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Ecover

COVER PHOTO: RICHARD MANDELKORN

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RETROFIT // Vol. 10 // No. 5 is published bimonthly by Fisher Media LLC, 98 Booth Meadow Lane, Durham, NC 27713, (919) 641-6321. POSTMASTER: Send address changes to retrofit, 2409 High Point Drive, Lindenhurst, IL 60046.

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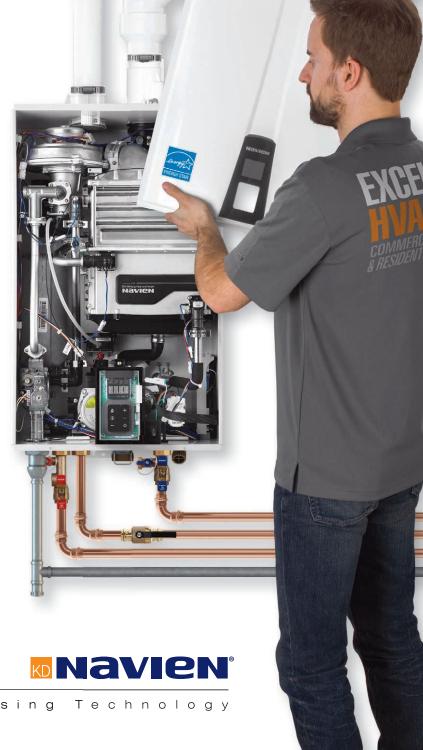


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22, 84, 85, 86, 90 and 92 to watch

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TIME FOR ACCOLADES

Hi everyone! I hope you have had a wonderful summer! I can't believe how quickly time has gone by this year. Actually, every year seems to fly by. Although it was September 2003, it feels like yesterday when I hired a young editor in her mid-20s. Sixteen years later, with the wisdom of age and experience in this industry, Christina Koch still is writing and editing for me. I tell everyone she is the best editor I have ever worked with!

It is for this reason I am proud to announce that Christina Koch is now the associate publisher of retrofit. She is so deserving of this promotion, and I am thrilled to have her as my associate publisher. She will continue her duties as editorial director but now also will be learning the ropes of the publisher role while helping us grow our

online and digital initiatives. In fact, Christina has made it one of her goals the past couple years to learn more about digital publishing, including initiatives like social media, native advertising, audio content and the expansion of our digital edition. She always says it's our job to provide retrofit's content in all the ways our readers want to receive it, and I'm delighted she's taken digital media under her wing. I am sure many of you will be taking advantage of our new online opportunities. (Watch for our house ad explaining our digital edition's new features in our upcoming November-December issue. We think you're going to love the additions!)

Meanwhile, this issue of *retrofit* is our annual education issue. We received nearly 100 educational facilities submitted to us for the issue and had the difficult job of whittling these down to 14 projects starting on page 36; the others will be showcased online and in our e-newsletters (sign up for the newsletter at www.retrofitmagazine.com/subscribe). Christina and I choose projects for the magazine we think are innovative and will provide guidance for situations you, our readers,

> come across in the field. Our education issue has always drawn the most retrofit projects of any issue of the year, and it definitely will not disappoint in content or design.

> In addition to these projects, we also have three amazing features, including the renovation of a Brutalist building in Harvard Square, Cambridge, Mass., which is our "Cover Story", page 28. Now known as the Richard A. and Susan F. Smith Campus Center, the building is the first-ever physical hub for students, faculty, staff, visitors and the community at large, to congregate. "Transformation", page 58, demonstrates that even a former public works building on a brownfield site in Pittsburgh can be made one of the world's greenest buildings. I think you'll be inspired by Phipps Conservatory and Botanical Gardens' Exhibit Staging Center. Finally, the monumental conversion of an old railroad depot in Lowell, Mass., into the Richard and Nancy Donahue Family Academic Arts Center at Middlesex Community College is featured in "Transformation", page 66. We know you'll love this issue!

> But I can't help but get excited about what's ahead! In our upcoming November-December issue, we'll be celebrating the winners of our inaugural Metamorphosis Awards program. We received 98 entries and our judges-Editorial Advisors Nathan M. Gillette, AIA, LEED AP O+M, CEM, director of Natura Archi-

tectural Consulting LLC, Grand Rapids, Mich.; John J. Noonan, vice president of Facilities Management, Duke University, Durham, N.C.; and William E. Holloway, AIA, LEED AP, principal, BERNARDON, Wilmington, Del.—are poring over the entries as I write this column. We'll be notifying winners by early September. I imagine our judges are having fun perusing all the wonderful submissions!

As we complete our 10th year of publishing retrofit, I am so thankful and appreciative of you, our loyal readers and sponsors, who support our magazine in print and online. We always welcome your feedback and will continue to put out the best magazine we can in the next 10 years!

I hope to see you at the upcoming fall trade shows!

JOHN RIESTER

Publisher, retrofit















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Ramona Schindelheim is an Emmy- and Peabody-award-winning journalist based in Los Angeles. As editor-in-chief of Working Nation, she writes about what's being done to close the gap between the skills employers need in their workers and the skills workers actually have. In "Business", page 20, Schindelheim tells the story of SkillsUSA, an organization that helps teens and young adults develop skills in engineering, construction, design, green technology and more. They put these talents on display each year at a competition akin to the Summer Olympics.



Today's schools are investing more in student success, and learning environments are becoming more active, projectbased and integrated with the professional community. In "Business", page 24, John Rozeluk (left), P.E., LEED AP, and Mo Black, BSC, MSC, uncover five new ideas in education and technology that are reshaping university campuses. Rozeluk is an associate principal at BuroHappold with extensive experience in high-performance building systems engineering design. Black is an associate principal and expert ICT,



audiovisual and security consultant at BuroHappold. Both work nationally from their offices in Los Angeles.

Henry Moss, AIA, LEED AP, is a principal at Bruner/Cott Architects, Boston. An expert in rethinking existing buildings to create new places, Moss was honored with the 2015 Boston Preservation Alliance Codman Award for Lifetime Achievement in Preservation. In our "Cover Story", page 28, Moss explains the updates to a Brutalist structure in Harvard Square, Cambridge, Mass., that have made it a physical hub for Harvard students, faculty, staff, visitors and the Cambridge community at large.





Christopher Norris, LEED AP, P.ENG., P.E., is a partner at bpl Enclosure Engineering, Atlanta. With more than 20 years of experience providing enclosure expertise for a wide variety of project types throughout North America, Norris shares guidance for fortifying existing buildings to withstand hurricanes in "Component", page 54.

Richard V. Piacentini is president and CEO of Phipps Conservatory and Botanical Gardens, Pittsburgh. Since 1994, he has led the green transformation of the property and its structures, including the recent makeover of a public works building into the facility's Exhibit Staging Center (ESC) with the goal of achieving Living Building Challenge, LEED Platinum and WELL Platinum. Read about the ESC's remarkable green "Transformation", page 58.





Kevin Bell, AIA, an associate with Leers Weinzapfel Associates, Boston, leads and coordinates digital technologies and their incorporation in the design process. His skills were part of the renovation of a 140-year-old railroad depot into the Richard and Nancy Donahue Family Academic Arts Center at Middlesex Community College, Lowell, Mass. Read the story in "Transformation", page 66.



With 5,000 openings, the historic window replacement project at the Starrett-Lehigh Building was one of the largest in New York City history. One of the most complex, too. To satisfy NYC Landmarks Preservation Commission guidelines, the windows had to match the original steel window profiles and sightlines using aluminum, thermally-broken frames while incorporating the original steel windows' operable vent design. Graham's customized SR6700 window met the challenge. Graham can meet yours too.



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- 5 Cost-efficient Innovations to Improve Our Nation's Infrastructure
- Council of Five Industry Experts Discusses 5 Pressing Issues for the Future of HVACR
- New York City's Race to Meet Citywide Carbon Emissions Law
- Common HVAC Issues Can Be Fixed During a Building Renovation

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The Window Job of the Year (If Not the Century)

Project Walkthroughs

The Starrett-Lehigh Building encompasses a full Manhattan city block. At 2.3 million square feet, it is larger than the Empire State Building. Named a New York City landmark in 1986, it is wrapped in miles of iconic ribbon windows, consisting of nearly 5,000 openings, making it truly "the window job of the year (if not the century)."

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Upgrade and Optimize Your Campus Environment with Simple, Scalable Lighting Retrofits

Wireless lighting control simplifies installation and improves space utilization.

For most college campuses, now is the perfect time to think about lighting control upgrades that create a more efficient, comfortable, productive living and learning environment. Why now? Because college campuses are getting older while technology is getting more and more sophisticated.

Aging buildings open the door to beneficial lighting upgrades

<u>Half of college and university buildings are more than 25 years old</u>, and half of those are more than 50 years old. Beyond building age, the era of the single-use classroom is waning and advanced pedagogies demand learning spaces that can evolve along with this changing educational landscape.

Smart, wireless lighting control systems, designed to provide better data and greater flexibility, can make significant contributions to spaces so they are adaptable, efficient, and ready for the next 25 years. To that end, commercial real estate firm JLL recently identified *smarter space utilization* and *leveraging data for greater efficiencies* as two of the top five campus facility trends.



"Campuses are looking for ways to upgrade and optimize mission-critical spaces with systems that offer contemporary design features and actionable data, and solutions that extend the life of these essential buildings," explains Bill Marushak, Sales Manager, College and University Programs at Lutron Electronics.

Because lighting is perhaps the most universal system in any built space, smart control systems can contribute valuable insights about how buildings are used, when they are occupied, and where simple facility changes can improve building efficiency.

Lighting control that works for a single room or the entire campus

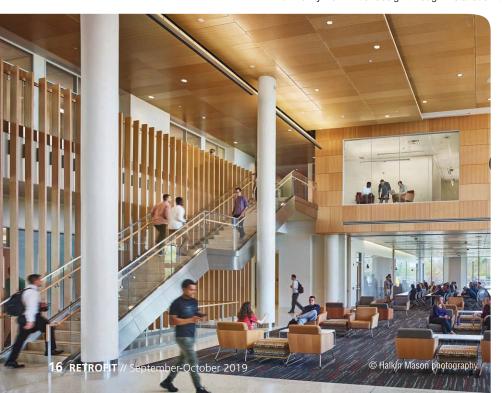
The good news is that best-practice lighting control isn't an all-or-nothing proposition. "Wireless control can be easy to design, install, and maintain even in older buildings," says Marushak. "Especially in renovation and retrofit projects, wireless solutions offer simple code compliance, flexibility from initial design through installation to the inevitable tweaks and adjustments that make a

system truly work for the people in each space."

You can start small and expand over time, ultimately integrating older spaces, new construction, and even outdoor spaces under a single data and management platform. Enterprise-level software protocols can deliver a simple, consistent user experience from a computer or smart mobile device, making actionable system data easy to access, understand, and present.

To consistently create the right environment for a broad spectrum of users, specify a system that accommodates a wide range of fixture types and control strategies, including occupancy and vacancy sensing, daylight control, scheduling, individual fixture control, and personal control. Look for a manufacturer with online and app-based assets that simplify lighting design and maintenance, can deliver a wide variety of features within the same control family, and help to streamline operations by reducing installation and maintenance time.

A smart approach to advanced lighting control helps put the campus of the future within reach today.





Wireless solutions get an A+ at Cal State Los Angeles

Cal State Los Angeles serves 28,000 students in the heart of Los Angeles. As buildings aged and systems had to be replaced, the school looked for solutions to improve the lighting environment across the campus while also simplifying maintenance and management for their busy facilities team.

Wireless solutions make system design seamless and easy to install. They offer intuitive, appbased setup and monitoring, and provide scalability essential to the constantly evolving nature of the campus. As a result, Cal State Los Angeles has adopted Vive as their campus standard for new building and retrofits.

Electrical Supervisor Emmanuel Free says the system saves time and money while delivering an overall better environment for students and staff. "With the scalable nature of Vive we can have components in stock, ready to support lighting retrofits and routine maintenance faster, and with better results from initial design to system setup," says Free.

Scheduling and scalability drive retrofits at DeSales University in Pennsylvania

Tucked into an intimate, beautiful setting in Eastern Pennsylvania, DeSales University has experienced tremendous growth and an expanding national reputation over the last decade. Its facilities — including world-class labs and learning technologies — are also undergoing significant upgrades.

Brother Joseph Schodowski, OSFS, General Maintenance, emphasizes how important it is to be able to tie multiple buildings together under a single software platform, and how lighting is

still a major contributor to energy use. "Whether a building is from the 1960s, or a state-of-the-art classroom for training tomorrow's medical practitioners, lighting control helps us provide students and staff with an environment that makes them comfortable and secure while keeping our energy and maintenance costs under budget," says Brother Joe. "I value the ability to install flexible control solutions, knowing that as schedules and budgets allow, we can continue to tailor and personalize features, and still keep operational costs in line."



