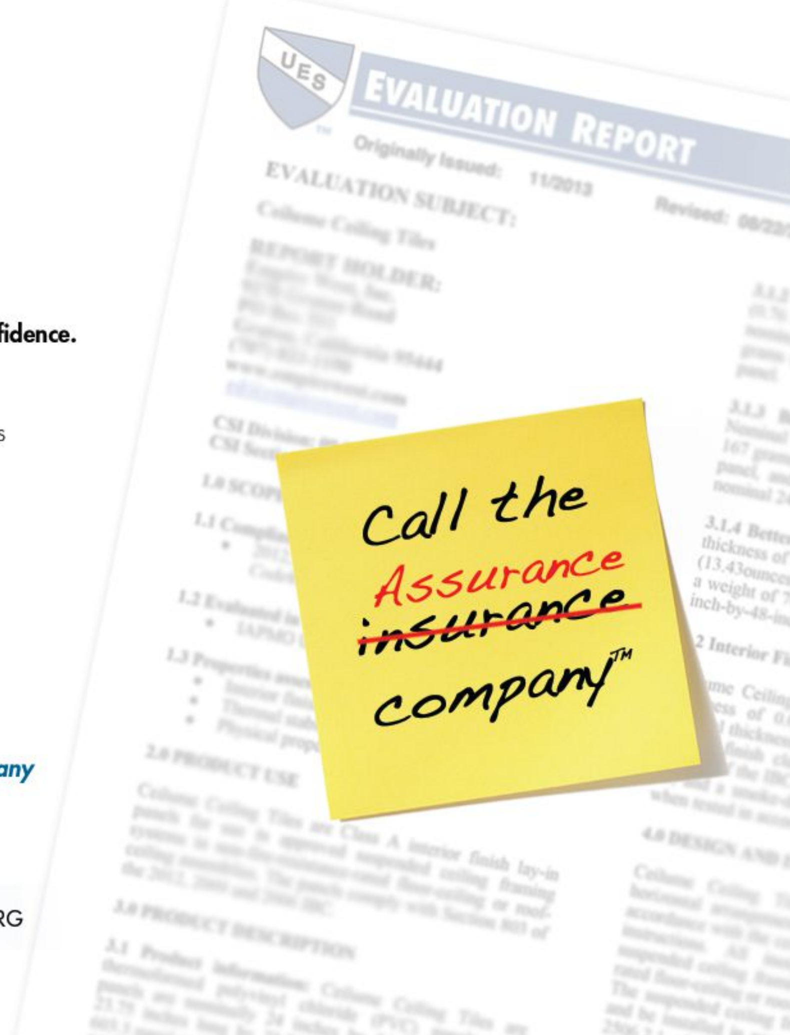

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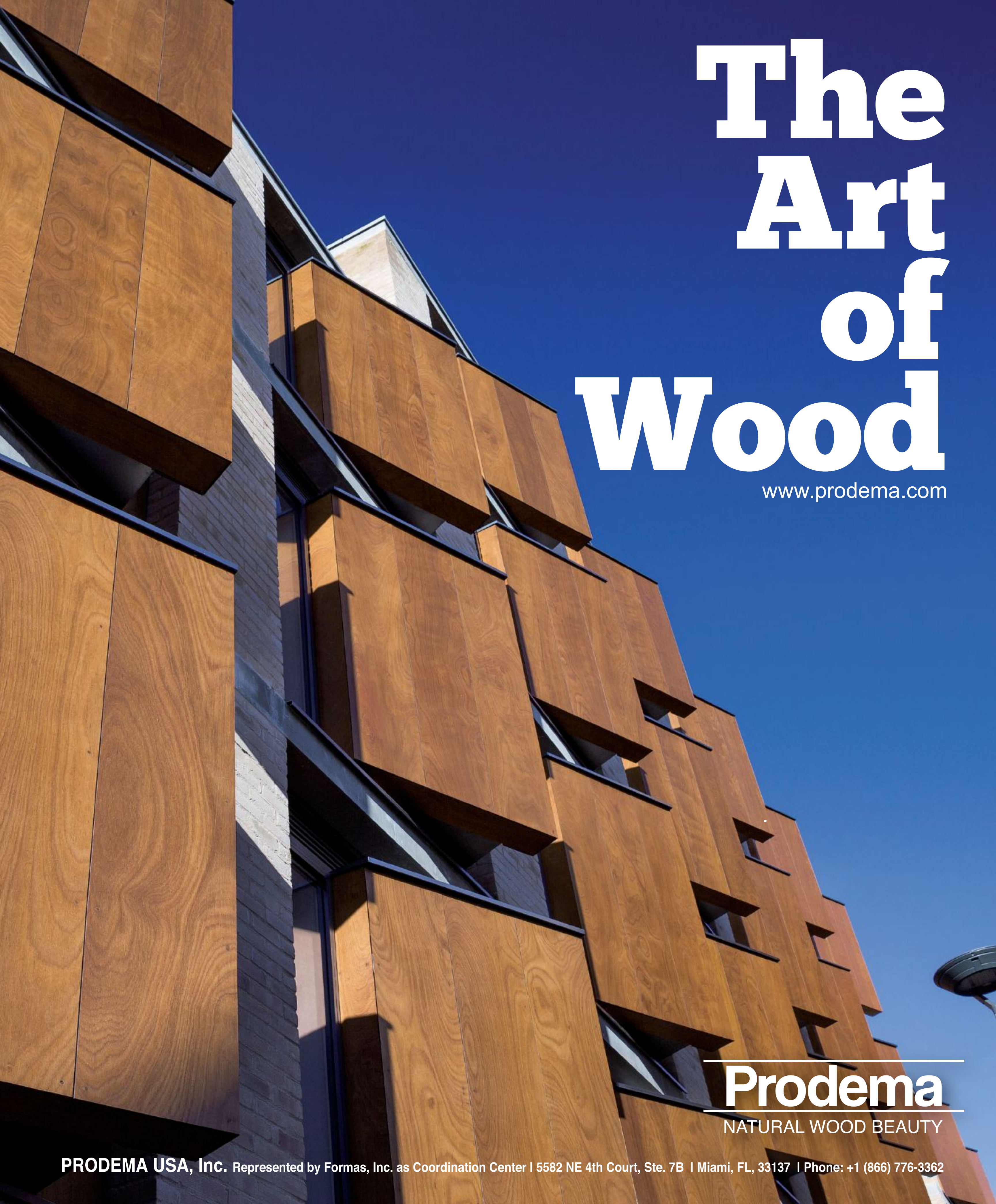
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“We’ve found [Lean] to be very effective with clients when there are a lot of voices that need to be heard, and you need one common goal.”

Learning to Lean In by Elizabeth Evitts Dickinson

A cultural shift was underway at Dyer Brown Architects, but not everybody was on board. It was 2015, and the 45-year-old Boston-based firm was in the midst of rebranding after several years of growth. A new generation of leadership was being installed and a number of younger staff had been hired, doubling the firm to 40 employees. Concerns about how to manage an influx of new business while valuing existing clients were brewing alongside the inevitable growing pains that accompany new leadership and hires. Firm leadership could sense percolating discontent, but staff members were wary of voicing doubts on the record. "There were many off-the-radar conversations," says senior architect Karen Bala, AIA.

The firm brought in a consultant to convene a town hall to address unease and build trust across generations. It didn't work.

In theory, "town hall meetings get 60 staff members into one room and have them talk about how they feel," Bala says. "But what happens is that only one or two people talk, and then you have 58 people who [don't]."

Dyer Brown tried again, this time hiring Haley & Aldrich, a Burlington, Mass.–based consultancy that offers workshops in the manufacturing and management philosophy Lean. Credited with turning Toyota into a leading car manufacturer after World War II, Lean aims to eliminate waste from workflows, and to foster continual improvement in productivity over time while respecting the role that employees play in the process. "Lasting gains in productivity and quality are possible whenever and wherever management and employees are united in a commitment to positive change," an internal 1988 Toyota brochure explains.

Dyer Brown employees fill out the Lean tool "Improvement Newspaper."

COURTESY DYER BROWN ARCHITECTS

Over the decades, a variety of industries, including tech and higher education, have embraced Lean principles. And in the last 10 years, the architecture, engineering, construction, and owner-operated (AECO) community has joined in, enticed by Lean's ability to evaluate complex challenges, create standardization, and foster creativity and efficiency concurrently. (Integrated project delivery, or IPD, principles are similar to those of Lean, and are often used in tandem with Lean.)

By bringing cross-disciplinary teams together at the outset of a project, Lean prevents the silo-ization that can occur in the building industry, reducing the need to expend resources on redesign, construction delays, and change orders. "Lean helps all of the different professionals—the owners, architects, engineers, contractors, suppliers, and lawyers—to have a much larger shared body of knowledge sooner in the process," says Zofia Rybkowski, an associate professor of construction science at Texas A&M University's College of Architecture who runs Lean exercises with AECO teams. "From a morale perspective, it's exciting. You have more people involved in the creative process."

Getting Lean

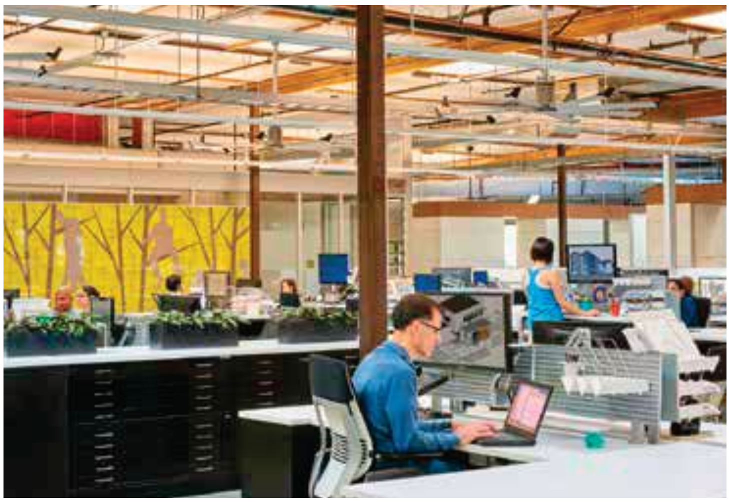
At Dyer Brown, Haley & Aldrich's Lean consultants conducted multiday workshops with the entire staff, breaking them into small teams to run a series of fast-paced, 15- to 20-minute exercises common in Lean. "High/Low Impact" asked participants to share problems in the firm, consider the root of each problem, and to develop countermeasures. Each countermeasure was mapped on a matrix of high versus low impact.

"The goal of this exercise is to see which countermeasures could be 'low-lying fruit' but have a high impact on the office," Bala says. For example, the staff determined that creating more meeting spaces in their office would have a high impact, but require a lot of effort (high difficulty). Improving team communication and initiating a mentorship program would also have a high impact but take less work (low difficulty).

In "Force Field Analysis," the group identified a shared goal—to work remotely—and then listed the forces preventing its realization. Telecommuting wasn't successful, the team concluded, because the firm lacked the tools to support it. The outcome: Dyer Brown made significant upgrades to its technology.

Overall, the firm coalesced around shared values, such as a belief that strong communication leads to mutual respect and trust, and that investment in employee growth and development was critical. Then they developed ways to translate those values into initiatives such as a formalized mentorship program and a firm-wide design charrette to rework their space

Unique Use of Colt Ventilators Helps Silicon Valley Firm Reduce Energy Consumption Down to Zero



ARCHITECTS: AP+I Design

Photo Credit: © John Sutton, courtesy of AP+I Design

When **AP+I Design**, a full-service architectural, planning and interior design firm in Mountain View, California purchased a 30-year-old building for its new headquarters, they challenged themselves with the audacious goal of retrofitting it into a net zero energy (NZE) building, one that generates as much power as it consumes. With Coltlite Louvered Ventilators from BILCO as one significant part of the plan, AP+I succeeded in being the first NZE commercial building in Mountain View.

In addition to using solar panels to harvest energy, super-insulating perimeter walls, and operable skylights for daylighting, AP+I installed Coltlite CLS glazed louvered ventilators in a unique manner. Integrated into their interior design, AP+I repurposed what are normally exterior ventilators as stylish walls for the smaller offices and conference rooms around the perimeter of the 14,300-square-foot building. The open office layout uses large fans to move air around the office, and the smaller rooms can open their Coltlite ventilators to circulate the air into the adjacent spaces.

As a design element, the glazed Coltlite louvers take advantage of the copious amounts of daylight flooding the space, while also allowing for privacy in the offices and conference rooms. With a simple hand crank, employees can open the louvers and allow air and ambient work noises from the central room into their office, or close them for a practically soundproof calm.

"We chose the Coltlites as a design element forming the bottom of our 'lanterns,'" said Carol Sandman, Founder and Principal of AP+I Design. "They are one of the first things that are shown on our tour of the office. The unique use of what is normally an exterior element draws a lot of questions, but it was the right element to help achieve our Net Zero Energy goals."