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IWFA GUIDE EXPLAINS WHAT WINDOW FILM CAN AND CANNOT DO

School intruders intent on harm is a community-wide concern, and delaying their entry with security window films on windows and doors may buy time to allow for more response time and save lives, according to the International Window Film Association (IWFA), Martinsville, Va.

"Recent school shootings reveal plain or tempered glass doors and windows are often the point of entry that is breached by intruders ready to do harm," says Darrell Smith, IWFA's executive director. "All glass doors and windows on the ground

level need to be evaluated with an eye toward security to protect everyone inside."

IWFA has published a free, downloadable guide at www.iwfa. com/consumers that states what security window film can and cannot do. No security window film known to IWFA will make glass bulletproof. Any claim to the contrary should be brought to the IWFA's attention.

Security window films are an option for any structurally sound window. The application of security window film may not prevent the

entry of a high-velocity projectile, but it may increase security by holding the glass together and reducing spalling and total window failure.

The average U.S. public school is more than 40-years old and most have not had a major renovation in 12 years, states the U.S. Department of Education, Washington, D.C. This leaves a majority of school leaders looking to improve security within the constraints of the annual budget. When designed to save energy, security window films may reduce solar heat gain by as much



as 80 percent. For energy savings and return on investment, they are proven to be a cost-effective solution with a payback period in many instances of less than five years. This benefit is likely to offset much of the capital costs of adding security window film to a school.

Organizations Partner to Promote Professional Licensing Standards

The American Institute of Architects (AIA) and National Council of Architectural Registration Boards (NCARB), both of Washington, D.C., are among several organizations who have helped found the Alliance for Responsible Professional

Licensing (ARPL), a new coalition of technical professions focused on educating policymakers and the public about the importance of rigorous professional licensing standards. ¶ ARPL is a unique coalition that brings together professional organizations and their registration boards at a time when there is significant concern over the appropriate level of licensing required by law. The coalition was formed to ensure their voices are heard by policymakers and the public amid the growing debate around licensing. ¶ "NCARB and AlA may approach the licensing debate from different perspectives but we fundamentally agree that rigorous standards must be maintained in order to protect the public we both serve," says NCARB CEO Michael J. Armstrong. "Complex professions are at risk of being swept up in broad calls to reduce licensing requirements for occupations and vocations. It is important for us to work with other technical professions to ensure public safety isn't compromised by broad brush deregulatory efforts." ¶ "When an architect designs a hospital or a school, the public must have confidence in its safety and structural integrity," adds AIA Executive Vice President/CEO Robert Ivy, FAIA. "The best way to maintain the public's confidence is to continue to require that architects demonstrate rigorous and ongoing education, examination and experience. Attempts to weaken or undermine professional licensing requirements for architects not only harm our profession, but could potentially endanger public health, safety and welfare." ¶ The alliance's formation reflects mutual interest between regulatory organizations and their professional society counterparts in making the case for reasonable regulation. Although the regulatory associations' mission is the protection of the public and the professional societies are the voices of their respective professions, recent trends and challenges in the regulatory and legislative environment have called for these groups to proactively engage together in the narrative around the importance of reasonable regulation and licensing. ¶ In addition to AIA and NCARB, members of ARPL include the American Institute of Certified Public Accountants, Durham, N.C.; American Society of Civil Engineers, Reston, Va.; Council of Landscape Architectural Registration Boards, Reston; National Association of State Boards of Accountancy, Nashville, Tenn.; National Society of Professional Engineers, Alexandria, Va.; and National Council of Examiners for Engineering and Surveying, Seneca, S.C. ¶ Learn more about Alliance for Responsible
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Hands-On Student Competition Creates Pipeline of Talent for Skills Trade



Each year, the programs train more than **340,000** teens and young adults around 130 occupations, graduating more than 100,000 jobready students.

Watch the Week in Review from SkillsUSA's National Leadership and Skills Conference.

he annual SkillsUSA Championship doesn't have the name recognition of the Super Bowl or the Summer Olympics but it is every bit the spectacle. Each year, more than 6,400 students gather in Louisville, Ky., to take part in the world's largest hands-on skills competition, demonstrating their mastery of engineering, carpentry, smart home technology, construction, cybersecurity, graphic design and more. (Learn more about the competition at www.skillsusa. orq/competitions/skillsusachampionships.)

For three days in June, the Kentucky Exposition Center was once again transformed into a small town filled with talented young craftswomen and craftsmen from around the country taking part in the National Leadership and Skills

Conference (NLSC). The conference was this year's culmination of Leesburg, Va.-based SkillsUSA's ongoing mission to promote the technical and soft skills that employers are looking for in the workplace today and that SkillsUSA's students have.

SkillsUSA is a national organization whose members are enrolled in public career and technical education programs in middle schools, high schools and community colleges.

Executive Director Tim
Lawrence says the non-profit
is the conduit for students,
educators and more than 600
industry partners to advance
skills training. "The magic of
SkillsUSA is its connections
to business and industry,
strengthening the talent
pipeline from schools to the
workplace," he notes.

Working with its industry

partners, the organization offers guidance and resources to 1,900 chapters across the country to ensure the members stand out among applicants competing for jobs in the skills trade. Each year, the programs train more than 340,000 teens and young adults around 130 occupations, graduating more than 100,000 job-ready students.

Skills USA's strategy to develop skilled workers comes at a critical time in the U.S. labor market. Although the construction industry is booming, the



(continues on page 22)

KINGSPAN LIGHT + AIR **GOES ALL-IN ON NORTH AMERICA**

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



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

What types of projects do you work on?

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





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

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

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

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

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



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

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













gap between the number of open positions and the skilled workers capable of filling them has never been greater. The latest figures from the U.S. Department of Labor, Washington, D.C., show 369,000 open jobs in the construction industry nationwide. (See the figures at www.bls.gov/news. release/jolts.to1.htm.)

With schools and public funding focused more on increasing college employment rather than creating a talent pipeline for employers, it has led to the disconnect between job seekers and employers, as well as widened the skills gap. Many students are exiting college without degrees and with insurmountable debt. Meanwhile, employers report students are entering the workforce short on soft skills, like communication and problem-solving.



Reversing the "college or bust" trend requires raising awareness about the opportunities for younger workers without a four-year degree. SkillsUSA also makes the trades more appealing to a new generation by adding an emphasis on technology and elevating them to competition status. The same reverence that sports legends receive is bestowed on competitors whether they are a master at applying mortar to bricks or can control a robotic arm.

"We need young people that are engaged in the trades, excited about the trades, have passion about the trades and the professions that we serve to enter that talent pipeline," Lawrence says.

SkillsUSA makes employment a priority for students by treating the NLSC as a giant job fair. Each student must bring a résumé and meet with employers who are looking to recruit talent from the competition floor.

While many SkillsUSA students compete in the more than 100 events as individuals, the event's TeamWorks contest tests the combined abilities of trades students representing four aspects of construction: carpentry, masonry, plumbing and electrical work. In only 16 hours, all teams must plan,

present and build the same structure from blueprints provided by SkillsUSA.

The pressures of time and competition are intended to bring out the best qualities in teams, such as the Georgia Northwestern Technical College squad from Calhoun, Ga. WorkingNation's filmmakers followed them during Team-Works 2018 and discovered what makes this particular SkillsUSA competition special. If the national conference is like a small city, then Team-Works reflects the spirit that holds it together.



According to SkillsUSA
Board Member Jim Bohn, the
immense presence of the
SkillsUSA Championships can
be intimidating. However, one
of the most critical aspects of
TeamWorks is how it brings
out every team's confidence
while performing under the
pressure of the deadline.

The timeframe to see a project from blueprint to completion may seem impossible at first glance. TeamWorks contestants work with the newest tools and materials, provided by the more than 30 sponsors of the event, including Bohn's employer, the Robert Bosch Tool Corp. (View more

sponsors at www.skillsusa.org/about/partners.) Beyond the confidence from working with state-of-the-art equipment, TeamWorks participants draw from their strengths and skills to complete their projects.

"With a teamwork experience, or a teamwork attitude, you can get a lot done, especially a project in a very short period of time, and really show that your skills working together can really accomplish something," Bohn says.

Although construction-related skills are highly visible at the competition, SkillsUSA cuts across many industries—arts and communication, health care, IT, STEM and cosmetology,



SkillsUSA's strategy to develop skilled workers comes at a critical time in the U.S. labor market.

to name a few. At this year's competition, more than 1,100 gold, silver and bronze medals, plus more than 530 recognition awards were handed out. Competitors were also recognized with scholarships to continue their education and tools of the trade.

To learn more about Skills-USA, including how to hire students that participate in the NLSC, visit www.skillsusa.org.



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LEARNING BETTER

FIVE NEW IDEAS IN EDUCATION, TECH RADICALLY RESHAPE UNIVERSITY SPACES

WRITTEN BY JOHN ROZELUK, P.E., LEED AP, AND MO BLACK, BSC, MSC

n recent years, academic facilities and campus social spaces have radically mutated to reflect modern instructional needs and the tug of educational technology. Instead of seeing higher education moving to an entirely online experience, schools are finding that the campus itself matters more than ever before. In the process, classrooms and academic buildings are becoming unrecognizable.

Two trends inform and shape this trend: First, schools are investing more in student success, focused on boosting student engagement—and graduation and retention rates. Second, learning environments are becoming more active, project-based and integrated with the professional community. Traditional lectures and stand-and-deliver teaching are yielding to flipped instruction and more distance learning integrated into curriculums. Many courses are designed "to bridge the

gap between education and enterprise," as one university dean explained.

Examples include Carnegie Mellon University's Mill 19 complex, developed by Regional Industrial Development Corp. (RIDC) and occupied by Carnegie Mellon University's Manufacturing Futures Initiative, Advanced Robotics for Manufacturing Institute and other technology companies. At Arizona State University, the Thunderbird School of Global Management is integrating distance learning with classrooms, meeting spaces, and offices in its modern, new facility to support graduate degree programs, executive education and the broader Phoenix community's top businesses.

These new environments are highly dynamic and embracing. A few key considerations jump out:

ICT IMPACTS. The most radical changes for university facilities extend from

the new information and communications technology (ICT) in use today. More college courses require interactive distance tools, which are bandwidth-intensive and need flawless web connectivity. Often resembling conference rooms rather than classrooms, these settings benefit from dedicated voice/video/content systems and digital monitors alongside typical projections, microphones and video cameras. The smart, video-based setups are supported by sound bar systems, IP-based phones and even virtual reality software to fully enhance the learning experience. Collaboration and process management tools, such as HTC Vive, provide immersive experiences for student deliverables.

Unlike typical portal or video lecture approaches, these tools for university learning support interactive, collaborative discussions bridging distance and varied media, including social media.

(continues on page 26)

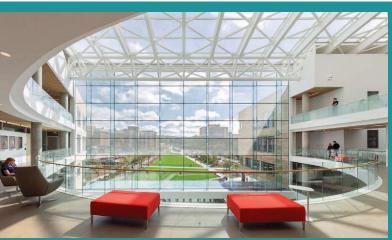


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The Tepper Quad Project provides a gateway to a major new quadrangle, the first expansion of Pittsburgh-based Carnegie Mellon University's north campus.



Classroom settings that resemble conference rooms benefit from dedicated voice/video/content systems and digital monitors alongside typical projections, microphones and video cameras.

Some rooms have dozens of microphones and several cameras to allow sharing of projects and coursework in real time. Increasingly, remote students and quest lecturers dial in via Skype or GoTo and access cloud-based meeting services—just a screen and a webcam connect them to the class—while local students use cloudlinked speakerphones.

MEP NEEDS. All this technology adds heat within campus buildings new and old. It also creates acoustical challenges that project teams need to mitigate. At the extreme end, server racks present highly sensitive equipment that can be impacted by slight temperature shifts of just a few degrees. These may need dedicated air-conditioning systems and spot cooling, and universities will choose to put some on dedicated uninterruptible power supply backups. Ductless split systems often work well for small audiovisual closets and server rooms, supplementing the central chilled-water plant.

By design, these academic buildings are more permeable than ever with more breakout spaces and informal meeting areas, as well as large, "active learning zones," such as innovation labs with moveable furnishings, temporary partitions, cluster decks and flexible learning tools. Often it helps to employ underfloor plenums for both HVAC delivery and other MEP and ICT access points, introducing conditioned air low and close to occupant study areas.

Many spaces resemble industrial lofts with open ceilings and plentiful duct runs and drop-down MEP points.