The firm has significantly reduced the need for mechanical forced air HVAC system. By using the Coltlite louvers to increase indoor air quality and movement, AP+I has completely eliminated its own energy bill. As a firm that is committed to environmentally responsible practices, they now use their own facility to demonstrate sustainable building design principles to potential clients.

"We want clients who visit our office to see how achievable a Net Zero Energy project is. We want them seeing us doing the right thing not only for the environment, but for our staff's health and well-being as well," said Sandman. "As anyone on our staff will tell you, bringing in daylight and fresh air makes everyone both feel and work better."

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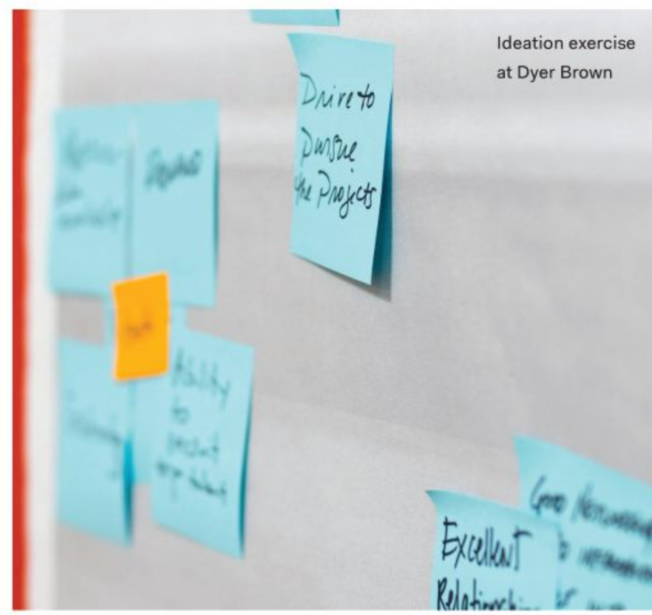
for more collaboration. Most importantly, they created a way to engage in office-wide issues in the future. "What was most striking about the process is that it wasn't anonymous—and you're not singling people out," Bala says. "The exercises remove personal investment in a way that allows everyone to be heard."

Dyer Brown now uses Lean principles with clients. "We've found it to be very effective with clients when there are a lot of voices that need to be heard, and you need one common goal," Bala says. For higher education projects, for example, the firm runs through the Lean exercises with all the



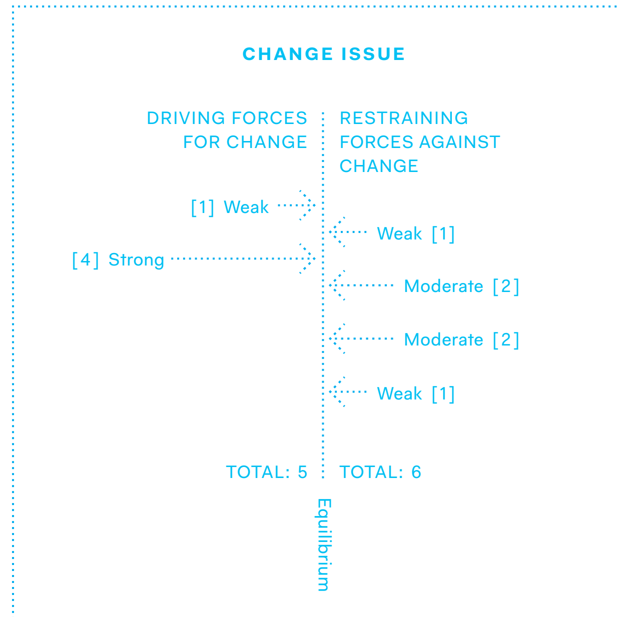
Ideation exercise at Dyer Brown

COURTESY DYER BROWN ARCHITECTS

stakeholders early on, and lets the clients determine a thesis. "We, as designers, hit [the thesis] through spatial layout, materiality, et cetera," she says. "People feel like they are a part of the process and the client owns that space."

For the design-development phase, Rybkowski also suggests "Target Value by Design" (TVD), an exercise in which key stakeholders work collectively to understand what the building owner considers valuable and how to offer the best value for the given budget. "With building design," she says, "we tend to throw in all these bells and whistles, but the fact is the client can't always afford it."

This often leads to two words architects hate most: value engineering. Rybkowski asserts that value engineering "is often applied too late in the design process so some of the best parts of the design are amputated." In TVD, because



Sample Force Field diagram (not necessarily used by teams in this story)

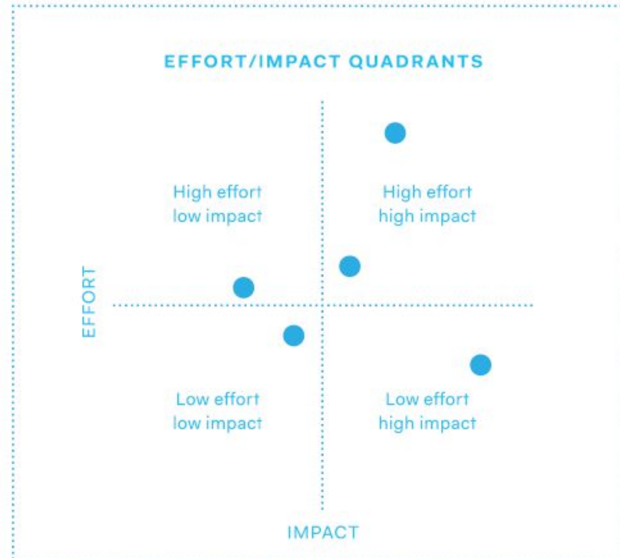
savings from avoiding wasteful practices is redirected toward value generation, "the owner does get more value for money."

Meanwhile, a Lean method known as "The Last Planner System of Production Control" aims to increase the accuracy of project scheduling. Instead of an individual scheduler, such as a construction manager, assigning deadlines and a workflow for people, they work with every discipline to map out a plan that reduces the risk of a single delay snowballing into a major delay. "You start at an end date and work backwards to figure out where you need to be," Rybkowski says.

Simplifying Complex Projects

Global firm NBBJ has been doing Lean for several years, says principal Janet Susi. A registered nurse who works on the firm's healthcare projects, Susi is a Lean Six Sigma Black Belt—meaning, in short, that she is proficient in Lean management and in particular, the Lean Six Sigma Methodology, a data-driven management approach that aims to remove redundancy in a company's process. Lean works particularly well in complex typologies, like healthcare, she says, because it debunks preconceived notions of how spaces are used.

For example, a West Coast healthcare provider with a large medical campus asked NBBJ to help



Sample Effort/Impact Quadrant grid (not necessarily used by teams in this story)

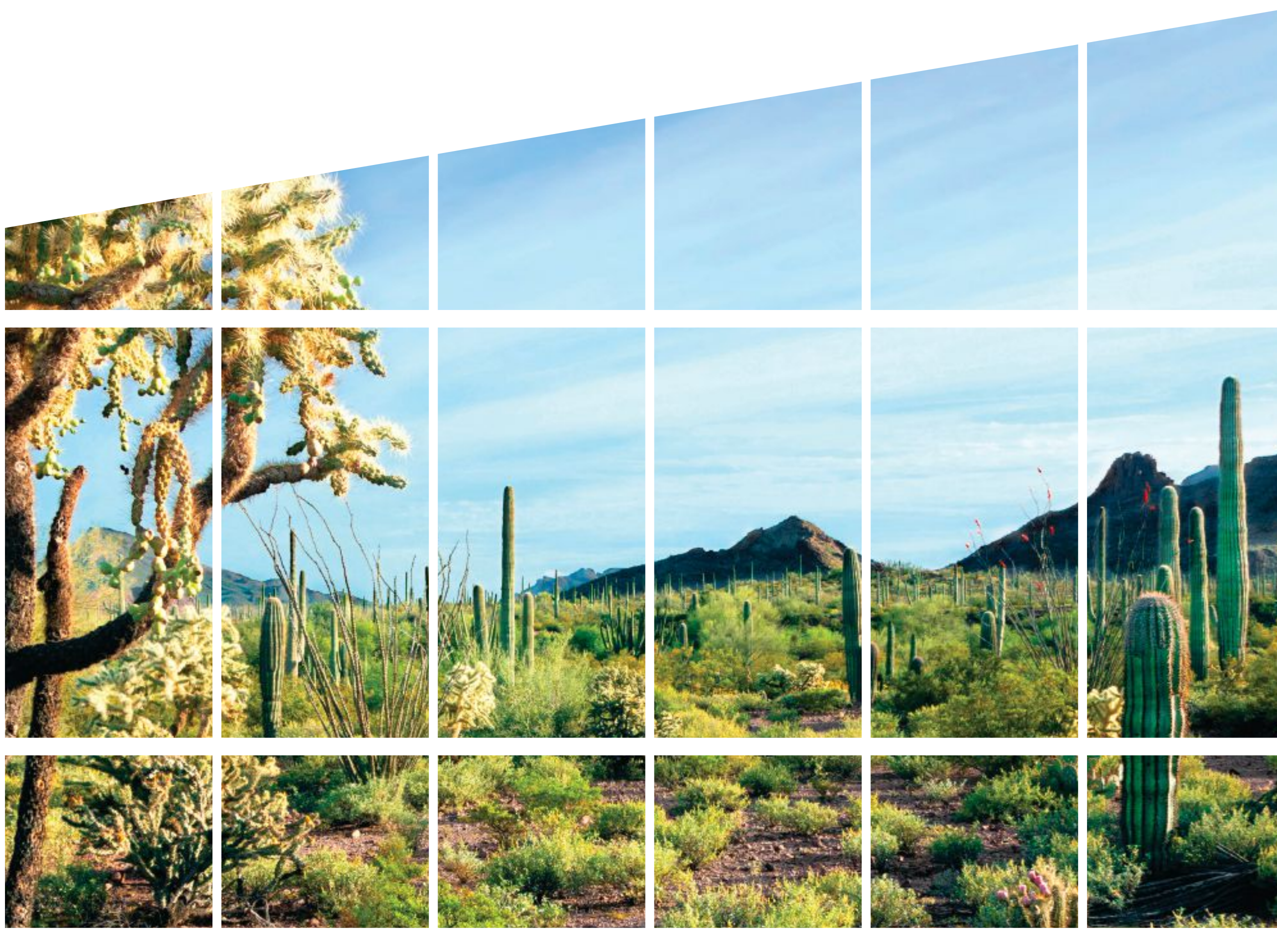
it use its facilities more efficiently and eliminate duplicating services. NBBJ began by shadowing a multidisciplinary group that included everyone from physicians to technicians to facilities management. "We map flow and existing processes—every step of a journey they take—so the group understands where bottlenecks happen or waste occurs," Susi says. "The idea is to make the challenges for the client as visible as possible, and then think creatively about how you can get past these challenges."

NBBJ may digitally model and test different design, layout, and building solutions to assess the impact the changes would have on the overall project, and build 2D tabletop models and 3D cardboard mock-ups with their clients to simulate real patient and clinical scenarios. The firm may also gather in-house and client teams for three- to five-day charrettes to focus on production, preparation, and process in a Lean exercise called "3P Methodology."

"It is the opportunity to empower teams to cut waste and simulate a process to achieve a higher level of safety, quality, productivity, and delivery," Susi says. "This helps everyone prepare for new ways of working and creates environments that can be flexible to adjust to whatever work or patient care looks like in the future."

Investment Requirements

One challenge of introducing clients to Lean is an expectation of immediate results. "They want to be



Lean, but the journey to get there does take a lot of rigor," Susi says. "To change an organization requires senior leadership to be consistent and to keep it on track."

Lean also requires an upfront financial investment to pay for consultants, training, and group meetings. Yet those who persevere reap its rewards, Susi says. "We've saved organizations millions of dollars in supplies alone."

Individuals interested in Lean can research continuous improvement techniques online and pursue certification. Firms can hire consultants to hold staff-training sessions, which can take anywhere from a two-day overview of basic Lean principles to months to develop a deeper understanding or obtain certification. Rybkowski and Bala both suggest starting with the Lean Construction Institute, which offers events, workshops, and activity ideas. Based on Rybkowski's experience, however, the teams that execute Lean best use a full-time consultant or have trained staff.

Dyer Brown is taking that latter approach. The office leveraged a grant from the state of Massachusetts aimed at training for companies and is sending two

"What was most striking about [Lean] is that it wasn't anonymous—and you're not singling people out."

—Karen Bala, senior architect, Dyer Brown Architects

staff members to Haley & Aldrich for additional workshops, Bala says. Still, she favors a team approach when working with clients on Lean: "I might suggest bringing in a consultant ... and a [Lean] champion in the firm, plus a senior member."

NBBJ has been training its staff for several years. "It is important that firms educate their employees about Lean principles, and how the tools and approach to architecture benefit the team and the client," Susi says. But, she adds, not every staff member needs to be trained as long as the firm as a whole understands the Lean ethos—which encapsulates the philosophy that emphasizes efficiency and people perfectly. "There's a lot of tools we can use, but using Lean helps us bring a better value to our clients," she says. "It takes the burden off of them to do what they do best."

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“To determine where the water would rush in if the sea level were 50 feet higher, Robinson traced contour intervals on Manhattan maps. The low-tide line would be around 31st Street.”

Kim Stanley Robinson’s Sci-Fi New York by Elizabeth Greenspan

In Kim Stanley Robinson's new science fiction novel, climate change has raised the sea level 50 feet and has devastated the world's coastal cities, but it hasn't shut down New York. Lower Manhattan is a permanently submerged yet lively "SuperVenice," while uptown, which occupies higher ground, hosts the city's newest cluster of 300-foot-tall skyscrapers. "It's what economists used to call the tyranny of sunk costs," the sardonic narrator explains in Robinson's *New York 2140*. "Once you've put so much time and money into a project, it gets hard to just eat your losses and walk." Even a drowned New York remains New York.

In more ways than one. The book's plot doubles as an exploration of the mechanisms and dysfunction of contemporary capitalism. Robinson imagines a financial crisis, modeled on the 2008 collapse, in which investors create a real estate bubble in the city's risky "intertidal zone," a treacherous stretch in midtown where the tides flow in and out twice a day and occasionally take down a moldy building or two. Then the bubble pops and political and economic chaos ensues.

The finance-centered narrative feels fresh largely because it is told against a remarkably plausible vision of a city responding to extreme climate change in the not-too-distant future. Hedge fund managers zip around Lower Manhattan's canals in expensive hydrofoils and park them in the flooded first floors of old buildings. To avoid crowded canals, New Yorkers traverse skybridges high above the water. Activists and revolutionaries find cover in the subcultures of the "underwater economy." Buildings stay dry thanks to superior sealants—imported from the Dutch, of course.

Unlike fantasy or other reality-bending genres, Robinson's science fiction unwinds within the constraints and biases of the real world, which is part of its appeal. When I spoke to Robinson, he explained his method by quoting H.G. Wells: "'If everything is possible, then nothing is interesting.'" He continued: "There's a reality principal to sci-fi, even if it's a hypothetical. It's a thought experiment."

Robinson's thoughtful attention to design and planning, especially of late, has made his work a kind of cause célèbre among architects and design critics. In April, he appeared at the Columbia Graduate School of Architecture, Planning and Preservation to discuss *New York 2140*. Last May, he joined London-based architect Usman Haque for a lecture series at the University of California, San Diego, where they imagined London in 2080, as the Thames River rises ever higher, flooding more of the city. And in August 2015, he appeared at the Ideas City festival, in New York, with Bjarke Ingels, founder of BIG. The festival organizer had asked Ingels: "If you could pick anyone in the world to have a conversation with, who would that be?" At the conference, Ingels explained his choice—Robinson—by discussing the similarities he sees between science fiction writers and architects. They both change an essential variable, he said, and then explore "the potential of that idea, the cascading consequences, the side effects, the conflicts, the possibilities that erupt from this one changed factor." In other words, he argued, science fiction and design share a process of innovation and speculation.

SPARTH

A Meticulous Attention to Design Detail

Robinson, 65, wanted to be an architect when he was young. Growing up in Orange County, Calif. (today he lives in Davis), he loved ancient history and archaeology; he spent sunny afternoons sketching the Parthenon and designing fictional island towns on treasure maps. But he wasn't a very good artist, and after a miserable ninth-grade drafting class, he turned his attention to words. His interest in architecture never waned, however: His most famous work, *The Mars Trilogy*, about the terraforming of the red planet over a span of 200 years, details the planning

and construction of roughly two dozen Martian cities, from early underground settlements to glamorous, café-filled seaside towns.

In *Red Mars* (1993), the first book in the trilogy, colonists build the city of Sheffield (named after the American science fiction writer Charles Sheffield), one of many "tent cities," as Robinson calls them, in which three layers, or membranes, of high-tech plastic form a dome over the landscape to keep in oxygen and provide insulation. Sheffield grows as immigrants construct smaller "tents" on the outskirts of the metropolis, soon connected to the city center by rail. Robinson imagines other cities tucked into found crevices and craters or perched on cliffs; he was particularly inspired by the villages of Crete while writing the *Mars Trilogy*, he said, because of their natural beauty and economically strategic location on the water.

In *New York 2140*, Robinson makes his visions of the future more specific and persuasive with his meticulous attention to design. Consider his skybridges, which are "clear plastic tubes, reinforced by graphenated composite meshes so light and strong they could span four or five blocks." It's a description that relies upon careful architectural considerations. "You don't want a skybridge pulling a skyscraper sideways," Robinson told me. "It isn't designed to withstand that kind of pressure." The author consulted his architect friends in Davis, as well as *The Heights: Anatomy of a Skyscraper*

Robinson's thoughtful attention to design and planning, especially of late, has made him a kind of cause célèbre among architects and design critics.

(Penguin Press, 2011), by Kate Ascher, and determined that old, "pre-flood" buildings wouldn't have been able to support skybridges; such additions in 22nd-century Manhattan would have to be ultralight, otherwise they would topple the structures. Like sci-fi, particularly utopian sci-fi, Robinson said architecture is "drawing in things that don't exist and saying this would be good, and then urging people to do it in the real world."

Robinson paints a romantic portrait of the design profession, one devoid of caricatures. In his reckoning, architects are not egoists or slaves to the market but artists making the world better, one project at a time. Perhaps it comes as no surprise, then, that the design community has embraced the author: He sees them as they want to be seen.

Throughout *New York 2140*, Robinson plays to his audience with inside design jokes. Much of the action takes place at the Met Life Tower on "Madison Square Bacino," as it's called in the future. Robinson chose the tower because its architect, Napolean LeBrun, designed it to look like the campanile in Venice's Piazza San Marco (which, by 2140, is long underwater too). Later in the book, when the story's quirky elder recalls the day that Manhattan flooded, he refers to it as the "Breach of Bjarke's Wall." He's referring, of course, to the Dryline or the Big U: the 10 miles of wall and public space around Lower Manhattan that the city has commissioned BIG to design as a buffer against rising sea levels. In the elder's recollection, residents stood on the wall, watched water rise, and then, with echoes of September 11, fled uptown to avoid getting swept away.

As much as Robinson finds common purpose with architects, he sees limits to the comparisons. "A picture is often worth a thousand words," Robinson told me, "but I've got nothing but a string of sentences to actually be clear about infrastructure." Book critics have at times accused him of committing "info dumps," a term he calls "stupid and snobbish." "I do have a lot of exposition because things need to be explained rather than drawn," he said.

Part of Robinson's success, in fact, stems from his ability to bring lyrical, poetic flair to cityscapes and street grids. One of *New York 2140's* best moments is its lengthy description of the tides flowing in and out of midtown, which Robinson intertwines with a scene of young "skimboarders" dangerously riding the surf, crashing into buildings and navigating algae-covered asphalt. "If you stood at Fortieth and looked south during the flood tide, you saw the bay's edge sluice up the green slick in low waves, rolling over the mat of waxy seaweed leaves in rushes of white foam, reflooring the street a long way before the verge of foam stalled and sucked back," Robinson writes. To determine where the water would rush in if the sea level were 50 feet higher, Robinson traced contour intervals on Manhattan maps. The low-tide line would be around 31st Street, his analysis showed, and the tides would swell to 41st Street or so, above which everything else would remain dry.

Attacking the System Architects Rely On

Writing about rather than designing the built environment also affords Robinson some significant freedoms, and not only because he can ignore the plumbing. "To convince people to part with hundreds of millions of dollars and effect the real world, this is a something that when you're a novelist you don't have to worry about," he said. This means, among other things, that he's free to go after those with the millions

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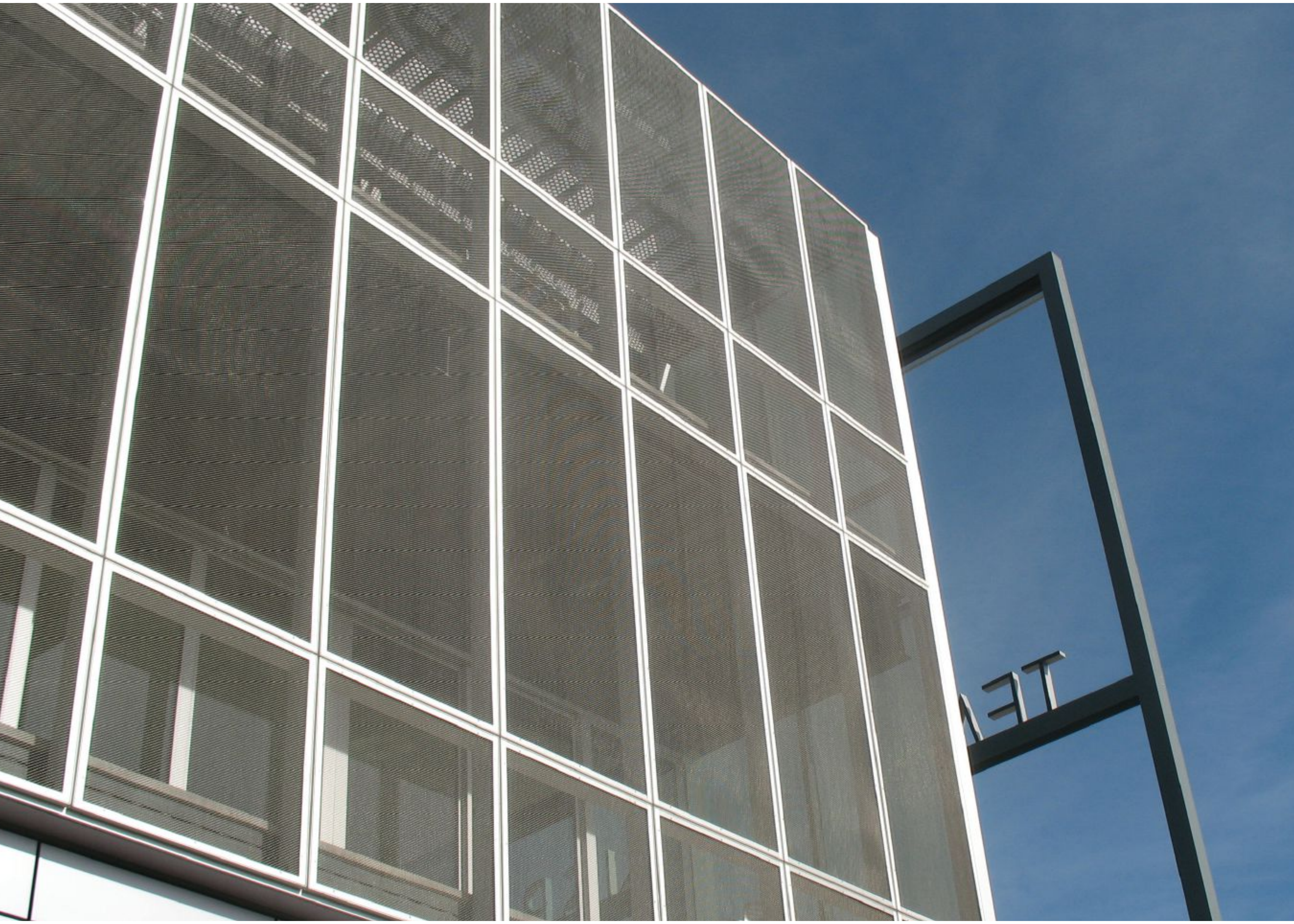

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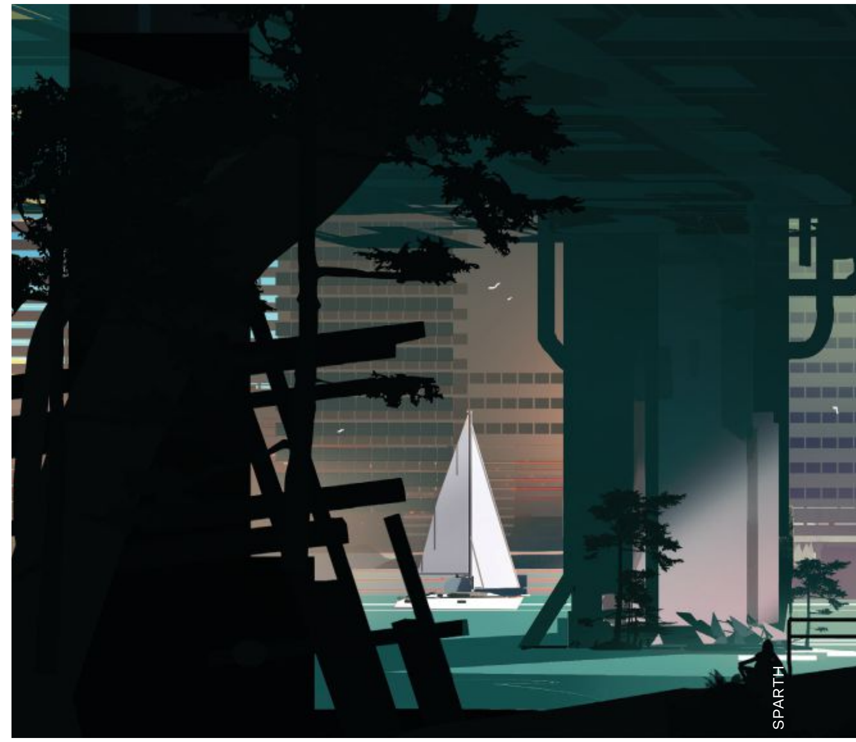
of dollars. The plot of *New York 2140* offers a strong critique of the hedge funds, the real estate industry, and the perverse property speculation that caused the 2008 financial crash—the same system that most practicing architects rely upon for their paychecks. For Robinson, responding to climate change means responding to the injustices and excesses of neoliberal capitalism. “Capitalism won’t go away unless we change it and reform it,” he said.