FEWER WIRES, CLEANER POWER. In years past, colleges were installing more hardwired data outlets, but today the physical plant is shifting to seamless wireless in all spaces so students can stay connected while moving from residence halls to labs to common areas to collaboration zones. Many of the classrooms use flexible, movable furnishings that can benefit from arrays of electrical floor boxes for power. The watchword is access, so professors and students can easily adapt to shifting curricular and pedagogical needs.

At Carnegie Mellon's Tepper Quad project, for example, this hub for technology-enhanced learning and research employs efficient voided biaxial concrete slabs—sometimes called "bubble decks" supporting loft-style MEP systems and integrating varied MEP and ICT services in their ceiling voids. The solution, which is new in the U.S., can reduce floor-to-floor dimensions and total building heights.

MOBILE AND FLEXIBLE. In addition to rolling furniture and modular physical plants, new education technologies enable nontraditional approaches to scheduling and occupancy. Meeting rooms, for example, may be scheduled online with automated access controls tied to their building management system for light-

ing and HVAC. Most universities prefer to include occupant overrides so users may personalize their room temperature, illumination levels and the like. Robust acoustic separations help make meeting rooms and larger collaborative learning spaces more private and less intrusive, benefiting the rest of the academic community.

THINK HEALTHY AND GREEN. Essential to these novel learning environments is a commitment to quality of life, wellbeing and green principles. Although the sustainability and wellness disciplines may not directly impact the instructional ICT deliverables, they still add substantial value by making academic buildings and innovation centers more attractive, resilient and lasting. For example, many buildings with chilled-water systems can choose to power down for the entire heating season and rely on individual split systems. The ductless equipment can also be matched with emergency power installations that are smaller and less costly than equivalent backup power needed for the entire central plant.

Wellbeing and green building are intimately related and undergird student success. At the RIDC Mill 19 project, housing Carnegie Mellon's Manufacturing Futures Initiative—and targeting LEED v4 Gold certification—the design solution encourages connection with the outdoors by drawing daylight and fresh air into the building wherever possible. To ensure

occupant comfort, the building has operable windows and sunlight glare-reduction measures, such as internal blinds, fritted glass and louvers. Biophilic strategies include multiple planted terraces throughout the building, along with internal landscaping.

For campus architects, planners and their building project teams, the question is, as new instructional technologies and online learning upend university academics, how should classrooms, labs and common areas change in response? The answer is to study the new models of instruction and look at the needs of these new educational platforms—without losing sight of the big picture of community and climate. The resulting facilities reveal emerging ideas and powerful catalysts for change in higher education, including transformational design approaches and lessons for future academic and instructional designs.





Wellbeing and green building are intimately related and undergird student success. At the RIDC Mill 19 project, a former steel manufacturing building being developed for Carnegie Mellon's Manufacturing Futures Initiative, the design solution encourages connection with the outdoors by drawing daylight and fresh air into the building wherever possible.



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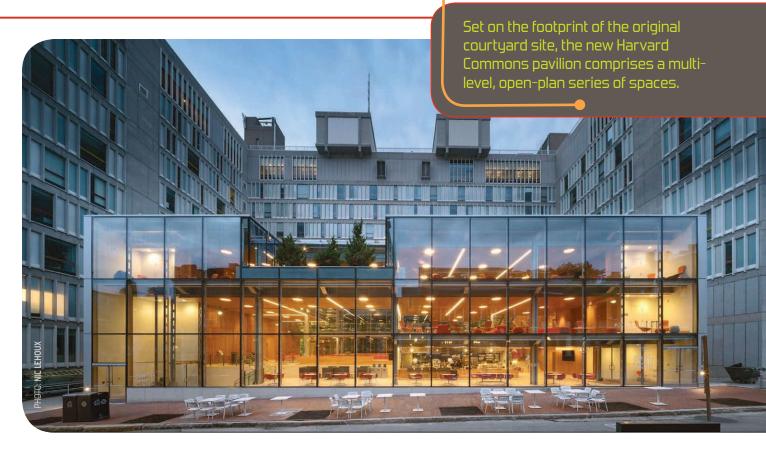


WRITTEN BY HENRY MOSS

Designed as an administrative building by Josep Lluis Sert, dean of Harvard University's Graduate School of Design, in 1958, Holyoke Center, a Brutalist building on Harvard Square, was completed in 1966. The 100-foot-tall concrete structure was a remarkable work of urban design for its time, proposing innovative street-level pedestrian space at its base. But as the seminal building approached its half-century mark, it had become unloved and well-worn during the passing years.

In 2013, seeking to realize its first-ever physical hub for students, faculty, staff, visitors and the Cambridge, Mass., community at large, university representatives decided to repurpose the lower floors of the building as the new Richard A. and Susan F. Smith Campus Center. Part of a multi-year effort to create and improve common spaces across Harvard to ensure its physical spaces would foster the intellectual, cultural and social experience, as well as support the wider community, the revived building was envisioned as the new meeting place of "town and gown."



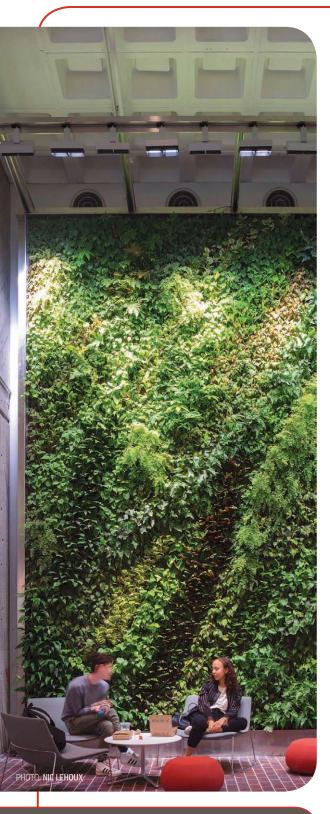


KEY INTERVENTIONS

In April 2016, a large-scale renovation and construction project comprising rejuvenated indoor and outdoor spaces was launched for the Campus Center with a transformational design by Hopkins Architects, London, which worked with our firm, Bruner/Cott Architects, Boston, as executive architect, as well as Arup, Boston; Faithful+Gould, London; Simpson Gumpertz & Heger, Waltham, Mass.; and Michael Van Valkenburgh Associates, Cambridge. Opened in fall 2018, the new building represents a radical reappraisal of the original, bringing bold and inventive new spaces to the heart of Harvard's campus.

Hopkins Architects' design reconfigured the building's first, second and 10th floors, reinterpreting the history and logic of Sert's architecture through a series of additions to and removals of existing fabric, creating new internal spaces interspersed with captured internal and external landscaping. Understanding Sert's original intentions for the building and how they had been compromised over the years was crucial to the plan. Harvard and the design team undertook a careful





Landscaped spaces and features allow occupants to experience and enjoy greenery and landscape year-round.

study to fully understand these aims, leading to several key interventions.

The first and second floors of the building, now largely open to public use, were originally realized as a series of physically separated pavilions with little connectivity between them or to the streets around them. Sert placed pavilions on all four sides of the building and to each side of its central arcade to provide frontage and activity onto the surrounding streets and to create new areas of public realm. The pavilions originally connected through from the street to the arcade but had been subdivided and blocked up over time until none of this legibility and connection remained. The existing levels and heights further limited their potential uses. The new plan connects all four quarters of the building into a new whole on the interior while on the perimeter providing visual and physical links to all four streets of the city block.

Each pavilion, along with the spaces that connect them, proffer social and meeting spaces that support multiple activities for the university community—malleable areas that recognize in equal measure a place for the individual and a place for the whole. Two new pavilions were added, and one was refurbished.

The new Moise Y. Safra Welcome Pavilion restores the clarity of the original plaza entrance on Harvard Square. Subsequent additions were removed to create a volume that carefully extends from Sert's façade in the character of his own pavilions. Proffering a new Harvard "gateway" for visitors and tourists alike, the space also provides information for the whole community on the many events and activities taking place on campus.

An originally proposed central public courtyard subsequently subsumed by retail space was resurrected and reinterpreted as the new Harvard Commons pavilion. A series of internal and external landscape "thresholds" mediate at either end of the arcade leading into this new space, the largest in the building. Set on the

footprint of the original courtyard site, it comprises a multi-level, open-plan series of spaces.

MODERN LEARNING

At the heart of the Commons is the "living room", a multipurpose space capable of supporting large-scale events while functioning as a gathering and social area day-to-day. This flexible approach was core to addressing the needs of today's students, whose learning culture has evolved from a static, classroom-based experience to a much more fluid "whenever, wherever" context. The barriers between social and study space, public and student space are blurred in the Commons, allowing for a flow of activities expressive of openness to a new age of learning.

Through the careful removal of existing concrete fabric, light, view and landscape were also introduced into the Commons, softening the arcade's singular linearity while allowing its defining order to remain, creating—in Sert's words—"an oasis in the middle of noisy crossroads."

The building's Dunster Street pavilion was refurbished. Its reconnection to the arcade was re-established, and its Sert-designed modernist roofscape of mechanical rooms was transformed into an occupiable landscaped roof terrace

Additional interventions on the first floor included opening them out across the building's width and length to form new public connections with the wider urban context of Cambridge and to create views from Holyoke Street across to Dunster Street. The entry floor's light-filled spaces now feature food venues, unique indoor landscape elements, and comfortable and healthy furniture across numerous spaces for relaxation, studying, informal gathering, programs and events.

The building's 10th floor was completely reorganized to provide a flexible suite of formal and informal gathering areas that openly engage Sert's building with the campus, the Charles River and the city beyond.

NEW MATERIALS

The new materials for the Campus Center are distinct from but complementary to the existing building fabric. A new architecture of steel, glass, timber, and stone sits alongside the in situ Brutalist concrete and traditional iron spot brick-paved sidewalks of Cambridge. The detailing and connection of the new structures and materials were designed to express and celebrate their construction, as well as to show a clear differentiation between old and new. Materials were also chosen to reflect the nature and use of the spaces within. The first-floor public areas are more robustly detailed with the upper levels softened by more natural materials, carpets and furnishings.

The introduction of the new landscaped vitrine in the center of the building brings light and greenery into the heart of the new common spaces. It is a key architectural feature within them, operating as a natural point of gathering and focus, as well as a permeable screen between the activities in the arcade and the Commons. Along with the arcade's green walls, these landscaped spaces and features allow occupants to experience and enjoy greenery and landscape year-round. The quality of the light filtered through the trees and plants creates places of repose, calm and pause throughout the structure.

Originally, Sert had playfully used color throughout the building as part of its architectural language but this was entirely lost over time. Taking inspiration from his palette of primary and complementary neutral tones, color was reintroduced to the Campus Center. On the interior, bold blocks of it enliven the space and create legibility and character; on the exterior, vibrancy and freshness has been restored to the façades as originally intended.

Sert's precast concrete fins and different window dimensions animated his façades with contrast between translucent panels and clear glass. Elevations broke with modernist practice by changing alignments that establish rhythms of figure and ground from floor-to-floor. Accumulated concrete fractures and glazing failures realized over five decades necessitated a meticulous renovation of all façades by our firm. Bruner/Cott Architects has a





FAST FACTS

OPENING DATE:

Sept. 20, 2018

CONSTRUCTION START:

Enabling works/façade restoration: March 2015 Main build/Campus Center restoration: April 2016

SIZE:

Entire build: 96,242 square feet

Holyoke Pavilion: 23,300 square feet

Moise Y. Safra Welcome Pavilion: 15,875 square feet

Dunster Street Pavilion: 5,800 square feet



1958: First Holyoke design proposal issued by Josep Lluis Sert, dean of Harvard Graduate School of Design since 1953

1966: Construction of the Holyoke Center completed

1970: Greenery in Forbes Plaza hardscaped

1984: Concrete fins on the façade replaced with aluminum

1986: Au Bon Pain "greenhouse" extension constructed

1989: 10th-floor terraces enclosed for office space

1992: Ground floor and arcade renovated

1999: Arcade given glass wall and north arcade doors

2013: Request for proposals issued for a new Campus Center as part of then Harvard University President Drew Gilpin Faust's "One Harvard" campaign

2013: Hopkins Architects selected as design architect and Bruner/Cott Architects as executive architect for the Campus Center

2015: Designs completed, project tendered and Consigli appointed as main contractor

2016: Works commence onsite

2018: Campus Center officially opened in the presence of Lawrence S. Bacow, Harvard University president; President Emerita Drew Gilpin Faust; Richard A. Smith, Harvard College '64, donor; and Chella Safra, widow of Moise Safra and donor of Moise Y. Safra Welcome Pavilion

Understanding Sert's original intentions for the building and how they had been compromised over the years was crucial to the plan.