And (spoiler alert), this is what Robinson does at the end of *New York 2140*—he changes capitalism. In the novel, rising sea levels and the consequent death and devastation have prompted politicians to intensify austere economic policies and harsh police tactics—until, that is, people demand something different. After the real estate bubble pops, fed-up voters clean out Congress and empower politicians to nationalize the banks. As he does in many of his novels, Robinson imagines a post-capitalist future.

It was this conclusion, of all the imagined things in the novel, that feels the most fantastical, probably



SPARTH

more than Robinson intended. He finished writing the novel before the 2016 election, when fed-up voters made a very different sort of anti-establishment statement, and the ending certainly betrays the book's pre-Trump origins—a time when it was easier to assume that American democracy and rule-of-law wouldn't change very much over the next century. Robinson's future is largely devoid of today's anger, xenophobia, and propaganda; reading his vision of a flooded, slowly disintegrating city felt, at times, bizarrely escapist.

Part of the reason his vision of New York is so vibrant, Robinson told me, is that he greatly enjoyed his research. When he was writing the book, he visited Manhattan often. "It was amazingly fun. It was like a romance with the city," he said of those trips. "The hassles didn't bother me." As often happens, however, the romance proved short-lived. "It's already over. When I went back, I was like, 'This is what it's like?' " He paused, then quickly added: "While it lasted, it was like a little glow." In life, as in sci-fi, Robinson prefers to end on an optimistic note.

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Portfolio:

Left to Right:
Chief operating officer Alan Ricks, design associates Alicia Olushola Ajayi and Kordae Henry, senior director Sierra Bainbridge, director David Saladik, and executive director Michael Murphy in the firm's Boston office.

MASS Design Group

Profile and Interviews by Katie Gerfen
Photos by Iwan Baan

Profile:

Innovative nonprofit MASS Design Group has taken on the status quo and become undisputed leaders in public interest architecture worldwide. As the firm approaches the 10-year mark, it's aiming even higher, bringing its model of purpose-driven design back home and to a broader audience.

Ask anyone who works at MASS Design Group about how they joined the Boston- and Kigali, Rwanda–based nonprofit design firm, and you'll hear tales of discontent with the architectural establishment and searching for deeper purpose in design. Take junior associate Bethel Abate, who, sitting in MASS's board room overlooking Boston Common, offers a politely devastating takedown of American architectural education. Abate, who grew up in Ethiopia and came to the U.S. to study architecture, says that "it was hard for me to translate what I was learning in school back to my culture or what I was used to." She pursued a summer internship at MASS in 2015 after a professor at Virginia Tech showed her the firm's work, and was so impressed by the mission of using design to enact positive social change, in Africa and elsewhere, that she joined full time after graduating.

Senior director Sierra Bainbridge got involved early in MASS's history, doing landscape design on the firm's first project, but breaks her no-nonsense demeanor to laugh at the notion that there was any formal arrangement for the pro bono work she did for MASS during her off-hours from James Corner Field Operations in New York. The agreement, she says, came together in "a very late-night conversation over dim sum." Her interest was piqued because, she says, "Socially oriented work is what I always did at school." Bainbridge felt so strongly about the mission of the fledgling firm that she left one of the most high-profile urban landscape projects in recent history: Two weeks after finishing construction administration on Phase I of the High Line for Field Operations, she went to Rwanda to see the MASS project for the first time. A month later she moved there to oversee construction.

Christian Benimana, MASS's Rwanda programs director, spent his childhood in Rwanda drawing houses, and went abroad to study architecture at Shanghai's Tongji University, in part because there was no avenue for studying architecture in his home country. While Benimana was abroad, MASS helped shape the country's first program, the Faculty of Architecture and Environmental Design at the Kigali Institute of Science and Technology, which Bainbridge then chaired. Benimana returned home in May 2010 to teach there. Six months later, Bainbridge brought him on as a full-time staff member at MASS.

Restlessness toward the status quo may be a common sentiment among MASS's current crop of 75 architects, designers, landscape architects, researchers, and engineers, but they are not pessimistic. Far from it, if the buzzy, purpose-filled vibe of the Boston office—a warren of light-filled, colorfully decorated rooms in a well-worn Beaux-Arts building—is any indication. The team that has come together over the years is fueled by the conviction that they've found a better way to do things, regardless of project type or location.

So it should come as no surprise that dissatisfaction with the architectural status quo was the very basis for the founding of the firm. In 2006, Michael Murphy and Alan Ricks were students at the Harvard University Graduate School of Design, and united in their dismay at the industry's focus at the time. "It was the heyday of formalism—everybody was running to the Middle East or China and building the most radical things we've ever seen," says Ricks, now MASS's chief operating officer. "There was very little conversation going on about the public interest and serving the majority of communities that don't have access to design." That didn't sit well with the two. "I think most people get into architecture with the idea of improving people's lives through the built environment," Ricks says. "But architects got caught up in this new freedom, where you could build anything."

A desire to change the prevailing order drives the MASS origin story, which has been told so often it's nearly legend: After attending a lecture by Paul Farmer of Partners In Health (PIH), a global organization focused on providing healthcare for marginalized people, Murphy reached out and offered to help design a new rural hospital the nonprofit was developing in Butaro, Rwanda, since many such projects relied only on contractors and engineers. Farmer agreed, and out of that initial opportunity, in 2008, MASS was born.

Murphy, Ricks, and some like-minded cohorts researched the mission of Partners In Health and the needs of the community before sitting down to design. "The simple fact is, these facilities would be built anyway, without an architect, and without asking fundamental questions like, 'Is design improving outcomes or is it making it more difficult to be successful?'" Ricks says. "We weren't proposing new or radical ideas. We were just asking pretty basic questions to try and uncover different ways of doing things."

The Butaro District Hospital, completed in 2011, was built with local labor, materials, and techniques. By using rotating shifts of part-time construction workers and craftspeople, the project engaged nearly 4,000 area residents during construction, injecting money into the community and fostering partnerships that still flourish. MASS continued its research after the building was complete, interviewing doctors and community members about what worked and what didn't.

This approach, of engaging in immersive, context-driven research during the pre-design phase; relying upon local labor and building practices during construction; and following through with post-occupancy studies after completion—in essence interacting with projects long before and after many other firms do—has become the model for how MASS handles projects to this day. The approach also fits the firm's rarely mentioned full name: MASS stands for Model of Architecture Serving Society. The acronym stuck instead, Ricks says, in part because early on they were self-conscious about sounding too self-aggrandizing, in light of the fact that "we hadn't built anything yet." Over time, though, the firm's portfolio and influence has grown to match the full moniker.

Working with groups such as the Clinton Global Initiative in Africa and GHESKIO in Haiti, along with a host of governments and community organizations, the firm has now completed 23 projects, in a range of typologies such as schools, healthcare facilities, and cultural buildings—a remarkable number for a firm that only officially incorporated in 2010.

With its projects and partnerships, MASS has become an international leader in the rapidly expanding subdiscipline of public interest architecture. Murphy, now the firm's executive director and a charismatic standard-bearer, gave a 2016 TED Talk that has been viewed online more than 1 million times. Ricks, a pragmatic intellectual powerhouse, was tapped in 2014 as a World Economic Forum Young Global Leader, an honor shared by the likes of Charlize Theron and Mark Zuckerberg. In the firm's Boston lobby, a wall is lined with more than 40 framed magazine covers touting them and their work, including not just the design magazines one would expect, but also consumer titles such as *Forbes*. And as this issue of ARCHITECT went to press, MASS was named the winner of a 2017 Cooper Hewitt National Design Award in Architecture Design.

Despite the accolades and rather meteoric rise, the firm's core philosophy still holds true: "The question is: 'Does architecture have an impact on people's lives, and can we design to shape and improve people's lives?'" Murphy says. After less than a decade, MASS has grown restless again, this time looking to expand its already considerable scale of operations, both in terms of project size and social impact.

How It Works

One thing that sets MASS apart is that it has won few projects through traditional competitions or RFPs. "The way that we get to projects is unique," says David Saladik, MASS's director of design. "Often it's through a desire to support great partners or to work with specific individuals. We reach out and say, 'How can we support you?' and offer services to people who haven't worked with architects and haven't really thought about their needs. Helping them through early planning gets them to the point that an architecture project can start."

MASS's operating budget comes from a trifecta of sources, Ricks says: half from fees, a quarter from donations or philanthropy, and a quarter from grants. "The grants, as a generalization, support research, the fees cover the projects, and the philanthropy goes toward what we call our 'catalytic' projects, where we're jump-starting, seeding, and subsidizing the process," he explains. Every year, the staffs in Boston and Kigali each go on a retreat where the teams are given information about the firm's budget and resources and then crowdsource ideas about potential initiatives for communities, building types, or issues of interest. The senior staff turns the ideas into organizational goals for the year and decides how to allocate funds. The firm reaches out to nonprofits and other groups in the of-interest sectors to see if design can help. The process gives agency to even the lowest-level staffers: "Everyone on the team really has a voice in how the office is run," says Abate, the junior associate. "It's not top-down."

MASS teams up with many local architects of record, and it has a strong relationship with London-based John McAslan + Partners, a firm that also has a strong social bent. McAslan's office invited MASS in 2014 to design a national archive for the records of the Rwandan genocide trials (page 134), and last year the firms collaborated on a competition entry for the U.K. Holocaust Memorial (page 133). MASS's approach has left an impression. "There is a danger that young architects do philanthropic work as a stepping stone to other things," says Hannah Lawson, John McAslan + Partners' director of education and culture. "MASS goes so far beyond that. It gives every project the right to great architecture, and really questions what architecture can do, and it does that with responsibility, accountability, authenticity, and evidence-based solutions. That is a process that can travel the world over, regardless of culture, budget, or client. It's a mature model for delivering extraordinary projects."

MASS's projects do help clients—facilitating better care at hospitals that treat everything from cancer to tuberculosis (page 126), for instance, and improving teaching and learning conditions at schools (page 112). But because the majority of the work has been located abroad in developing regions, the firm has faced its share of criticism. "There are certain questions we get about 'Is our work a colonial act?'" Ricks says. "But we think it is actually about decolonizing the way things are built by fostering locally produced modes of design and construction—not just importing methods. We are coming to places that we are invited, and working deeply with those communities and finding local people to partner with."

Making It Bigger and Bringing It Home

A major focus of the firm as it matures is increasing the size of its projects, in order to effect change on a larger scale. The strategy is bearing out already with projects like Redemption Pediatric Hospital in Monrovia, the capital of Liberia. After helping the country's ministry of health develop healthcare design standards for post-Ebola recovery, a small project has morphed into a $15 million hospital implementing those standards, funded in part by money that MASS helped secure from the World Bank.

But the firm's expansion plan isn't just about square footage, it's about continuing to push the profession to engage on a broader scale, and, according to Murphy, to get architects to realize their power to enact change. "We make decisions as designers that affect the sociopolitical and cultural makeup of a place, whether we want to or not," he says. The hands-on approach that MASS has developed is relevant not only "to a rural context in Rwanda, but to communities here in the U.S.," Murphy says, and the firm is making a concentrated effort to take on more work here and demonstrate the wide applicability of its methods.

One of the firm's recent projects, the offices of Boston Healthcare for the Homeless Program, spurred the team to investigate how design can help combat a growing epidemic in the U.S.: opioid addiction. MASS is working with community groups looking at conditions along Boston's "Methadone Mile," and Patricia Gruits, MASS's director of research, is leading a studio at the Rhode Island School of Design on the topic. Back at the office, the firm is sponsoring four research fellows from Boston Architectural College. The hope is that this contextual analysis can uncover solutions to create healthier, safer spaces in the region.

In Poughkeepsie, N.Y., Murphy's hometown, a shuttered planning department and bankrupted city services have gutted support organizations in the downtown core. MASS worked with local group Family Services to develop conceptual designs for a center that would co-locate youth groups, healthcare nonprofits, and social services such as a Planned Parenthood, mental health services, and a homeless day shelter in order to share resources and minimize overhead. The project allowed MASS to deploy its model in a way that has citywide implications, but it also served as a helpful reminder, Murphy says.

"What architects do well is bring a perspective that's based on a range of outside experiences," he says. "If we do that with sensitivity and empathy, then we can partner closely with those that have hung in there to try to change peoples' lives, often with very limited resources. Inevitably they need to build something, and that's when architects can provide a valuable service."