MATERIALS

EXTERIOR CLADDING //

ACM PANELS: Alcoa Architectural Products, now Arconic, www.arconic.com

INSULATED METAL PANELS: Dimension Series and Metal Wrap from CENTRIA, www. centria.com

STEEL CURTAINWALL: Roschmann Group, roschmann.group

EXTERIOR LOUVERS: PL-5700 from Construction Specialties Group, www.c-sgroup.com

EXTERIOR DECK TILES: Thermal Ash by Thermory USA, www.thermoryusa.com

ROOFING //

MEMBRANE ROOFING: Sika Sarnafil, usa.sarnafil.sika.com

GREEN ROOF ASSEMBLY: American Hydrotech, www.hydrotechusa.com

GLAZING //

GLASS FLOOR SYSTEM: Greenlite Glass Systems, greenliteglass.com

INSULATED GLASS UNITS: Saint-Gobain, www.saint-gobain.com

INTERIOR GLASS: Cristacurva, www.cristacurva.com/en, and Oldcastle BuildingEnvelope, obe.com

DOORS //

ENTRANCES: C.R. Laurence Co. Inc.,

METAL DOORS: Apex Industries, www.apexindustries.com

SLIDING DOORS: Keller Minimal Windows, www.minimal-windows.com

HARDWARE //

LOCKSETS: Schlage, www.schlage.com

CLOSERS: LCN, us.allegion.com

EXIT DEVICES: Von Duprin, us.allegion.com, and Blumcraft from C.R. Laurence Inc., www.crlaurence.com

PULLS: Ives, us.allegion.com

CONVEYANCE //

ELEVATORS: Otis, www.otis.com CUSTOM VERTICAL PLATFORM LIFT: Garaventa Lift, www.garaventalift.com, with Handi-Lift Inc., www.handi-lift.com

INTERIOR FINISHES //

ACOUSTICALLY TRANSPARENT PANELS: Claro from Decoustics, decoustics.com/ products/claro

CEILING CLOUD PANELS: Island from Rockfon, www.rockfon.com

ACOUSTICAL PLASTER: StarSilent from Pyrok, www.pyrok.com

SUSPENSION GRID: Armstrong Ceiling & Wall Solutions, www.armstrongceilings.com

PAINTS AND STAINS: Sherwin-Williams, www.sherwin-williams.com, and Tnemec Inc., www.tnemec.com

LINEAR WOOD CEILING PANELS: Cross Piece Grille from 9Wood, www.9wood.com

PLASTIC LAMINATE: Wilsonart, www.wilsonart.com

SOLID SURFACING: DuPont Corian, www.corian.com

STONE: Crème Ole Marble and Alcove Bluestone

TILE: Custom color from Daltile, www.daltile.com

RUBBER SHEET FLOORING: Noraplan Sentica from Nora, www.nora.com

BROADLOOM AND TILE CARPET: New Stratford (fly ash removed) from Bentley, www.bentleymills.com

RAISED FLOORING: Tate Access Floors, www.kingspan.com/us/en-us/aboutkingspan/tate

VERTICAL GARDENS (Green Walls):
Plant Wall Design and Vertical Gardens
Technology and Installation by
Brightview, www.brightview.com

MODULAR BRICK PAVERS: Endicott, endicott.com

SPECIALTIES //

EXPANSION JOINTS: MM Systems, www.mmsystemscorp.com

CEMENTITIOUS FIREPROOFING: Grace Construction Products, gcpat.com

INTUMESCENT FIREPROOFING: Cafco from Isolatek International, isolatek.com

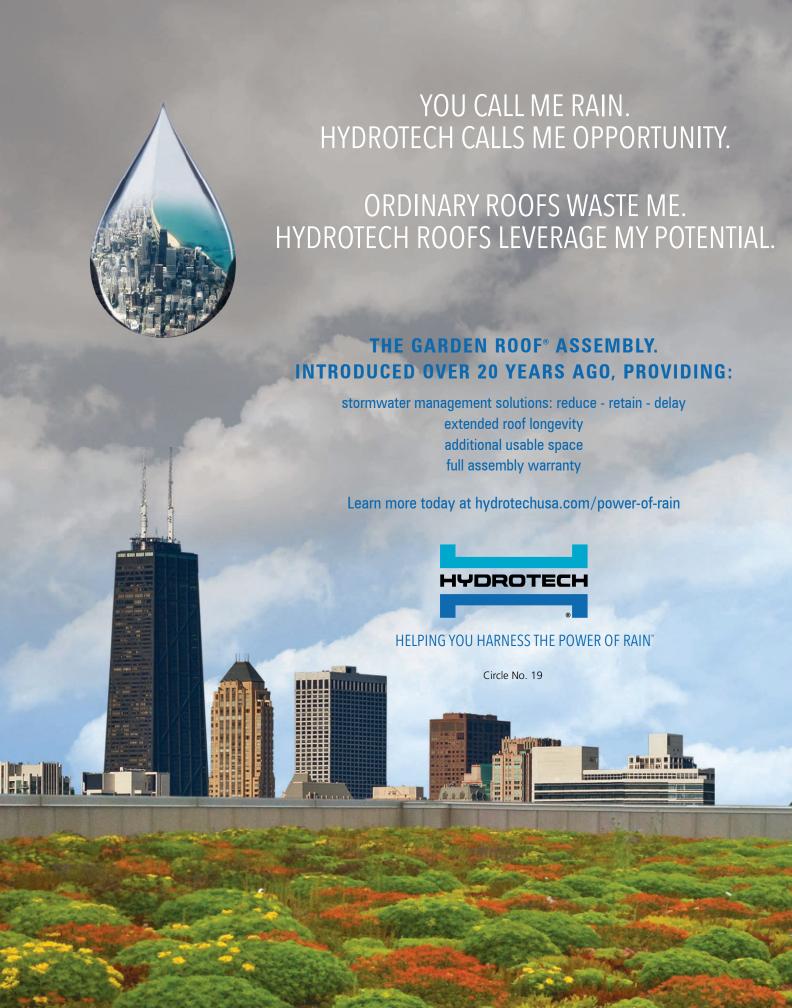
CHESS TABLES: Landscape Forms, www.landscapeforms.com

venerable history in the restoration and renovation of mid-century buildings and had recently renewed Sert's Boston University School of Law Tower—a concrete structure contemporary with Holyoke Center—the learnings from which were applied to the Campus Center.

Simpson, Gumpertz + Heger conducted a study to predict the extent of necessary repairs and concrete replacement on the façades. Hopkins Architects' design team then designated which portions should remain, which should be removed and how the newly designed sections should relate to the original architecture. We initiated extensive testing to determine best processes for the façades' renewal. First, the building was cleaned, and the right mixes of cement, lime and aggregate were determined to match the existing concrete of its architectural surfaces. Physical repair of spalling, fractures and concrete cracks ensued, followed by the application of solar/safety films to the building's windows. Following restoration, the application of Sert's colors on the vision panels across the windows brought the façades back to life. They now serve as backdrops for newly designed outdoor spaces with ample accessible café-style seating, chess tables, new lighting and many new trees.

STAKEHOLDER ENGAGEMENT

Stakeholder outreach throughout the entire process ensured the Smith Campus Center project aligned with the needs and hopes of the entire Harvard community. The close relationship between client and architects, as well as project consultants, ensured this outreach had a meaningful effect on the design and related initiatives, evidenced by the building's immediate success upon opening. This formative project provided an opportunity to create a new place for the university and its surrounding community to come together, responding to Sert's architecture in a manner that is transformative and dynamic but which, with each intervention, is grounded in and sympathetic to the history and design of the building.



TOPEKA CENTER FOR ADVANCED LEARNING & CAREERS Topeka, Kan.



>> RETROFIT TEAM

ARCHITECT OF RECORD, DESIGN, CONSTRUCTION DOCUMENTS, CONSTRUCTION ADMINISTRATION: Architect One, Topeka, www.ao.design VISIONING, PROGRAMMING, DESIGN: DLR Group, Overland Park, Kan., www.dlrgroup.com GENERAL CONTRACTOR: KBS Constructors Inc., Topeka, kbsci.com

METAL PANEL INSTALLER: Meridian Roofing Solutions, Topeka, meridianroof.com

MECHANICAL: Central Mechanical, Topeka,

www.centralmechanical.com CEILING INSTALLER: Drywall Aesthetics Inc.,

Topeka, (785) 224-9625

FLOORING: Commercial Floorworks, Overland Park, (913) 402-4788

MATERIALS

The scope of work encompassed improvements to approximately 71,200 square feet of space, including facility master planning, interior demolition, construction, new finishes, and new furnishings and fixtures throughout.

The following materials were used in the renovation:

EXTERIOR CLADDING: Alcoa Architectural Products, now Arconic, www.arconic.com, and Berridge, www.berridge.com WINDOWS: Oldcastle BuildingEnvelope, obe.com

PAINT: Sherwin-Williams. www.sherwin-williams.com

LIGHTING: H.E. Williams Inc., www.hew. com; Mule Lighting, www.mulelighting.com; McGraw Edison.

www.cooperindustries.com; and ConTech Lighting, www.con-techlighting.com TERRAZZO FLOORING: Tectura Designs, www.tecturadesigns.com

CEILINGS: Arktura, arktura.com, and USG, www.usg.com

ACOUSTICS: Tectum, www.tectum.com CARPET: J+J, www.jjflooringgroup.com, and Tarkett, www.tarkett.com

ROOFING: GAF, www.gaf.com EXTERIOR SUN CONTROL: Construction Specialties Group, www.c-sgroup.com HVAC: Daikin, www.daikin.com; Krueger, www.krueger-hvac.com; and Bell & Gossett,

bellgossett.com









>> THE RETROFIT

To support an innovative program in professionbased learning, Topeka Public Schools repurposed the former Capital City High School into the Topeka Center for Advanced Learning & Careers (TCALC). DLR Group's design for the renovations and additions focused on transforming the existing facility's image into a professional work and learning environment with highly interactive, creative and technology-laden spaces. The renovated building provides new classroom, lab, research and collaboration venues that reflect those found in high-end workplaces.

The existing facility was originally part of the Kansas State Hospital system built in the early 1960s. Designed to serve as a clinical and research center for mental sciences, the existing building was underwhelming in character. The

nature of the operations prohibited the use of windows. In 1981, the facility was converted to an education and activity center for the Topeka School District with a major addition, providing additional classrooms, a gymnasium and library. The addition incorporated one narrow window per classroom with masonry walls that provided minimal thermal comfort.

Design goals for the new TCALC facility included providing additional daylight to all spaces and allowing light to penetrate deep into the building, maximizing the use of the existing larger volumes to support the programmatic elements and transforming the building image to reinforce the mission of a professional learning environment.

Strategic additions along the south side of the building that feature larger volumes created opportunities to improve the building scale and image along with the ability to reflect daylight deep into the space with the use of an aluminumfinned shade structure. The existing gymnasium was transformed into the social commons that incorporates a learning stair and introduces daylight through new clerestories while the library was converted to a large-format presentation space.

TCALC's program relies on strong partnerships with business, industry and post-secondary institutions. Students engage in real project work for real businesses while receiving high school and college credit. Areas of study include engineering/advanced manufacturing, energy/ environment, bioscience/biomedical, business, health/human services, teaching and design thinking/innovation.









CARLYLE COURT, NEW YORK UNIVERSITY | New York

>> RETROFIT TEAM

ARCHITECT: Superstructures Engineers +
Architects, New York, www.superstructures.com
RESTORATION FIRM: Skyline Restoration, Long
Island City, New York, skylinerestoration.com

MATERIALS

Skyline Restoration and Superstructures
Engineers + Architects worked with the university
to update perimeter conditions for the 15-story
building, which was built in 1987 and houses
approximately 740 students. Its roof and terraces
needed to be brought up to code and waterproofed for leaks because of issues with door
thresholds and parapets. The project required a
turnaround time of between six and 10 days.

Between 1,500 and 1,800 square feet of Kingspan's Optim-R vacuum insulation panels were used in the retrofit project. Optim-R is

a next-generation insulation comprising rigid vacuum insulation panels with a microporous core, which is evacuated, encased and sealed in a thin, gastight envelope to provide R-values and an ultra-thin insulation solution.

"The existing roofing system's insulation thickness was minimal and the doors and through-wall air-conditioning units were very low," says Michael Stripunsky, senior associate, Superstructures Engineers + Architects. "The distance from the top of the existing concrete deck to the bottom of the air-conditioning unit wall penetration was less than 8 inches. If traditional insulation had been used, the top of the new roofing system would have been just at the level of the wall opening."

Optim-R's level of thermal efficiency—up to R-28 on 1 inch and R-57 on 2 inch using calculated edge thermal resistance properties—

combined with minimal thickness, provides a suitable solution for applications like that of the student housing building, where a lack of construction space or depth is an issue.

"In a case like this, using Optim-R was a cost-effective and efficient solution. We saved the client money and time and allowed for normal building operation," Stripunsky adds. "Using Optim-R also allowed us to avoid costly modifications to the existing perimeter conditions."

INSULATION MANUFACTURER: Kingspan, www.kingspaninsulation.us

>> THE RETROFIT

NYU is one of New York's largest and most prestigious universities. It sits on roughly 230 acres, spans more than 100 buildings and is home to approximately 28,000 undergraduate students that are housed in more than 20 residence halls.

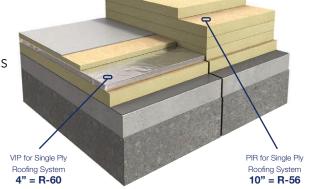




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Low Energy – Low Carbon Buildings

ATHENS HIGH SCHOOL | Athens, Texas











>> RETROFIT TEAM

ARCHITECT: Claycomb Associates Architects, Dallas, www.claycomb.net WALL PANEL INSTALLER: Heritage One Roofing, Dallas, www.heritageoneroofing.com

MATERIALS

The existing high school was split between two buildings that were separated by distance and elevation, explains George DeJohn, project architect/manager, Claycomb Associates Architects. "As part of the additions we bridged this gap between buildings so students could walk indoors continuously between spaces. We also had an opportunity to create a new main entrance that was clearly visible and give the entire school a new modern façade."

To create the modern design, metal was chosen. Metal also provided a medium on which to prominently feature the school's custom maroon color on the building's new main entrance. "The main entrance was highlighted with a large protruding wall clad with maroon metal composite panels," DeJohn says. "The wall serves as a waypoint for visitors to find the front door and also emphasizes the district brand with the school color. The white and silver metal panels near the entrance and throughout the rest of the exterior serve as a backdrop that help makes the maroon panels stand out."

Installed on the school were 10,800 square feet of 24-gauge 12-inch PAC-CLAD Flush Panels in White and Silver finish; 17,500 square feet of 24-gauge 12-inch Flush Soffit panels in White finish; and 5,500 square feet of PAC-3000CS Composite Panel finished in custom maroon color on the school sign and big red wall.

Although cost of the metal panels was questioned, the investment was made for the metal's ability to create a different look and to signify something special. "Metal was chosen for soffits and walls to break up the school's facade with something other than brick and for its durability," DeJohn notes.

PAC-3000CS is a metal composite material, also known as aluminum composite material (ACM). The square shapes created by the reveal joints in the ACM panels, not the metal itself, create a modern look for the school, DeJohn explains.

In addition, PAC-CLAD Flush Panels were specified to be installed vertically at different locations around the building, which helped create an oversized fascia around the perimeter. The most prominent usage was around all sides of the upper levels of the gymnasium.

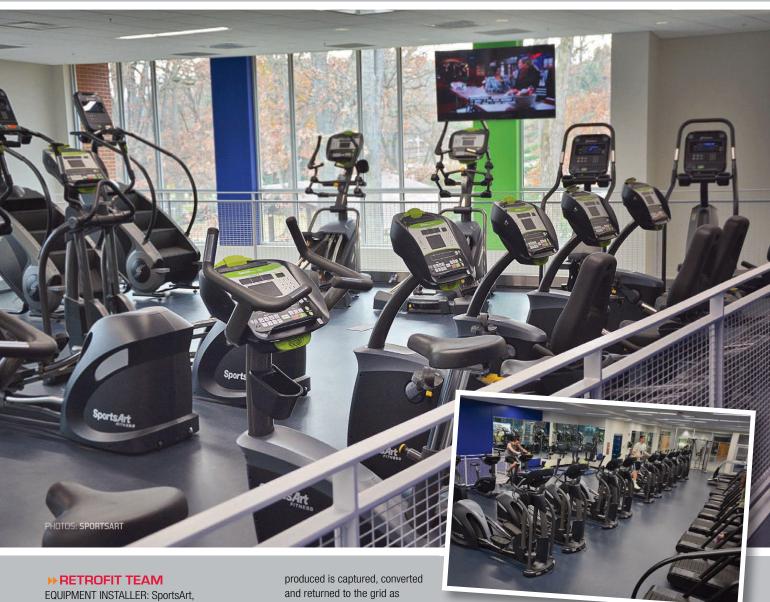
The school's main entrance and the sign in front of the building are curved, which presented challenges for the Heritage One Roofing team, which installed the panels. "The ACM panels went up, over and down the back side of the sign so the top panel had to be tapered because the sign is wider in the back. It worked out well because the panel fabrication was spot on," explains Dwayne Maynard, superintendent, project manager and estimator for Heritage One Roofing. "On the walls surrounding the main entrance, the length of the trim pieces had to be adjusted to accommodate the building's curve but that worked out fine, too."

Soffits around the main entrance also were curved, which meant Maynard's team had to pie-piece the panels together. "We calculated where to put the joints and lined them up with lighting fixtures. We worked with the owner a lot on this, who had the last say on design aspects, colors and joints. The architect was involved, too, and ultimately the plan was approved," Maynard recalls.

METAL PANEL MANUFACTURER: Petersen, pac-clad.com

STEVEN A. ADLER ATHLETIC COMPLEX |

Penn State Altoona



www.gosportsart.com

MATERIALS

Penn State Altoona, a commonwealth campus of Pennsylvania State University, has installed SportsArt's ECO-POWR line of equipment, which pumps up to 250 watts (energy) per hour of electricity back into a facility's electrical grid. The 10 ellipticals, four recumbent cycles and two upright cycles use built-in micro inverters to harness the human energy being created while the equipment is in use. This process helps to offset the recreational facility's and user's carbon footprint. Up to 74 percent of the energy being

utility-grade energy, which also helps save money spent on electricity.

All of the equipment in the facility uses SportsArt's SA Well+ System, a homescreen that provides real-time data on energy generated by the gym user. The facility also includes two pinnacle cross trainers and one bilateral upper-body ergometer from SportsArt's standard, self-powered line of cardio equipment.

"One of the primary goals of Penn State Altoona is to integrate sustainability and environmental stewardship in our operations as an institution of higher education," says Brent Baird, director of Athletics. "By partnering with

SportsArt, we are demonstrating our commitment to this goal and setting an example for our students of how to make sustainability a part of their everyday lives. We are also enhancing the students' recreational experience by providing such high-quality equipment."

EQUIPMENT MANUFACTURER: SportsArt, www.gosportsart.com



Watch students and staff use the equipment and generate energy for the grid.

STUDENT LEARNING COMMONS, SPRINGFIELD TECHNICAL COMMUNITY COLLEGE | Springfield, Mass.









>> RETROFIT TEAM

ARCHITECT: Ann Beha Architects, Boston, annbeha.com GENERAL CONTRACTOR: Consigli Construction, Boston, www.consigli.com WINDOW INSTALLER: A & A Window Products Inc., Malden, Mass., aawindowproducts.com

MATERIALS

Building 19 is part of the Springfield Armory National Historic Site and is one of 13 buildings on campus that is nationally registered. It housed gunstocks from 1846 until it was closed and given to the college in 1968. However, because of the old infrastructure and the many considerations that go into renovating and remodeling historic sites, it sat largely unused for nearly 50 years.

One of the largest challenges in updating Building 19 into a student learning commons was its windows. Because the building was never fully enclosed, major updates would be required to make it an accessible, usable space. The building is large—767-feet long and 3-stories high. The fenestration would make up nearly 50 percent of the building's façade (552 windows). In addition, because of the historic construction, no two windows are alike with openings ranging from 10 by 7 feet to 10 by 13 feet.

The architect turned to St. Cloud Window and the SCW3000 series to update the windows while maintaining the historical look and feel of the building. St. Cloud Window worked with the National Park Service and the Massachusetts Historical Commission to develop the fenestration, fully enclosing the building while maintaining natural light. In addition, historical louvers originally designed for ventilation were retooled as exterior sun shades to manage heat.

WINDOW MANUFACTURER:

St. Cloud Window, www.stcloudwindow.com

>> THE RETROFIT

Today, Building 19 is an accessible, sustainable and vibrant part of campus life, housing administrative offices, a student commons, student services, a health center, café, study spaces, a library and campus bookstore. The building recently won a Robert H. Kuehn Award from Preservation Massachusetts.



AUSTIN HALL, SAM HOUSTON UNIVERSITY | Hunstville, Texas

>> RETROFIT TEAM

ROOFING CONTRACTOR: Empire Roofing, Austin, Texas, www.empireroofing.com BUILDING ENVELOPE CONSULTANT: Armko Industries Inc., Austin, www.armko.com

MATERIALS

Armko Industries was contracted to determine the best plan of action for resolving issues with and restoring the Austin Hall roof, internal gutters and cupola to a watertight condition. Empire Roofing and Armko Industries put together a plan that required the removal of the stainless-steel flat-seamed panels and the internal gutter liner. The Texas Historical Commission was involved in the renovation to ensure the new roof would be as historically accurate as possible. Armko Industries specified removal of the existing stainless steel (installed in 2009-10) and reroofing with McElroy Metal's 20-ounce copper 238T standing-seam roofing system on all roof sections, as well as adding interior gutters and related sheet-metal components.

Specifications called for siding to be removed at the cupola walls and a new liquid-applied waterproofing membrane applied over the new sheathing with new siding installed to match the original siding. At the base of the cupola, the specifications and details called for the installation of through-wall flashing, using 20-ounce copper. Titanium PSU-30 high-temp selfadhering underlayment covered the roofing substrate and was used as a lining in the internal gutters, under the 20-ounce copper.

"We set up scaffolding and worked on the octagonal cupola first," explains Aaron Todd, who leads Empire Roofing's metal roofing and sheet metal division. "The design incorporates a convex curvature with all roof sections meeting at the apex. We measured everything we needed for the cupola roof and gave the cut list to our shop fabricators, who produced the panels and trim for the cupola roofing, the design of which was proposed by Empire and approved by the Texas Historical Commission and Armko. We also had a 10-foot mechanical brake onsite to fabricate and

modify any panels as needed during the installation process."

Todd says standing seams were incorporated at each hip of the cupola to avoid the need to solder vertical joints. At the apex of the cupola, standing seams were folded down and lapped under the finial skirt. The crew sealed/riveted/soldered the finial base to the copper panels to create a watertight and wind-resistant detail at this very exposed and relatively flat area.

Symmetrical standing-seam systems do not have male and female legs but are comprised of panels with matching left and right legs. The panels are joined with a mechanically seamed cap. The panels are non-directional. The seam design on a symmetrical panel is more watertight than a double lock because there is no interruption of sealant in the seam at the clip locations. A symmetrical panel can be replaced if there is ever damage or a reason to pull a panel out of the roof at a later date.

To ensure the internal gutters didn't cause problems, the Empire Roofing crew used sandpaper to etch the flat 20-ounce copper before it was fabricated into gutters. Once fabricated and roof-loaded, the gutter pieces were joined in 40- to 50-foot sections in the interior gutter, then lifted out and placed on sawhorses. All joints and seams were fully soldered on the sawhorses and then placed in their respective areas inside the internal gutter troughs where the few remaining seams were joined and soldered. The gutters then were coated with Kemper 2K PUR, a solvent-free, fleece-reinforced and liquid-applied waterproofing system based in polyurethane resin. The roofing project was completed in February 2019.

COPPER PANEL SUPPLIER: McElroy Metal, www.mcelroymetal.com **GUTTER WATERPROOFING** MANUFACTURER: Kemper System, www.kemper-system.com UNDERLAYMENT MANUFACTURER: InterWrap, www.interwrap.com

THE RETROFIT

Historic Austin Hall is the oldest building west of the Mississippi River to have been used continuously by an educational institution. It was first occupied in October 1851 and completed the following year.











>> RETROFIT TEAM

ARCHITECT: Gensler, Austin, www.gensler.com ELECTRICAL ENGINEER: Glumac, Austin, www.glumac.com ELECTRICAL REPRESENTATIVE: Bell & McCoy Cos.,

Austin, www.bellandmccoy.com

MATERIALS

Every aspect of the 2017 locker room renovation was designed to make UT facilities reflect the university's commitment to continued excellence throughout the football program. Lighting in the updated facility had to easily accommodate everything from players hanging out between practices to academic study sessions, team meetings, and the supercharged minutes right before players take the field. The lighting controls had to quickly and easily transform the environment, especially on game day, so the Quantum Integrated Lighting Control System was chosen.