Spreading the Word

For a firm that resists complacency, habitually challenging both its own practices and those of the architecture profession, it's a mixed blessing that its mission is aligning with the zeitgeist. The discussion of how good design can be an arbiter for positive social change is louder now than ever before—especially with young people. "I definitely think there's a paradigm shift happening: Students all over hope that architecture can effect significant social change," Murphy says. "The risk is that we are at an apex of interest and the pendulum will now swing back to the autonomous argument of architecture—that we as a discipline will allow a 50-year cycle of 'Does architecture affect lives, or is it an art form?' That doesn't get us anywhere, and, most importantly, it hurts young practitioners and paralyzes them from actually being able to practice."

With that in mind, the firm is training the next generation of practitioners in East Africa in public-interest practice with an initiative called the African Design Centre. "We have had opportunities to test our model for creating impact with design, and we are formalizing how we pass that on to new architects and designers and support them as they use that model to create impactful projects in their own countries," Benimana says. The two-year program embeds fellows in MASS's Kigali office while they take on a design/build project. The experience will help them learn how to source funding, work with local groups and construction teams, and conduct post-occupancy research so that the approach to design can continually be refined. The first class of 11 fellows from eight African countries convened last September, and they will break ground on a primary school in June.

MASS's leadership believes that transparently sharing their practices, mission, and processes—a rarity in a world where a firm's secret sauce is often closely guarded—can only increase how design thinking can make an impact on the greater good worldwide. "That way," Benimana says, "we are able to replicate solutions at a larger scale than just MASS alone can cover."

Left to Right: Design associate Nadia Perlepe (at left), director Patricia Gruits, and Boston Architectural College fellow David Morgan hold meetings in the Boston office kitchen.

Project 01:

The Mubuga Primary School
Musanze District, Rwanda

Headmaster Innocent Uruzugundi explains how the renovations and additions at this rural primary school campus made a difference in the lives of the students, and serve as a model for other schools in the region.

MASS did extensive research and needs assessments at the outset of the Mubuga Primary School project. Ultimately, the firm renovated some existing classroom buildings, rebuilt others, and added new classrooms, offices, and a library, all united by a landscape that serves both the students—with new play structures and sports fields—and residents of the district at large. “We created one space for community gatherings such as weddings and put lots of flowers there because people love to have flowers at their wedding,” says MASS senior director Sierra Bainbridge. “A school is the center of the community because there are no other municipal buildings. Knowing how big a role it plays pushed us to expand the programming to bring dual uses as much as we can.”

What were the school buildings like before the renovation and addition?
Innocent Uruzugundi: The school was made of 11 rooms, and those rooms were not sufficient for the number of students, which was around 817. The way the classrooms were oriented, on a sunny day the classrooms were hot, which made them uncomfortable for the children.

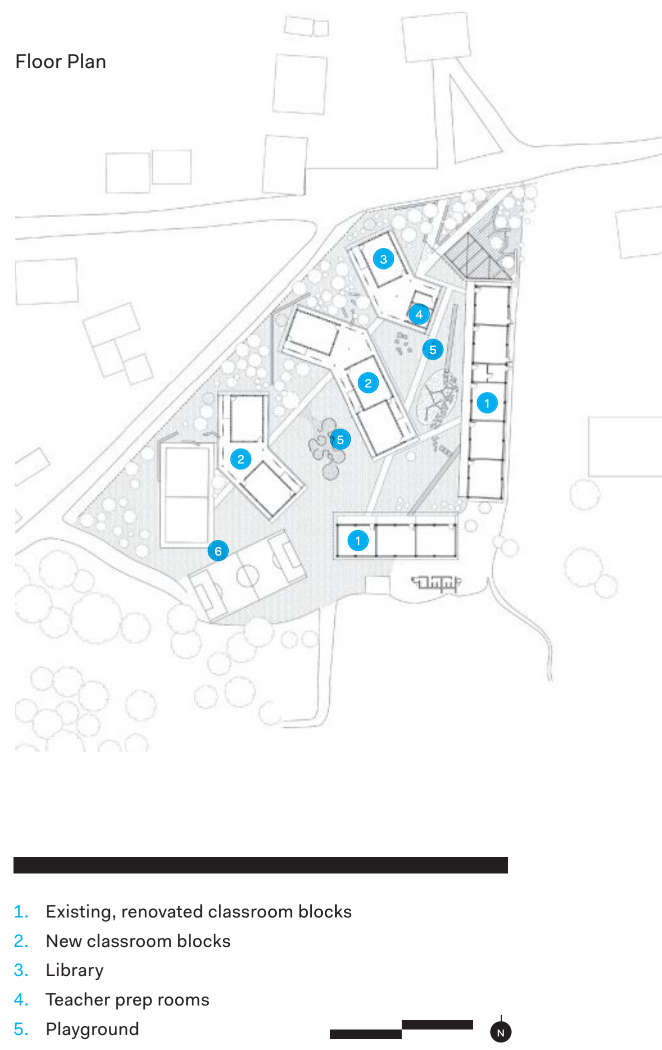
What was the process like working with MASS to develop the new buildings for the school?
The idea for the project started in 2011, but the design started in 2013, after I became headmaster. The process involved the donors, clients, and MASS, and consisted of discussion of our needs. There were inadequate facilities for us to work with, so the idea came up to build five more rooms including a library, a staff room, and a head teacher's office.

Have the new buildings changed how the teachers work and the students learn at the school?
The orientation of the new buildings was changed, and now we do not have any problem of discomfort in the rooms. MASS put vines in front of the old classrooms to shade the buildings, so now even on sunny days, the students are comfortable. The performance of the children has changed because they have an environment where they can see and learn comfortably, and the teachers have facilities where they can prepare the lessons. These facilities are also used to help the teachers to improve their skills in English, and all the teachers in the area come here to learn. Because the children are comfortable and we have more rooms, the number of children has gone up to around 900.

Does the design of the new structures represent the community around the school?
The school increased the pride of the community. Even the people from outside the district are overwhelmed when they pass across the school. Because this is the new school typology, they are overwhelmed by how the schools are designed. It makes them feel like a special design for a school is more expected here in Rwanda. The community uses the playground and landscape for entertainment—even weddings. The local government uses the school for meetings.

Also, the materials that they used in the buildings came from the community, they are not the materials which are imported from outside. It is really great for the people who have contributed to the construction—for instance, the woven doors—because these buildings represent their culture and they have received the revenue, which has helped them to develop their income. This is really great for the community.

Floor Plan



1. Existing, renovated classroom blocks
2. New classroom blocks
3. Library
4. Teacher prep rooms
5. Playground
6. Athletic fields

When MASS began working on the renovation at Mubuga, buildings that were 10 years old needed 80 percent of their materials replaced, buildings five years old needed 40 percent. "A ministry of education document articulates infrastructure standards and guidelines, everything that you would want in a school: quality materials, quality lighting, a campus approach with certain facilities," says Patricia Gruits, MASS director of research. "But they aren't being built like that. There's a gap between the aspiration and the implementation. We saw an opportunity to provide a model that says, 'This is how you can achieve all of your goals in a low-cost way.'"

Project Credits
Project: The Mubuga Primary School, Musanze District, Rwanda
Client: Rwanda Ministry of Education, Funded by the M^2 Foundation
Architect: MASS Design Group, Boston and Kigali, Rwanda · Kyle Barker, Christian Benimana, Andrew Brose, Patricia Gruits, Michael Murphy, Annie Peyton, Alan Ricks, Theophile Uwayezu
Structural Design: NOUS Engineering
On-Site Structural Oversight: MASS Design Group · Kayihura Nyundo, Christian Uwinkindi
Geotechnical Engineer: Kigali Institute of Science and Technology Soil Mechanics & Geotechnical Engineering Laboratory
General Contractor: Daniel Ahintuje
Landscape Architect: MASS Design Group · Sierra Bainbridge, Martin Pavlinic
Size: 10,500 square feet
Cost: $285,000 (construction materials, labor, and management)

"We were trying to create a place that was comfortable, that created a better place to learn, a place that was safe and healthy, where students could come and have clean water, and have a clean landscape," Gruits says. "But it also had to be playful—that's a huge part of attracting children to school and keeping them in school. Mubuga was one of the lowest performing schools in the district. Out of around 78 schools, it was at the bottom. Since the building was completed, it has risen to 36. They've seen some dramatic improvements in just a year."


P-6

Project 02:

Butaro Doctors' Sharehouses
Butaro, Rwanda

Psychiatrist Priya Kundu describes how MASS's second housing complex on the Butaro Hospital campus supports local and visiting doctors treating patients in rural Rwanda.

How long have you been in Butaro, and what brought you there?
Priya Kundu: I've been here almost six months. I'm a Pagenel fellow, through Harvard and Partners in Health (PIH). It's a global mental health fellowship, and I'm accompanying the team here—there are psychiatric nurses and a psychologist—to see patients, both in the hospital and in the outpatient clinic. I also travel to health centers in the district. This is my first job after residency—I just finished that at Oregon in July—and I'll probably be here until summer 2018.

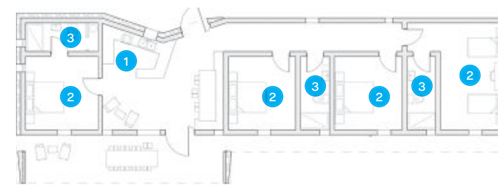
Tell me about living in the sharehouses.
I really love it. I think the design of the housing is really beautiful. There are four of us in my house—a pathologist, a surgeon, and general practitioners—but I'm lucky to have my own bathroom. And the views are really beautiful. The only thing, and these aren't even complaints, is that the floors get really cold. I have to always have slippers or socks when I walk around. And when it rains heavily, it gets noisy because of the roofing. It's woken me up in the middle of the night.

Does it create community among the doctors?
I would say so. We have our breakfast and dinner together and there aren't too many of us so we get to know each other pretty well. We are a little bit further from the PIH office and the hospital, and I think that helps foster closeness, but in the house that I live in, I still feel like I get a good amount of privacy because I have my own room, so I can have solitude if I need it.

Do you think having housing facilities helps make it easier for Butaro to retain doctors?
I feel like the housing is one of the nicest things about working here. Other locations don't have housing as nice as Butaro and I feel like it helps to have a nice place to stay. If we didn't have this, our only option would be the "bunker," which houses the PIH offices and housing. They don't have windows. Or we'd have to rent a place in the village, but you don't know the condition it would be in, or if there's hot water.

How does living in the sharehouses affect your ability to treat your patients?
It's really nice to have creature comforts, to have a nice bed, to have your own room, to have a nice bathroom with hot water. I think it makes a huge difference. I feel like I can sleep well, which is important, and there's just a sense of calmness about being in the housing. It's quiet in the evenings because it's not really in the the village or in a big community. And I think those are all really nice things about living there.

Floor Plan



1. Communal kitchen/dining
2. Bedroom
3. Bathroom

The Doctors' Sharehouses are MASS's second housing complex and fourth project on the expanding campus of the Butaro District Hospital, where the firm first started working in 2008. All of MASS's buildings on the site, including the Butaro Ambulatory Cancer Center (completed in 2013), have entailed community involvement in the construction process, employed local labor, and strived to inject as much money into the local economy as possible. "The landscape is one of the easiest ways to get people involved, especially in the places we work," says MASS senior director Sierra Bainbridge. "You don't have to be a skilled mason. You don't have to have particular abilities. Everybody knows how to do planting there, and probably better than we do. In all of our projects, we're looking for the opportunities where we can have that maximum community involvement to get that relationship with the place started very early."

The three communal sharehouses accommodate up to five doctors apiece, and encourage interaction between the residents in communal spaces. “People are trying to use some of the techniques that we teach them while constructing these houses,” says Jean Paul Uzabakiriho, a MASS junior associate. “Some techniques are not typical here, but they are going to be changing the village in the near future.” And some are already influencing local construction: “You can start seeing a couple of building elements being copied: We’ve seen local houses with clerestory windows at the gable, which is not common, and was copied from Butaro Doctors Housing I,” says Christian Benimana, MASS’s Rwanda programs director. “But you hope that eventually more can be taken up: the door system and the window system. We hope that we can simplify them enough that they can be picked up by anyone, and perform.”

Project Credits
Project: Butaro Doctors’ Sharehouses, Butaro, Burera District, Rwanda
Client: Ministry of Health; Partners In Health
Architect: MASS Design Group, Boston and Kigali, Rwanda · Garrett Benisch, Commode Dushimimana, Marcela Laverde, Sarah Mohland, Alan Ricks, Nicolas Rivard, Jean Paul Uzabakiriho
Structural/Civil/M/E/P Engineer: MASS Design Group · Tim White, Christian Uwinkindi, Obed Sekamana
Geotechnical Engineer: Geoconsult
Construction Manager: Partners In Health; MASS Design Group
Landscape Architect: MASS Design Group · Sierra Bainbridge, Martin Pavlinic
Size: 3,715 square feet
Cost: $600,000

Project 03:

GHESKIO Tuberculosis Hospital
Port-au-Prince, Haiti

The director of the nonprofit that runs this facility for multi-drug-resistant tuberculosis treatment, Dr. Jean William Pape, describes how the new building made an impact on patient care.

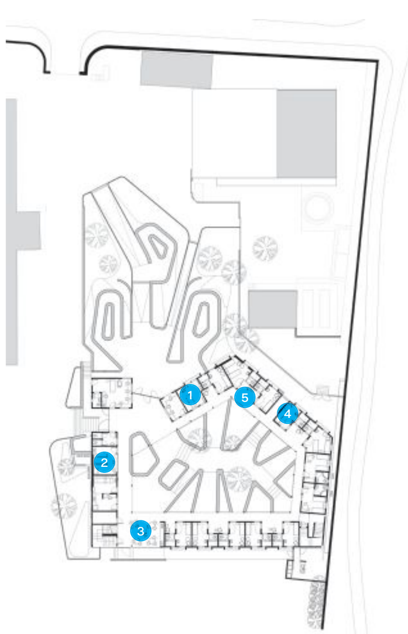
How did the Tuberculosis Hospital project start?
Jean William Pape: In 2015, tuberculosis [TB] surpassed HIV/AIDS as a cause of mortality worldwide. It is also the number one cause of death due to infectious diseases in Haiti. GHESKIO is one of the largest care providers for AIDS and TB in the Americas. While simple TB is treated with effective drugs for six months on an ambulatory basis with a cure rate over 95 percent, multiple-drug-resistant TB [MDRTB] is a major emerging infectious disease problem worldwide, requiring 24 months of treatment directly observed with a cure rate of 55 to 60 percent. The first three to six months are treated in a hospital; hence a hospital is a must during the early treatment of this terrible disease.

How were patients with MDRTB being treated before this new facility opened?
Hospitals must be built with natural light and great ventilation as both prevent transmission. Our first MDRTB hospital was in Léogâne. After that hospital collapsed in the 2011 earthquake, our patients were kept under individual tents. Their life under tent conditions was horrible and very hot during the day. They were confined most of the time to their tent or in the limited open space available to them. We had four cases of attempted suicide, and one case who succeeded, in patients with MDRTB who also were treated for AIDS with a drug known to cause hallucinations and depression.

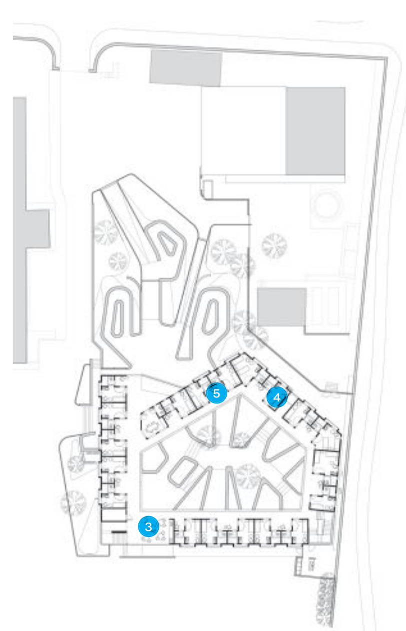
How has the new facility changed how patients are treated? Have you seen better patient outcomes?
The new facility is beautiful, colorful with open gardens, plenty of ventilation, and a lot of sun. No case of depression or attempted suicide has occurred. Our overall mortality is 20 percent—much below the average mortality of 40 percent worldwide. It is like day and night. Both staff and patients are very happy.

During the design process, how did MASS engage with you as a client, and with the broader community?
MASS was incredible. They fulfilled all my requests. They studied every single detail and responded promptly to all inquiries. They met with all of us, listened carefully, took notes, and provided a perfectly finished product. MASS are architects of beauty, but at the same time they are practical. They met with local artisans and used their products, including local wood- and metalwork. They made sure that the building is adapted to our way of life and representative of our culture. Their buildings cannot leave you indifferent.

Ground-Floor Plan

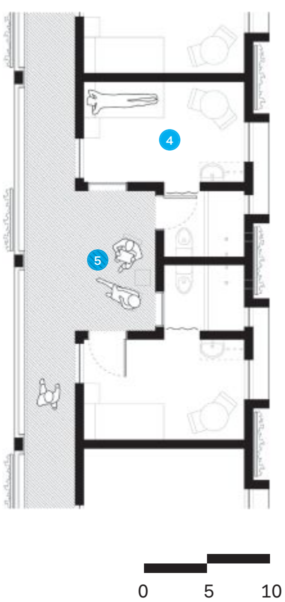


Second-Floor Plan



1. Outpatient consultation
2. Pharmacy
3. Patient gathering space
4. Patient room
5. Consultation area

Patient Rooms Plan Detail



The hospital was designed with reinforced concrete walls and a steel roof, a common construction system in Haiti, but engineered to better withstand future earthquakes. “We tried to design with what was sold in local hardware stores or markets, so the building can be kept up with locally sourced materials,” says Adam Saltzman, a MASS project manager who did construction administration on the GHESKIO Tuberculosis Hospital. “The earthquake was so devastating because people just don’t build high-quality buildings. Part of that is economics, and part is that the shortage of resources leads to bad habits. We tried really hard to work with the contractors directly to help them understand why we were doing what we were doing, to make sure they could carry on those practices. Sometimes that was a friendly conversation, and sometimes it meant knocking things down until they were built right. But not only did we get good buildings, I think everyone involved took something away from it.”

The hospital incorporates exam rooms and 35 naturally ventilated patient rooms, all sited around a central landscaped courtyard. “For projects in the health arena, you can accommodate so much program in the landscape for much less money and make the landscape that much more inviting,” says Sierra Bainbridge, senior director of landscape architecture at MASS, who led the design of the courtyard at the hospital. “For tuberculosis, some of that is very clinical: Being outside where the air is flowing creates comfortable and beautiful places where families can be together, and exposure to sun and light is healing for tuberculosis patients. In general, beautification is supportive for people. Here they're in a place where the space is being respected, and is respecting those people themselves.”

Project Credits
Project: GHESKIO Tuberculosis Hospital, Port-au-Prince, Haiti
Client: Les Centres GHESKIO
Architect: MASS Design Group, Boston and Kigali, Rwanda · Sierra Bainbridge, Michael Murphy, Robertho Jean Noel, Alan Ricks, David Saladik, Adam Saltzman, Christopher Scovel, Amie Shao
M/E Engineer: Berelec
Structural Engineer: CBI Consulting
Civil Engineer: Fall Creek Engineering
Construction Manager: GBS Group · Raphael Izmery, INTL. ASSOC. AIA
General Contractor: Chantiers d'Haiti
Landscape Architect: MASS Design Group · Sierra Bainbridge
Landscape Consultants: Jardins & Accessoires
Size: 1,400 square meters (15,069 square feet)
Cost: $2 million

On the Boards:

Colorado College Housing
Colorado Springs, Colo.

This 150-bed residential dormitory is third in a series of projects for Colorado College, which were among MASS's first U.S. commissions. The design aims to create safe environments for students that also encourage social cohesion. Apartments are laid out based on behavioral psychology that encourages democratic decision making, and they are connected by social spaces that encourage community interaction. The housing was designed in 2015, and remains unbuilt.

African Rural University Library and Community Resource Centre
Kagadi, Uganda

This university in Rwanda's Western Region educates women and gives them the tools to become forces in economic development on the continent. MASS designed a resource center for the campus where students and community members can collaborate and engage in locally focused research. A demonstration garden and seed library, cultural archive, AV suite for recording oral histories, and auditorium are topped by a communal rooftop terrace. The library and resource center opens in 2018.

Butaro Cancer Support Center
Butaro, Rwanda

Unlike MASS's first two residential projects for the Butaro District Hospital campus, which house doctors, this building serves patients who have traveled to the hospital for treatment. The 8,934-square-foot structure is sited next to the MASS-designed Ambulatory Cancer Center, and provides living quarters, communal spaces, and a cafeteria that seats 72. Arcades create social space and reduce the potential for communicable infection in immunocompromised patients. The Cancer Support Center will open in 2018.

U.K. Holocaust Memorial Competition Design London

MASS teamed with London-based John McAslan + Partners on a submission for the U.K. Holocaust Memorial competition, and their scheme was selected as one of 10 shortlisted designs. The designated site is adjacent to London's Palace of Westminster, where the British Parliament meets, and McAslan and MASS configured their memorial to be visible at grade only as a stone-lined pathway cut into a grassy knoll. Upon entering, visitors are confronted with a mound inspired by the Jewish tradition of laying a stone on the grave of a loved one. There are 6 million stones in all, representing the number of Jews murdered in the Holocaust. "It's all about healing. We think this is the way to think about architecture: you have healing on multiple scales," says MASS co-founder and chief operating officer Alan Ricks. "You have healing of the body—that's health. You have healing on the scale of the community—that's education. And then you have at the scale of the city, or the country, and that is the scale of these memorials." The winning scheme will be announced this summer.

Mattapan Housing
Boston

MASS has partnered with area nonprofits Nuestra Comunidad CDC and Preservation of Affordable Housing to develop affordable, transit-oriented housing in Boston's Mattapan neighborhood. The complex includes 135 residences and 10,000 square feet of commercial space to try to spur economic growth in the area and foster connections with surrounding communities. "We have a goal to continue to pursue issues of equity and health in architecture here in the U.S.," says MASS director David Saladik. "There's a housing crisis in Boston—the high end of the market is taking care of itself, but there's not enough workforce or affordable housing happening. So we thought it'd be great to get involved in that and try to improve the design quality." The project will be completed in 2020.

One Acre Fund Headquarters
Kakamega, Kenya

One Acre Fund supports small farmers in six countries in East Africa, providing financing, training, and seed and fertilizer distribution. MASS has designed a 258,334-square-foot naturally ventilated headquarters that opens out, via sliding panels, to landscaped courtyards and pathways. Centralizing operations (the fund currently works out of three rented spaces) will allow the organization to work toward its goal of serving 1 million farmers by 2020. The One Acre Fund Headquarters will be completed later this year.

Kigali Genocide Memorial—African Center for Peace
Kigali, Rwanda

Rwanda's Gacaca courts were convened to try perpetrators of the 1994 genocide and move the divided country toward reconciliation. After the trials concluded, the records of the proceedings were distributed throughout the country, putting them at risk of loss or damage. MASS was invited to design a national archive on the site of the planned Kigali Genocide Memorial (by John McAslan + Partners)—not only to preserve history, but to invite visitors to share their own stories and heal as a nation. It was designed in 2014 and remains unbuilt.

Manifesto:

The New Empowerment

I. Architecture and Power

Architecture is a physical manifestation of the power relationships in our world. It reveals the political, economic, and cultural priorities of those who have the privilege to build. But whether we acknowledge it or not, architects have power, too.

When we design for a more beautiful world, we embrace the power bestowed upon us, and fulfill our fiduciary responsibility to serve and protect the public good.

What is the alternative? Done irresponsibly, architecture is a weapon. It can disrupt public assets, threaten environmental security, displace culture, and reinforce entrenched social injustice and economic inequality.

We must ask ourselves: How can we use architecture as a tool for healing? Whatever we design, at whatever scale, we must seek opportunities to restructure the relationships of power inherent in all architecture.

II. A Call to Action

Our practice has been labeled "a social architecture firm." We are unsettled by this label because it suggests the possibility that architecture can exist outside a social and political context—that architecture either has an autonomous form or a social purpose. This is a false dichotomy. Autonomous form is impossible. All architecture is social. The question is how we design processes to foster beauty, to reinforce the social fabric, and to improve lives in the communities we all serve.

We are optimistic. Today we see that architects are deepening their investigations into the social and political implications of their buildings. Designers are not only acknowledging their power but finding ways to share it with the communities they serve.

And so, form does not follow function. Nor does it follow purpose. Form *is* purpose.

For too long, architects have felt disempowered by systems seemingly beyond their control. But when we hold ourselves to the highest standards in our fiduciary responsibility to the public good, we not only empower architects, we empower public decision making.

We call this "The New Empowerment."
We recommend five principles to enact it.

III. The Five Principles

Find the mission.

Each architectural project must achieve a simple, legible, and transmissible idea. We call this "The Mission," and all architecture has one. The Mission must speak to greater societal goals outside the building and seek to affect systemic change to society at large.

A building influences systemic change by affecting policy, changing individual behavior for the better, and continually improving its own typological category.

Immerse in context.

The history of design offers myriad excuses for why context-driven research does not happen. But we know the risks when it does not—if we do not ask the right questions or build consensus, we may fail the very people we seek to serve.

Deep contextual work is usually impossibly time-consuming and prohibitively expensive. It can also be uncomfortable. Implementing such immersive methods can be a mindset problem, but surely it is a structural problem of schedule and cost, too. New practice models are needed to enable the complete architectural process. And public awareness must be expanded. The public must learn to expect more from architecture.

Search for proof.

We all know that spaces shape behavior. Ask a prisoner or a nurse whether a building affects their daily life, and you'll quickly see that the question should not be *if*, but in what way and by how much. And yet, definitive proof of the impact of architectural choices is difficult to measure. That does not mean we should not seek to do so.