Lighting plays a major role throughout the space. In a design unique to the Longhorn program, each locker glows orange. Cove lighting throughout the space is fully adjustable and a lighted corridor along the main entryway creates a must-stop photo-op for virtually everyone who visits the space, including other UT athletes, visiting teams, the media, and the families of players and recruits.

Beyond the lighting scenes themselves, lights can be adjusted in every area, including the showers, to ensure players can tune the lights to their preferences. Engraved keypads take the guesswork

out of selecting the right scene: Daily,

Recruiting or Game Day. Matt Smidebush, assistant director, Football Operations, explains, "When Coach presses that Game Day button, he wants lights, music and energy to reach epic levels immediately."

College athletes are limited to a defined number of practice hours, but football is family to these players and in many ways this space is an on-campus home. The facility includes study tables; comfortable couches; gaming systems to encourage socializing with peers; and a quiet place to meet, study film or just relax. The integrated lighting control system ensures the atmosphere reflects the players' mood and

LIGHTING CONTROLS MANUFACTURER: Lutron Electronics, www.lutron.com

▶ THE RETROFIT

The Longhorn locker room already is making its mark on the UT football players and recruits. Every aspect of the lockers, every design element, every piece of furniture and every lighting sequence was carefully chosen to set a new standard of excellence. For many players, this place exceeds their wildest expectations, giving them a genuine home-away-from-home.



>> RETROFIT TEAM

ARCHITECT: Page, Washington, D.C., pagethink.com DESIGN: University of Delaware College of Electrical and Computer Engineering, Newark, www.ece.udel.edu GENERAL CONTRACTOR: Bancroft Construction Co., Wilmington, Del., www.bancroftconstruction.com

MATERIALS

The former metal foundry turned iSuite includes a cyber range, collaborative hub and a makerspace. Working with the college directly, the facility was designed using Page's 3D printers and a student-created virtual-reality model, developing a half-scale mockup to demonstrate that inverting metal fabric for the space would in fact be successful.

"We've seen metal fabric draped as a catenary before, but this is the first time someone has used Fabricoil in the 'wrong direction,'" says Lou Krupnick, AIA, associate principal at Page. "We reversed the fabric and used its tensile properties to produce a curve that way."

The space features 750 square feet of 5/16-inch, 15-gauge aluminum Fabricoil with a powder-coated satin copper finish. The resulting ceiling treatment produces "true curves," with the coiled wire fabric wall constructed in a similar fashion.

Hovering over the collaborative hub, the coiled wire fabric weaves through room-wide lights providing a well-lit atmosphere and effective light diffusion throughout the space. In addition, the coiled wire fabric walls add dimension to the space without obstructing views for students

and faculty. "Coiled wire fabric really fit into the electrical genre of the collaborative space," Krupnick adds.

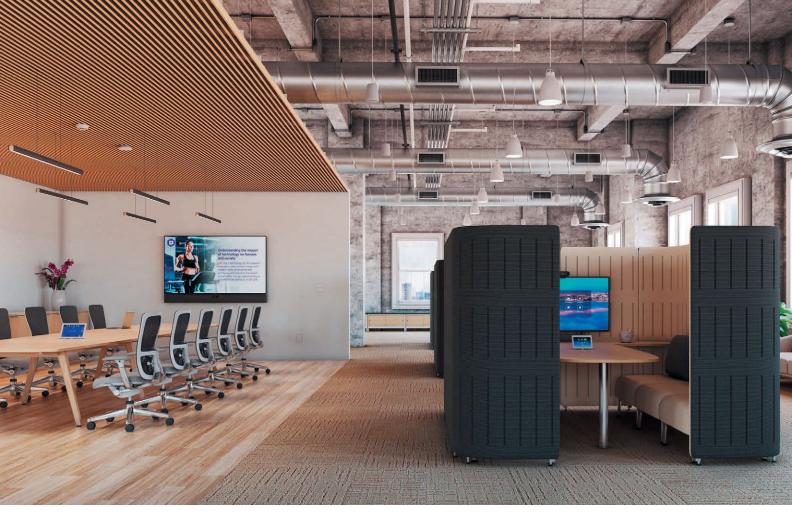
Fabricoil products carry Declare labels from the International Living Future Institute, Seattle.

METAL FABRIC MANUFACTURER: Cascade Architectural, www.cascade-architectural.com

>> THE RETROFIT

University officials credit the innovative space with an "immediate and noticeable increase in enrollments," helping the school project a particular image that truly speaks to the students.

The facility, which was completed in 2017, was recognized with a Construction Excellence Award by the Delaware Contractors Association, Newark, for being the most technologically innovative project of 2017.



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>> RETROFIT TEAM

RECORDING STUDIO DESIGN: Notes for Notes, Nashville, Tenn., notesfornotes.org

MATERIALS

Tarkett provided key donations to support the development of the All-Star Digital Arts Suite at Boys & Girls Clubs of Cleveland's East Tech Teen Center. Tarkett donated 3,025 square feet of iD Inspiration LVT; 1,125 linear feet of wall base; and 300 square feet of Color Essence VET (vinyl enhanced tile).

The studio provides students with the opportunity to learn about musical performance, music production and the music industry, opening the door to career opportunities for young people in the city of Cleveland. The goal is to prepare kids for what's next-whether that's college, a career or being job-ready when they graduate from high school.

This project fully renovated the digital arts suite at the high school, installing a sound recording studio with new equipment, a collaborative workspace stocked with Mac desktop computers and a vibrant lounge area. The site, which will be utilized by students at East Technical High School and members of local Boys & Girls Clubs, will be instrumental in helping retention rates at the high school and Boys & Girls Clubs.

FLOORING MANUFACTURER: Tarkett, www.tarkettna.com

>> THE RETROFIT

Boys & Girls Clubs of Cleveland provides safe, fun places for kids after school at 13 locations, including the East Tech Teen Center. Each day, nearly 1,000 kids come to a club, where they find academic help; caring adult mentors; and opportunities in athletics, art, music and career readiness.

The All-Star Legacy initiative was launched by Major League Baseball and the Cleveland Indians with a \$5 million donation and includes several community enrichment projects that will impact thousands of people throughout greater Cleveland. The All-Star Digital Arts Suite is one of five projects the initiative is supporting.





>> RETROFIT TEAM

ARCHITECT: Perkins + Will, Toronto, perkinswill.com GREEN INFRASTRUCTURE SPECIALIST: Ginkgo Sustainability, Toronto, www.ginkgosustainability.com

MATERIALS

Constructed in 1967, Bata Library was designed to house the stacks for displaying half a million books and publications, provide ample space for extensive card catalogs and offer quiet areas for solitary studying. "The university endeavored to re-imagine the library for how students access information and how they work today," says Shelley Strain, LEED AP, GRP, sustainability coordinator, Trent University Facilities Management. "It needed a redesign that would support digital access to information and create inviting spaces where students can gather and work together."

A 278-square-foot living wall, installed in the library's atrium with the LiveWall Indoor Living Wall System, is an essential design element in the Perkins + Will plan. Completed in October 2018, the green wall is almost 7-feet high and was constructed in two side-by-side sections each 20 feet in length. Totaling 278 square feet, the living wall connects two adjacent seating areas to create an inviting open space, softens the center of the library's interior and complements the tone of the cedar ceilings.

The LiveWall Indoor Living Wall System is a modular system that establishes a "vertical garden" mounted onto walls. In the typical indoor installation, its vertical furring tracks are attached onto the surface of a wall protected by a waterproof membrane. Horizontal aluminum rails, which include conduits to bring water to the system's integrated irrigation components, are bolted to the tracks. LiveWall modular planter boxes, which are high-impact, UV-resistant, architectural-quality moldings, slide into the rails. Finally, separate liner inserts, which are removable and reusable plant containers that hold the growing medium and pre-grown nursery plants, are dropped into the planter boxes.

The Bata Library living wall includes 150 LiveWall modular planters manufactured in a bluestone color. The irrigation system uses drip stake assemblies, which inject water and fertilizer into the growing medium. The light fixtures are equipped with LiveWall Norb (Nutri-Orb) bulbs, a specialized white-light LED grow bulb that provides the light spectrum and light nutrition plants need for healthy growth while giving off a pleasant white light similar to regular indoor lighting.

The installation required plants not easily light-stressed by near constant lighting. Species that can tolerate slightly dry conditions also were chosen for the atrium. "The plant palette features seven tropical species with similar light and water requirements," explains Sasha Liston, sales manager and research and development lead, Ginkgo Sustainability. "The organic design mixes 380 plants, including upright and billowing species that have a variety of leaf shapes, variegation and textures."

Following LiveWall maintenance guidelines, Ginkgo Sustainability services the Bata Library green wall every two weeks. After each visit, Ginkgo Sustainability sends a maintenance report to Trent University Facilities Management. According to Strain, it is important to notify students about scheduled maintenance visits so they have the opportunity to observe; ask questions; and

learn about the features, functions and benefits of the green wall.

LIVING WALL MANUFACTURER: LiveWall LLC, livewall.com



>> THE RETROFIT

Bata Library is a prominent landmark on the Trent University campus, which was designed by Ronald Thom (1923-86), an influential Canadian architect. His work reflected the harmony with nature characteristic of Frank Lloyd Wright's Prairie style while incorporating the modern sensibility and simplicity of the Bauhaus movement.

"Thom strove for excellent design that harmonizes with natural settings and natural beauty," says Dr. Leo Groarke, Ph.D., president and vice-chancellor, Trent University. "Featuring a living wall in the redesign of the Bata Library is a wonderful way to honor this legacy."

In addition, Trent University has a longstanding commitment to a green campus. However, many of the critical elements of sustainability, such as energy retrofits, are not visible to students. A green wall at the center of the library helps the community make a connection to the university's green initiatives.

KENNEDY SPACE CENTER |

Merritt Island, Fla.

→ RETROFIT TEAM

ARCHITECT OF RECORD: BRPH, Orlando, Fla., www.brph.com
STRUCTURAL ENGINEER: Construction
Engineering Group, Melbourne, Fla., cegengineering.com
RAILING INSTALLER: RDS Industrial, Cocoa, Fla., www.rdsindustrial.com

MATERIALS

Kennedy Space Center is one of the most popular U.S. tourist destinations, drawing more than 1.5 million visitors each year. A ramp near the entrance represents the journey through space and runs through the complex's historic Rocket Garden, which showcases the early years of the U.S. space program. The railings on the ramp feature 450 linear feet of Feeney CableRail infill.

Although the project team had planned from the start to use cable railing for the ramp area, team members originally had selected a cable railing product from another manufacturer. When they began running into performance issues with that product halfway through the project, they contacted Feeney.

The ramp creates a pathway through the Rocket Garden and is designed to resemble a slingshot orbit, which is commonly used to increase or decrease a spacecraft's speed or redirect its path. This unusual shape accounted for the most challenging part of the project: There were no "straight edges". This meant the project team had to design the railing with elliptical curves all the way around, which was no easy feat.

The project took six months to complete. The Feeney team got up to speed quickly and helped to ensure the project was completed on time and within budget. Today, the cable railing provides visitors with an unimpeded view of the Rocket Garden and surrounding area, giving them a sense of "space".

CABLE RAILING MANUFACTURER: Feeney, www.feeneyinc.com







PHOTOS: FEENEY



>> RETROFIT TEAM

ARCHITECT: Cope Architecture, Knoxville, www.cope-associates.com GENERAL CONTRACTOR: Johnson & Galyon Construction, Knoxville, johnsongalyon.com

MATERIALS

A former marble processing plant built in 1908 was transformed into a series of warehouses and workshops, as well as a computer training lab,

employee break area, offices and conference rooms. Kalwall translucent sandwich panels were fitted into the original clerestory encircling the central hall and flooding the open-concept work space in natural diffuse daylight.

The 91,000-square-foot project, which cost \$18.7 million, was built to LEED Silver criteria.

TRANSLUCENT SANDWICH PANEL MANUFACTURER: Kalwall, www.kalwall.com

>> THE RETROFIT

The project was named a Collegiate Citation winner for Historic Preservation in American School & University's annual Educational Interiors Showcase. The jury praised the design for its "fabulous reuse and conservation of available space. The open, collaborative environment will support the mission of the university."





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>> RETROFIT TEAM

MECHANICAL CONTRACTOR: Estock Piping Co. LLC, Chesterfield, N.J., (609) 291-1989

MANUFACTURERS' REPRESENTATIVE: Wallace Eannace Associates Inc., Plainview, N.Y., wallaceeannace.com

PRODUCT SPECIALIST: Ferguson, www.ferguson.com

MATERIALS

The college required replacement of condenser water piping between chillers and cooling towers. The existing piping was black steel that was severely corroded and scaled. In fact, chunks were falling off the corroded black steel pipe and clogging the strainers, potentially damaging the pumps and chillers. The college had a four-month window in the winter of 2017-18 to change the piping.

Joe Estock of Estock Piping says Aquatherm pipe cost more than black steel but the labor savings more than made up for it. However, after he won the job, he became worried: He had zero experience with Aquatherm pipe. He turned to Ferguson for help. Ferguson product specialists make sure installing contractors are comfortable with the product and have everything they need to do the job. Ferguson trained Estock and his pipefitters on how to use the tools, spending three to four days total onsite.

Estock's crew needed some scissor lifts and a couple forklifts to move the Aquatherm Blue Pipe around the jobsite, but it was light enough they could easily make fusion joints with the pipe in the air. Estock's crew did all the fabrication themselves for assemblies, such as manifolds, inside the college's large mechanical room. All told, the crew installed approximately 40 feet of 24-inch pipe, nearly 100 feet of 18-inch pipe, 20 feet of 16-inch pipe, 60 feet of 10-inch pipe and 157 feet of 12-inch pipe.

The main advantage of the Aquatherm Blue Pipe was the weight, Estock says. For example, the Aquatherm 18-inch Blue Pipe SDR 17.6 used on this job weighs 22.9 pounds per foot and comes in about 19-foot lengths. The second advantage was the speed of making heat-fused joints in PP-R pipe. "With the time constraints, God knows what would have happened if this were black pipe," the college's facility manager says. "We might still be welding down there."

PIPE MANUFACTURER: Aquatherm, www.aquatherm.com





GATEWAY SCHOOL DISTRICT | Monroeville, Pa.

>> RETROFIT TEAM

LIGHTING INSTALLER: Facilities team, Gateway School District, Monroeville, www.gatewayk12.org

MATERIALS

In late 2017, the Gateway School District completed an upgrade from fluorescent to LED lighting in five of its schools. The schools were originally equipped with standard electronic ballasts and T8 lamps. To overhaul these lighting sources, district representatives chose Universal Lighting Technologies Inc.'s Tube and Driver Kits, which included 2,100 two-tube; 1,620 three-tube; and 90 four-tube replacements. The replacement tubes and drivers were installed into the existing fixtures similar to a ballast retrofit, which made installation quick and easy. The LED drivers are dimmable to 1 percent, which increases their application flexibility for classrooms and conference rooms.

In schools, proper lighting can optimize learning. LED technology offers controllability, light uniformity and less maintenance, as well as reduces electrical demand and energy consumption compared to conventional lighting systems.

"We chose the Universal EVERLINE Tube and Driver solution because some of our buildings have asbestos in them, so we wanted to put the new tubes in existing fixtures," says Robert Brown, the district's director of facilities. "The installation was very easy. Plus, the LED products have made maintenance much easier. With the fluorescents, changing lamps was a daily occurrence. Now we almost never have to do it. My electricians are freed up to do more important work than changing ballasts."

Brown adds teachers were almost startled by the improvement in the quality of light. "They were used to living in a cave with yellow light," he says. "The LED light is so much better that many teachers are using the dual-switch system so they only use half the lights. They also take advantage of the dimming capabilities. It's made a world of difference."

Despite the upfront costs, Brown estimates the rebates for the LED upgrade totaled nearly \$30,000 and lighting bills have been reduced by 9 percent.

LED MANUFACTURER: Universal Lighting Technologies, www.unvlt.com

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LINK

WRITTEN BY | CHRISTOPHER NORRIS, LEED AP, P.ENG., P.E. Evaluate and Harden Your Building Enclosures against Hurricanes

n recent years, reports. of natural disasters seem to be ever more common. On Aug. 24, 2017, Hurricane Harvey made landfall at San Jose Island, Texas, breaking a record 4,323-day drought in major hurricanes making landfall in the U.S. Harvey rivaled Hurricane Katrina as one of the costliest storms with an estimated \$125 billion of damage. Harvey was followed by Hurricane Irma, which made landfall in the Florida Keys, and then hurricane Maria devastated Puerto Rico soon after.

In 2018, Hurricane Michael became the first Category 5 hurricane to make landfall in the continental U.S. since hurricane Andrew in 1992, all but destroying the town of Mexico Beach, Fla. Although hurricanes and major storms are not preventable, the related damage can be mitigated through improved design of new buildings and retrofitting of existing buildings.

Building enclosure integrity plays a key role in protecting a structure from hurricane damage. If a building enclosure is breached, internal building pressures are increased, which has an additive effect to external wind pressures and can lead to a complete structural failure. If you do business in hurricane-prone areas, now is the time to evaluate and harden your building enclosures to withstand these events.

Establish Performance Criteria

The first step in considering a hurricane hardening retrofit of an existing enclosure is to establish a desired outcome in terms of the design event, as well as acceptable post-event performance. What types of events is the enclosure to be designed to withstand? What level of post-event performance is acceptable? Design events will be dependent on the building location and occupancy type.

The required/desired post-event performance level is ascertained by the building function, as well as the budget and individual owner preferences. For example, the performance requirement for a postdisaster structure, such as a hospital, may be to sustain minimal damage and remain operational following a design event; whereas the requirements for a residential building may be that the structure remain intact and repairable following a design event. Some owners may elect to establish higher performance levels than others for individual reasons. The key is to establish an acceptable outcome for a given design event and evaluate the existing building based on acceptable outcome.

Typical categories for desired performance post-disaster are:

■ NO PERFORMANCE: Substantial damage to building; occupancy may pose life risks; may not accommodate disaster evacuation.

- LOW PERFORMANCE: Substantial damage to building; repairs are necessary; delays in re-occupancy; risk to occupants.
- MODERATE PERFORMANCE: Moderate and repairable damages; minimal impact to occupancy; low risk to occupants.
- HIGH PERFORMANCE: No substantial damage to building; fully operational through disaster.

Evaluate the Existing Building

The building enclosure is the first line of defense against harsh weather. Wind loads are carried by the enclosure back to the primary building structure. The building enclosure and primary structure must work together as an integrated system.

When considering a retrofit for high winds, first establish a design wind speed and calculate the associated wind pressures. Design wind speeds and pressures are established using wind-speed maps and equations from ASCE 7-10 "Minimum Design Loads for Buildings and Other Structures". Following ASCE 7-10 provides design wind pressures for the building structure and the exterior cladding elements.

Design wind pressures are used to evaluate the building structure. If the primary structure is not able to withstand the design pressures, the cost and feasibility to retrofit the structure is evaluated and a feasible level of primary structure retrofit established. This provides a performance level for the primary structure and deter-



If the enclosure fails, the structure is exposed to increased wind pressures and water infiltration, resulting in damage and possibly failure of the primary structure. Likewise, the ability of the building enclosure to carry wind loads is limited by the primary structure. The enclosure can never carry any more loading than the primary structure that supports the enclosure. In designing a retrofit, it is key to follow the load paths, identify the weakest link in the chain and initiate the retrofit design from this point.

mines the level of retrofit needed for the building enclosure.

As an example, ASCE 7-10 calculations may determine a design uplift pressure of 100 pound per square foot for the roof, but the existing roof may have a significantly lower structural capacity. Retrofit of the roof structure to 100 psf may not be feasible. In this case, replacement of the roofing system with a new system rated to 100 psf would be of no value because the roof structure itself would fail prior to the roofing system.

BUILDING ENCLOSURE INTEGRITY PLAYS A KEY ROLE IN PROTECTING A STRUCTURE FROM HURRICANE DAMAGE.

Enclosure Elements to Consider

The following building-enclosure elements should be reviewed and considered when retrofitting a building for high winds:

→ WINDOWS/OPENINGS: **IMPACT RESISTANCE**

Any unprotected openings should be designed to resist large and small missile impact below 30 feet in height and small missile impact above 30 feet in height. The specific large missile size and velocity are determined by building code, and windows are tested per test standards ASTM E1886 and ASTM E1996. In general, impact resistance requires laminated glass, which is structurally glazed to the frame, so the glass remains intact following an impact.

If windows are not impact-rated, replacement with impact-rated windows should be considered. If an impact-rated glass is used, the wind-pressure resistance of the glass, frame and attachments to the primary structure are then reviewed to confirm the window will carry structural loads back to the building structure. The water-penetration resistance of windows should also be considered beause they will be subject to heavy wind-driven rains during a design event.

Hurricane shutters also may be used to provide hurricane-impact protection. If hurricane shutters are used, the windows will be protected from the design wind pressures and from wind-driven rain, but the shutters and the attachment of the shutters must be reviewed for wind-pressure resistance.

For large glass openings, such as curtainwall and window wall, postinstalled lamination films and edge sealants may be considered as a retrofit option to provide impact resistance.

→ LOUVERS

Like windows, exterior louvers also are subject to large and small missile impact requirements. In addition, louvers often can be a source for water infiltration during hurricanes if not properly specified. Specialized louvers for highwind-velocity regions that are tested and rated in accordance with AMCA 550 "Test Method for High Velocity Wind

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P.O. Box 7038 • Akron, Ohio 44306 800-321-2381 • Fax 330-773-3254 info@mussonrubber.com • www.mussonrubber.com Driven Rain Resistant Louvers" should be used.

→ ROOF-EDGE CONDITIONS

Structural failures under high-wind events are often initiated by failures of roof-edge details. Roof-edge failures can lead to a progressive failure because wind is able to penetrate under the roof membrane and unzip the entire roof. Current building codes require roof-edge metal and coping to comply with the test methods of ANSI/SPRI ES-1 to prevent roof-edge failures. Roof-edge metal attachments should be reviewed in evaluating existing enclosures for retrofit.

→ EXTERIOR WALL ASSEMBLIES/ CLADDING ATTACHMENTS

During a hurricane event, exterior walls are subject to high positive and high negative wind pressures and may also see debris impact. The underlying wall structure should be evaluated to determine if a structural retrofit is necessary. Like roofing, the capacity of the base

wall structure determines the feasibility of retrofitting the exterior cladding and attachments. Wall cladding failures typically occur because of negative wind pressures (suction) and failures often occur at building corners where suction pressures are higher. During evaluation, attention should be focused on these regions. Often, the same cladding attachment methods are used for the field of walls as the corners, which can result in failures at the building corners where wind pressures are higher.

→ REVOLVING DOORS

Revolving doors are also a part of the evaluation process for hurricane resistance. Revolving doors are intentionally designed to fold flat and "pancake" under high pressures as a safety feature for building egress. This can result in the failure of revolving doors under high wind pressures. Revolving doors should be protected during high wind events or consider replacing them with vestibule features.

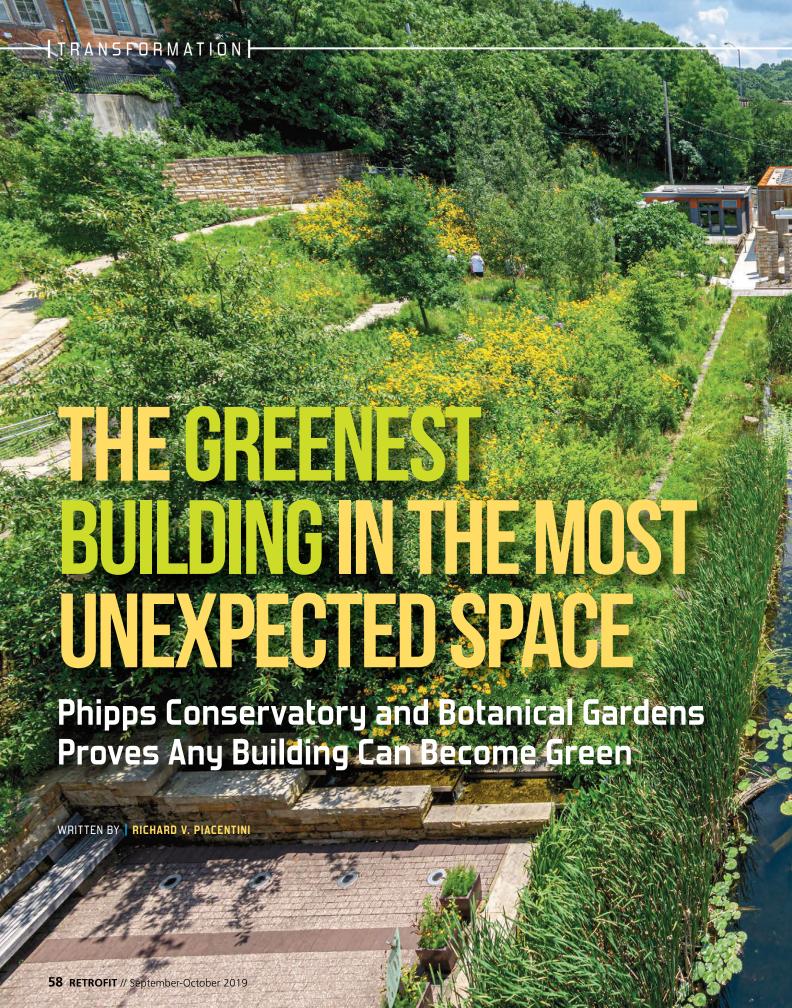
The Time Is Now

There are many factors to consider when evaluating existing building enclosures for a hurricane-hardening retrofit. The key steps to put in place during this review process are:

- Establish the desired post-event performance.
- Establish the design event criteria (wind speeds and wind pressures).
- Evaluate the existing building structure and feasibility of the structural retrofit if needed.
- Evaluate the existing building enclosure elements and retrofit up to the capacity of the underlying structure.