Buildings are living systems. They are too complex to be explained by isolated variables and definitive causal relationships. Instead we should evaluate architecture systematically and over time. In this way, the search for evidence becomes the product itself.

Invest upstream.

All architects give away services. But for whose benefit and at what cost? Uncompensated, speculative work devalues architectural labor and forces us to trade in quickly produced renderings that rarely reflect reality on the ground or the needs of the community. Such practices threaten our ability to fully enact our responsibility to the public's interest.

Instead, we have to become partners early in the process. We can do this by investing in the organizations and leaders we want to support and by sharing our services to accelerate the realization of their ambitions. This helps determine when a project is ready to be realized, and to unlock the capital necessary to build it.

Justice is beauty.

It is not only that all people deserve a beautiful environment, or that a building that is functional can also be beautiful, but that a building must be beautiful for it to be fully functional. All of us have a fundamental right to a built world that is beautiful, and one that improves our quality of life. The question is how far we architects will go to fight for it.

—Michael Murphy and Alan Ricks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Angel Jasper

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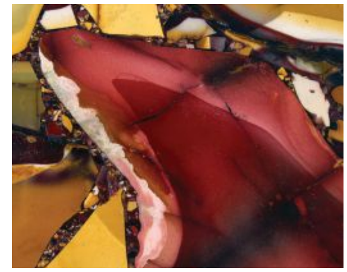
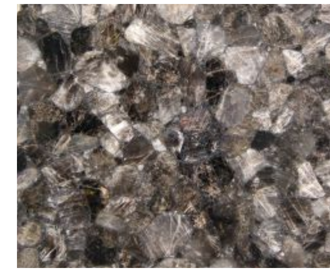
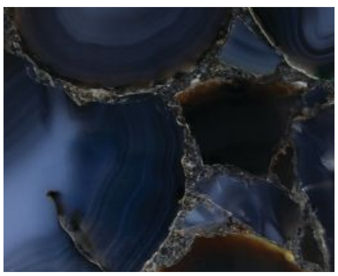


Mookalite Jasper



Smoky Quartz

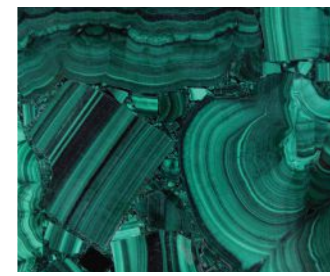


Brazilian Agate

Gemstone Slabs Lend Semi-Precious Flair to Counters and Surfaces

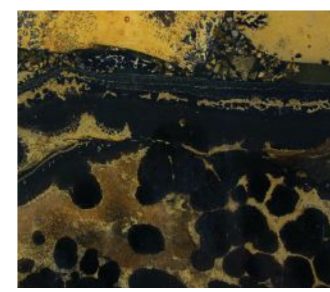
TEXT BY SELIN ASHABOGLU

Los Angeles-based tile company Walker Zanger's Lumineux Collection includes 16 types of large, bold slab surfaces made out of small pieces of semi-precious stones. The stones are sorted and arranged by color and size to achieve a uniform surface—according to the company, a single slab could contain stones from various parts of the world. The fragments are then combined with resin and treated under high pressure, resulting in a 0.75"-thick slab. The final product is suitable for indoor wall, floor, and counter- or tabletop applications. Lumineux is offered in a standard size of 96" by 48", and can be custom ordered up to 102" by 55". *walkerzanger.com*

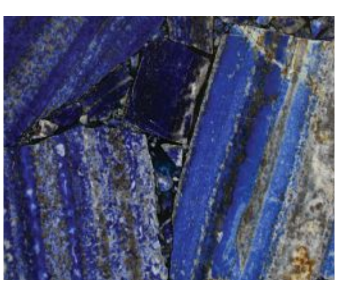


Malachite

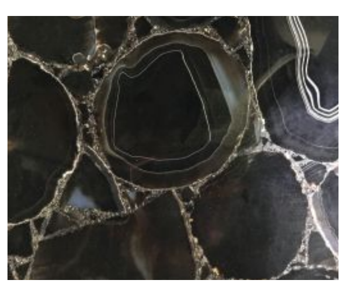
Fools Gold Pyrite



Graphic Feldspar

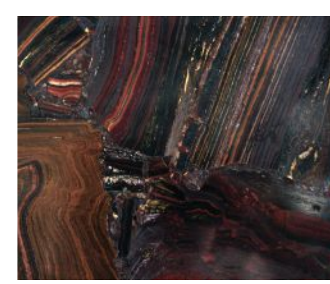


Lapis Lazuli



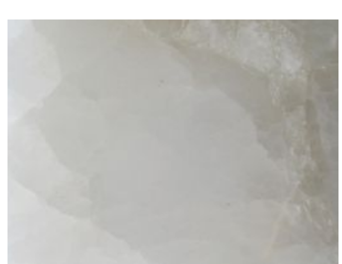
Black Agate

White Quartz



Red Tiger's Eye

Retro Petrified Wood



Pearl Stone

Red Jasper

Lavender Quartz

> *For more information on Walker Zanger's Lumineux Collection, visit bit.ly/GemstoneSlabs.*

The 2017 AIA Housing Awards Honors 14 Projects as "The Best in Housing Design."

TEXT BY GREIG O'BRIEN

Last month, the Institute picked 14 winners for its annual Housing Awards, a program begun 17 years ago to "promote the importance of good housing as a necessity of life." The jury was tasked with selecting winners in four categories (custom houses, production houses, multifamily, and special housing), and while their selections included big, beautiful, glass-enclosed houses (such as the Blue Lake Retreat by Lake|Flato Architects, shown above), the jurors also gave trophies to projects exemplifying other well-deserving housing types, including Brooks + Scarpa's The Six Affordable Veteran Housing in Los Angeles.

ANDREW POGUE

> *To see all of the winners of the 2017 AIA Housing Awards, visit bit.ly/2017AIAHousingAwards.*

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A New Exhibit at Cranbrook Celebrates the Iconic Work of Alexander Girard

> *See more images from the Cranbrook exhibition at bit.ly/GirardsUniverse.*

TEXT BY VICTORIA CARODINE

Starting June 17, the Cranbrook Art Museum in Bloomfield Hills, Mich., will host "Alexander Girard: A Designer's Universe"—the U.S. debut of a traveling exhibit of Girard's work that includes furniture, textiles, graphics, architecture, sculptures, and drawings. Pieces from his collection of folk art—from which he drew inspiration—will also be on view. The exhibit is organized by the Vitra Design Museum in Weil am Rhein, Germany, where it was on view last fall.

Raised in Florence, Italy, Girard studied architecture in London and Rome. He relocated to Michigan in 1937 where he became friends with designers at Cranbrook such as Eero Saarinen and Charles and Ray Eames. Shortly after settling in the area, he opened his own office, gallery, and retail space in Detroit's Grosse Pointe. He designed more than 300 colorful textiles, wallpapers, prints, and pieces of furniture for Herman Miller as the head of the company's textile division and as its director of design, a position he held for 21 years beginning in 1952.

The exhibit will feature furniture such as arm chair No. 66310, Herman Miller textiles, and photos of Girard's projects, such as the 1953 Miller House in Columbus, Ind., and the 1960 La Fonda del Sol restaurant in New York. "Alexander Girard: A Designer's Universe" will be on view until Oct. 8 and is sponsored by Herman Miller and Maharam.

Top: Girard in his Grosse Pointe, Mich., studio, in the 1950s.

Left: Samples from Girard's archive, maintained by the Vitra Design Museum, stored in boxes that he arranged and labeled by color.

TOP: CHARLES EAMES; BOTTOM: ANDREAS SÜTTERLIN, COURTESY ALEXANDER GIRARD ESTATE, VITRA DESIGN MUSEUM


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Olympia Place
Amherst, Mass.
Holst

TEXT BY EDWARD KEEGAN, AIA
PHOTOS BY CHRISTIAN PHILLIPS

Opening Page: The wings of Olympia Place inflect in to shelter the entrance to the west and a courtyard to the east (shown).

Right: The building's wings are clad in Englert metal siding and roofing, and bookended with façades of Belden Brick.

Traditional New England dormitories can be stern things—hulking masonry structures organized around a central entrance with row upon row of flanking wings. But when local developers Archipelago Investments engaged Portland, Ore.–based Holst (with Boston-based DiMella Shaffer as architect of record) to build a new, privately developed student housing complex between the University of Massachusetts and the town of Amherst, Mass., the architects had a more contemporary take on the form in mind.

The designers had to maximize the buildable area on an awkwardly six-sided, 45,284-square-foot site set into a hill. The building sits in a sprawling, wooded area that increasingly has become home to private student housing that serves four area schools. Holst partner Dave Otte, AIA, felt it was important to reference traditional dormitory forms of the region. Even so, "formal didn't seem quite right," he says. "Rectilinear is natural for urban sites. ... We wanted to take a traditional form and do something with it." That "something" involved inflecting the wings surrounding the central entrance block to create a front and rear courtyard.

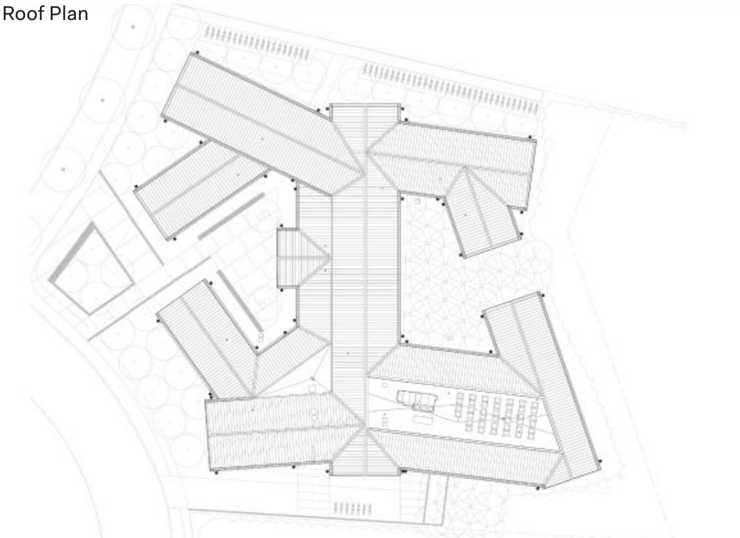
The four- and five-story structure is capped with common gable forms, realized in a distinctive way: The wood frame building is clad mostly in white, standing-seam metal that makes the roof and walls appear as one continuous bent plane. Only the gabled ends receive the red brick masonry most often associated with New England institutional buildings. These employ precast brick sills and lintels with vertically oriented windows that provide yet another modern touch. The recessed openings emphasize the height and abstract nature of the composition. Otte recalls that an early study sketch for the project depicted these red gabled objects "floating" in a snowstorm, a memorable image that helped define the design intent.

Otte describes the client's desire to "create spaces that are more hospitality-driven than dorm-like." This resulted in a conscious effort to free up the middle of the complex on the first and second floors, where a double-height lounge becomes part of the entry sequence and a destination space for residents. The space sits at the center of the building, and faces the entrance on the west and a private courtyard for residents to the east. The custom railing system—which is deployed at the grand stair, the second floor balcony, and as a semi-permeable room divider—uses wood slats that play on the verticality of the trees in the courtyard.

The complex houses 72 units, with mostly three- and four-bedroom configurations, that have a total of 217 beds. The large units are another break with the traditional form of the dormitory, with many apartments occupying the full floor of entire wings. Most units enjoy multiple exposures, allowing cross ventilation. The plan varies from single- to double-loaded corridors, so many public areas on the upper floors have access to light and views overlooking the courtyards. Hardly stern and rarely hulking, Olympia Place makes the most of its landscape.

Fifth-Floor Plan

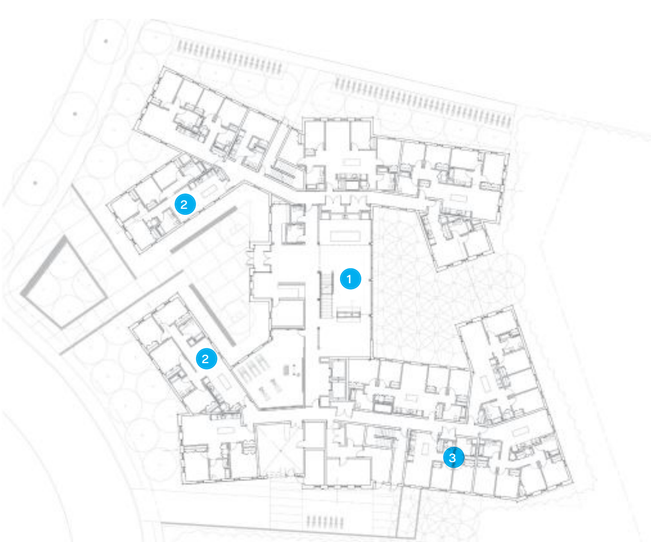
Roof Plan



Second-Floor Plan

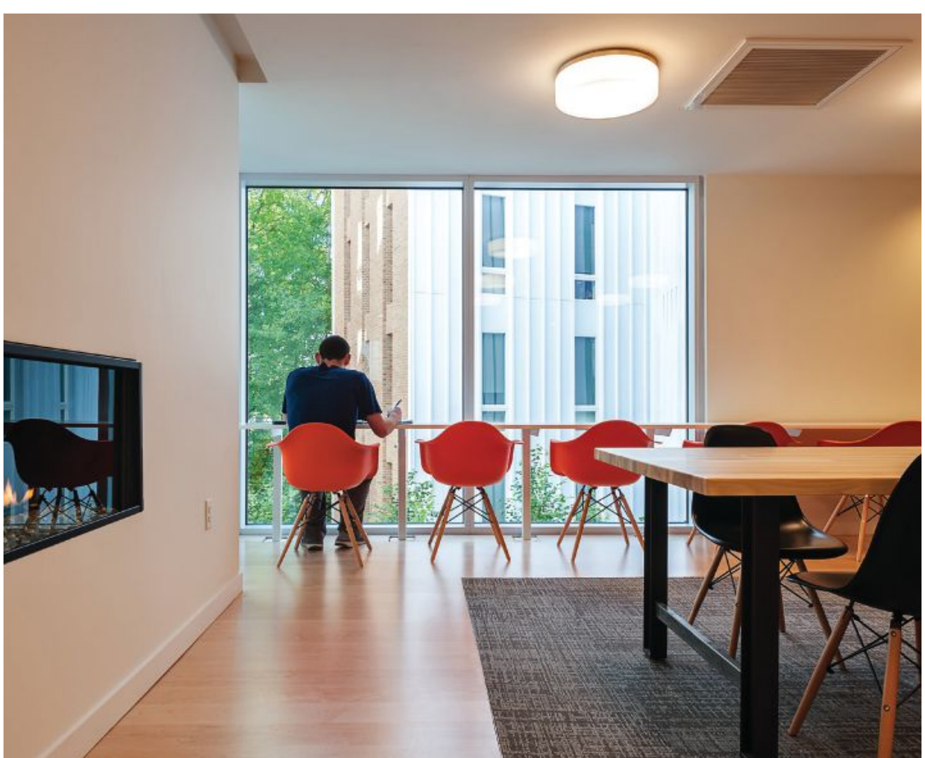
Third- and Fourth-Floor Plan

Ground-Floor Plan



Opposite: The hospitality industry–inspired common areas use warm wood tones and furniture from Article.

1. Lobby/lounge
2. Entrepreneurial space
3. Residential unit



Above: Tall windows with Solarban 60 glass bring natural light into the units.

Left: Shaw carpet and fireplaces that punch through from one room to the next unite the common spaces.

Project Credits
Project: Olympia Place, Amherst, Mass.
Client: Archipelago Investments
Design Architect: Holst, Portland, Ore.
Architect of Record: DiMella Shaffer, Boston
Structural Engineer: L.A. Fuess Partners
Mechanical Engineer: Harry Grodsky & Co.
Electrical Engineer: Energy Electric
Plumbing Engineer: Gervais Plumbing
Civil Engineer: SVE Associates
Geotechnical Engineer: John Turner Consulting
General Contractor: Cutler Associates
Landscape Architect: Soren deNiord Design Studio
Lighting Designer: Biella Lighting Design
Size: 98,413 square feet
Cost: Withheld

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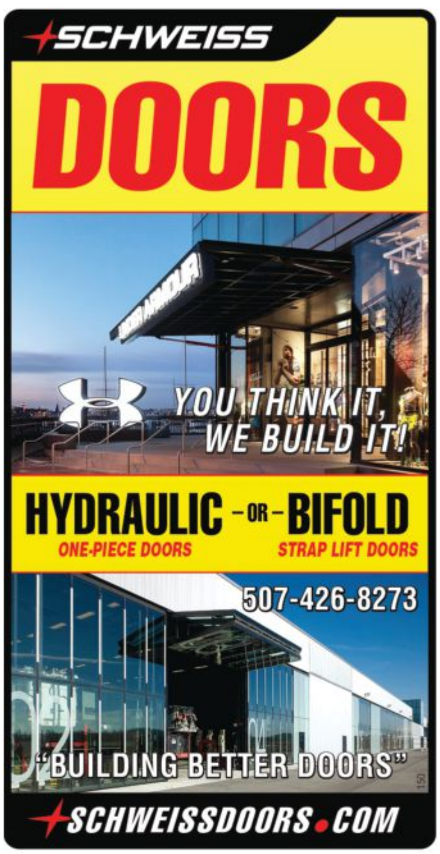
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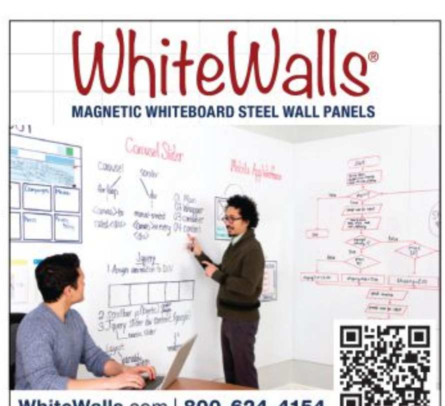
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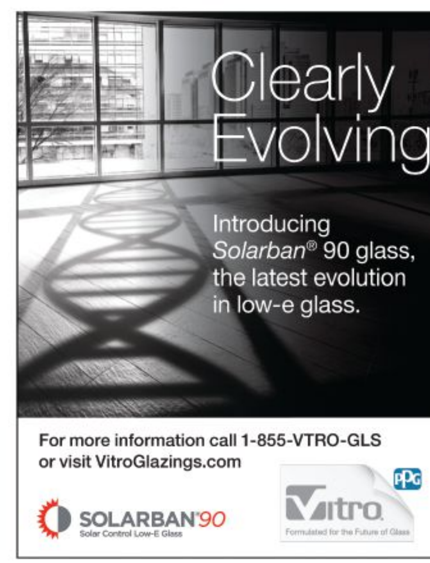
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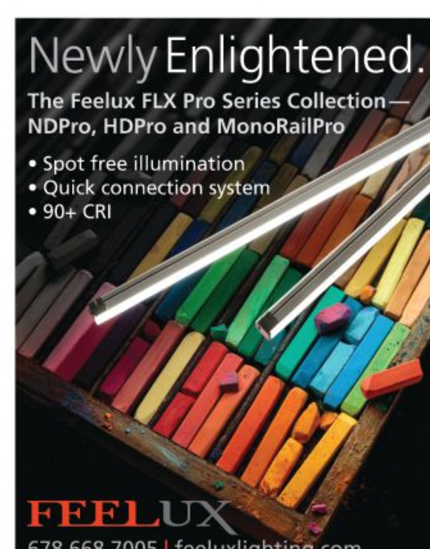
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Ad Index

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Editorial: MASS at Scale

MASS Design Group has become famous for good reason. I mean, what's not to like? The optics, as marketers say, are fabulous. By bringing architecture to clients in low-income countries—a school in Rwanda, a hospital in Haiti—MASS is as feel-good as it gets. The resulting projects, despite being built with limited means and in relatively primitive conditions, are beautiful and humane. The process engages local workers, who earn fair wages and learn valuable new skills. Founders Michael Murphy and Alan Ricks are committed, thoughtful, and telegenic, and they are fittingly self-aware, as white Americans, that they operate in hazardous territory between altruism and colonialism.

The kudos are warranted. But I hope history will remember MASS for another, equally praiseworthy, and potentially more far-reaching accomplishment—presenting the profession with a compelling, scalable alternative to the conventional business model. Sure, there are other important groups that support the less fortunate through architecture: university design/build programs such as the Rural Studio, 501(c)(3) developers of the Make It Right variety, and commercial design firms that do pro bono work. But as a practice that's incorporated as a nonprofit, MASS is a rare specimen, and worthy of imitation. So it's great that the firm's leaders are trying to propagate its philosophy and methodology more broadly, under the name The New Empowerment.

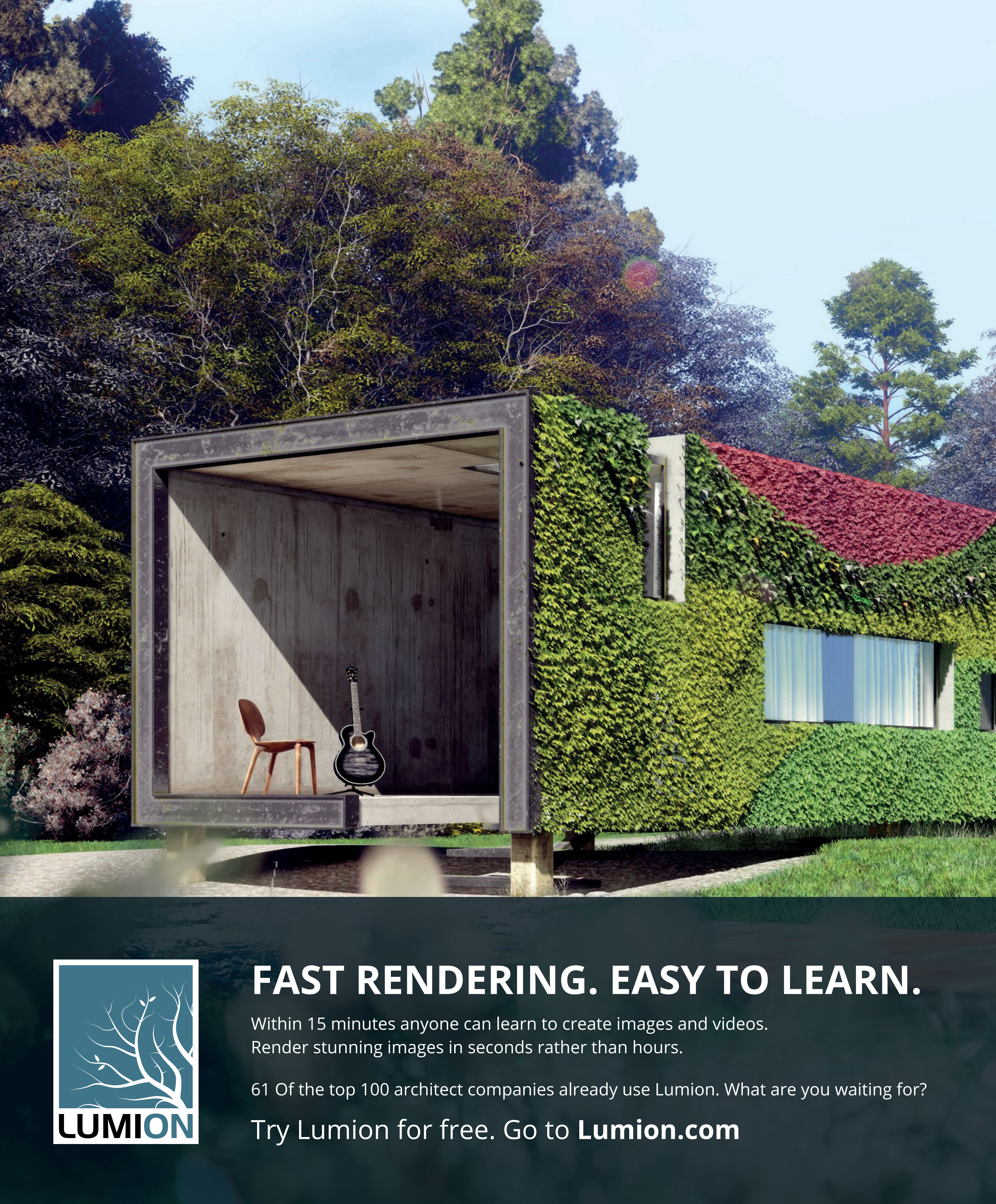
More power to them, I say.

To more fully understand MASS's modus operandi, read my colleague Katie Gerfen's profile of the firm (page 106), the accompanying portfolio, and the manifesto its leadership wrote specifically for this issue. In brief, MASS believes, with just cause, that the definition of social architecture should encompass all architecture, not just projects for the poor. Building design and construction are innately political acts that have broad impact, the firm maintains, and architects should undertake every commission with due forethought and a sense of long-term obligation.

In these tumultuous times, the profession must embrace utopian thinking and experimentation, in the renegade spirit of the early modernists. As the fragility of the status quo and the limitations of neoliberalism become increasingly apparent, architects and other experts are received with increasing skepticism by the general public, and technological advances and new financial pressures put many legacy industries, including architecture, in unprecedented adapt-or-die situations. Entrenchment is not an option.

It's one of the great problems of the age: the search for the next economic paradigm, one that will direct the digital revolution toward more equitable outcomes, replace fossil fuels with renewable energy sources, shift the material culture from consumption to conservation, distribute authority and responsibility as fairly as possible, and prioritize human health, security, and dignity. An intemperate pursuit of profit, heedless of effects on collective prosperity, runs counter to these imperatives. To reverse the global backslide into civil unrest and authoritarianism, new, more inclusive and sustainable models will need to take hold in business generally and in architecture practice specifically. We should be grateful to MASS for showing us a way.

STEPHEN VOSS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