We all want to be prepared in the event of a hurricane. As the old saying goes "a chain is only as strong as its weakest link". Taking a holistic proactive approach in evaluating the primary structure in concert with the building enclosure is key to a successful retrofit. Hurricane season is upon us. Let's be ready!









► Retrofit Team

ARCHITECT // FortyEighty Architecture, Pittsburgh, www.fortyeighty.com

CIVIL/STRUCTURAL ENGINEER //

Common Ground, Gibsonia, Pa., discovercommonground.com

MEP ENGINEER // lams Consulting LLC, Pittsburgh, www.iamsconsulting.com

LANDSCAPE ARCHITECT //

Studio Phipps, Pittsburgh, bit.ly/30SL6Q0

GENERAL CONTRACTOR //

Massaro Corp., Pittsburgh, www.massarocorporation.com

BIOPHILIC CONSULTANT // Shepley Bulfinch, Phoenix, www.shepleybulfinch.com

YOGA COURT DESIGN //

Karl Steinmetz Designs, Pittsburgh, www.karlsteinmetzdesigns.com

BUILDING ENVELOPE COMMISSIONING //

Building Performance Architecture, Pittsburgh, buildperformarch.com

MECHANICAL EQUIPMENT COMMISSION-

ING // CJL Engineering, Johnstown, Pa., www.cjlengineering.com

DESIGN CHARRETTE FACILITATION //

7group, Sinking Spring, Pa., sevengroup.com

ROOFING CONTRACTOR // Strongland Roofing Systems, Vandergrift, Pa., www.stronglandroofing.com

buildings and understand that they can be beautiful and comfortable places to live, learn, work and play.

The CSL is a research and administration building and the first and only building to achieve Living Building Challenge, LEED Platinum, WELL Platinum and SITES Platinum certifications. It demonstrates how new-construction projects can use innovative off-the-shelf strategies to construct highly efficient buildings that are good for people and the planet. The Nature Lab at Phipps is one of the nation's first sustainable, modular classroom spaces. Completing these two projects and watching them operate successfully for several years, including generating all their own energy and capturing and treating all water onsite, gave Phipps' team the knowledge and resources to take on the transformation of the ESC with the goal of achieving three of the world's most rigorous building standards: Living Building Challenge, LEED Platinum and WELL Platinum. The buildings are evaluated after a one-year performance period and are certified if they meet all the requirements. The CSL was evaluated and was Living Building Challenge Certified in 2015. The Nature Lab finished the one-year performance period and is currently being evaluated. The ESC started the one-year performance period in April 2019.

Phipps' crew knew the ESC would

primarily be used as a maintenance facility. In many places, the health and wellbeing of maintenance staff are often overlooked and they are typically given some of the unhealthiest buildings in which to work. At Phipps, the health of all staff is a top priority. Designing to achieve the WELL Platinum building standard would ensure the rehabilitated space would be the healthiest possible environment for staff as they work on new exhibits for Phipps' seasonal flower shows. The building houses a workshop, finishing and welding rooms, storage rooms and office spaces for the crew, as well as a yoga studio, meditation room and fitness center for all Phipps staff to use.

Non-toxic Materials and Biophilic Design

The features of the ESC benefit not only the building occupants but the plants and animals that surround the facility, demonstrating that sustainable practices that are good for people can be good for the environment, too. For example, Phipps' team avoided Living Building Red List materials, which contain chemicals that have been designated as harmful at any stage in their life cycle—from production to use to disposal. Instead, the team focused on Declare label products, which divulge all ingredients in the product, allowing Phipps to avoid building materials with toxic

chemicals. Natural materials add to the aesthetic quality of the building while supporting human and environmental health. Black locust lumber with no need for pressure treatment was used on the deck and an interior wall, and locally sourced sandstone was used in the Yoga Court.

Phipps' design team focused heavily on biophilic design, a design movement that is based on reinforcing humans' innate desire to connect to nature. An intense series of biophilic design workshops ensured connections to nature and natural shapes and forms were paramount throughout the building. Simple features, like plentiful windows and sliding doors, both of which can be opened on temperate days, increase airflow and provide daylight to minimize the use of harsh overhead lights, connecting occupants to nature while reducing the amount of energy the building uses.

New landscaping was added outside of and even on top of the building in the form of a vegetative living wall and a green roof, which also manages stormwater. The

MAL WELLS THAT HARNESS ENERGY FROM THE EARTH'S CONSISTENT 55 F UNDERGROUND



TEMPERATURE.



BOTTOM LEFT: THE ESC'S ROOF HOLDS PHOTOVOLTAIC SOLAR PANELS, WHICH CAPTURE THE SUN'S ENERGY TO CONVERT TO ELECTRICITY. TO AVOID ENERGY WASTE, BAT-TERIES INSIDE THE BUILDING STORE POWER THAT CAN BE USED BY THE FACILITY ON OVER-CAST DAYS AND AT NIGHT. BOTTOM RIGHT: COMFORTABLE TEMPERATURES THROUGH THE FACILITY ARE PROVIDED BY RADIANT FLOOR HEATING AND COOLING TIED INTO GEOTHER-

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RESTORATION MATERIALS // Prosoco,

prosoco.com

MECHANICAL FASTENERS // SFS,

www.sfsintecusa.com

COR-TEN WEATHERING STEEL //

MetalTech-USA, metaltech-usa.com

VEGETATED ROOF ASSEMBLIES

- ◆ SOIL RETAINER AND MANUFACTURED **GROWING MEDIA //** Columbia Green Technologies, columbia-green.com
- DRAINAGE AND FILTRATION LAYERS // Keene Building Products, keenebuilding.com
- ◆ PROTECTION LAYER // Carlisle SynTec, carlislesyntec.com

HOLLOW METAL DOORS AND FRAMES //

Curries Co. (ASSA ABLOY), curries.com

FLUSH WOOD DOORS // Masonite Architectural. architectural.masonite.com

OVERHEAD COILING DOORS // Overhead Door

Corp., overheaddoor.com

FOLDING ALUMINUM-FRAMED STOREFRONTS

// NanaWall Systems Inc., nanawall.com

ALUMINUM WINDOWS // Kawneer Co. Inc.,

kawneer.com

WINDOW INSECT SCREENS // Kawneer Co.

and Phifer Inc., phifer.com

WINDOW CONTROLS // Clearline Inc.,

clearlineinc.com

ROOF-MOUNTED SKYLIGHT DOME ASSEMBLY

// Solatube International Inc., solatube.com

SEALANT FOR TUBULAR DAYLIGHTING

DEVICES // Tremco, tremcosealants.com

AUTOMATIC DOOR OPERATORS // ASSA ABLOY Entrance Systems, assaabloyentrance.us

NATURAL CLAY PLASTERING // American Clay

Enterprises LLC, americanclay.com

GLAZED PORCELAIN TILE AND TRIM //

Daltile Inc., daltile.com

CERAMIC TILING // Laticrete International Inc.,

METAL EDGE/TRANSITION STRIPS FOR **CERAMIC TILING AND RUBBER TILE FLOORING**

// Schluter Systems, schluter.com

ACOUSTICAL PANEL CEILINGS //

USG Corp., usg.com

LINEAR WOOD CEILINGS

- ◆ WOOD GRILLE CEILING PANELS // 9Wood Inc., 9wood.com
- ◆ METAL SUSPENSION SYSTEM // USG

CORK FLOORING AND RUBBER TILE

FLOORING // Capri Collections,

capricollections.com

LINOLEUM FLOORING //

Forbo Flooring Systems, forbo.com

TILE CARPETING // Mohawk Group,

mohawkflooring.com

EXTERIOR AND INTERIOR PAINT //

PPG Architectural Finishes Inc., ppgac.com

PAINT FOR LAGOON //

National Paint Industries, ipaint.us

SOLID PLASTIC LOCKERS // Scranton

Products Inc., scrantonproducts.com

ROLLER WINDOW SHADES //

Draper Inc., draperinc.com

LIGHT-FILTERING FABRIC //

Mermet USA, mermetusa.com

SOLID SURFACE COUNTERTOPS //

DuPont Corian, corian.com

WATER CLOSET, LAVATORY AND SERVICE

SINK // Kohler, us.kohler.com

WATER CLOSET FLUSH VALVE AND

URINAL // Sloan, sloan.com

LAVATORY TRAP, DRINKING FOUNTAIN TRAP AND KITCHEN SINK TRAP //

McGuire, www.mcguiremfg.com

MIXING VALVE (SINK) // Watts, watts.com

ANGLE STOP FITTING (SINK) //

Chicago Faucets, chicagofaucets.com

DRINKING FOUNTAIN AND KITCHEN SINK //

Elkay Manufacturing Co., elkay.com

HAND SINK // Advance Tabco, advancetabco.com

EYE WASH, MOP BASIN AND SHOWER BASES

// Acorn Engineering Co., acorneng.com

HAND SHOWER UNIT AND HEAD //

Symmons, symmons.com

HEAT PUMPS // Waterfurnace, waterfurnace.com

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mcnichols.com

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DESIGNING TO ACHIEVE THE WELL PLATI-NUM BUILDING STANDARD ENSURES THE REHABILITATED SPACE IS THE HEALTHIEST POSSIBLE ENVIRONMENT FOR STAFF.

exterior of the building is made out of weathering steel, which naturally rusts to reflect the weathering of time. Subtle features, like the imprints of leaves and horseshoes in the concrete, pay tribute to the history and natural connection to the site, which housed riding stables in the early 1900s.

A lagoon adjacent to the ESC is a beautiful amenity that Phipps staff and visitors can enjoy. Its primary purpose is to store rainwater, and it replicates the natural treatment processes of marshes and wetlands while providing habitat for fish, frogs and other wildlife. Sanitary water is treated and reused through a constructed wetland that uses plants, microbes, sand filters and UV lights to clean the water to near-potable standards.

Employee comfort inside the building was of utmost importance to the design team, and the ESC proves that pleasant and sustainable spaces are not mutually exclusive. Comfortable temperatures through the facility are provided by radiant floor heating and cooling that is tied to geothermal wells buried deep in the ground to harness the natural energy from the Earth's consistent 55 F underground temperature.

The roof of the ESC is home to photovoltaic solar panels, which capture the sun's energy to convert to electricity. These panels are expected to produce

all the energy the ESC uses each year. To avoid energy waste, batteries inside the building store power that can be used by the facility on overcast days and at night.

An important innovation in the ESC is the use of direct current, or DC, electricity for lighting the building. A typical building operates on alternating current (AC). Solar panels collect electricity in the form of DC. That means any electricity produced by solar panels has to be converted from DC to AC before it can be used. All LED lights, however, operate on DC, which means the electricity has to be converted back to DC before it can light the building. Converting electricity from DC to AC and back can waste 10 to 15 percent of the energy produced. The ESC breaks this wasteful convention by powering all lights in the building by DC with no conversion. Solar panels produce DC electricity, which is stored in the batteries, and the batteries then supply all the current needed to operate the lights.

The ESC offers an exciting new experience for Phipps' quests, as well. Visitors can get a peek behind the sustainable scenes by entering a vestibule in the building and watching facilities staff construct props for seasonal flower shows in real time. An adjacent window provides a look into the exhibit archive room where statuary, topiaries, props and more from past shows are displayed.

Green Inspiration

The ESC proves the greenest building can be one that already exists. With the right priorities, even the most unsightly and unhealthy spaces can become spaces that are good for the people who inhabit them and beneficial to the environment. Phipps representatives are excited to share this facility along with the adjacent CSL and Nature Lab as examples of three of the greenest and healthiest buildings that can be found anywhere, representing retrofit (ESC), new (CSL) and modular (Nature Lab) construction. Phipps Conservatory and Botanical Gardens' team hopes these buildings will serve as inspiration to other individuals and organizations around the world.

The vision: Meet sustainability goals and building aesthetics.



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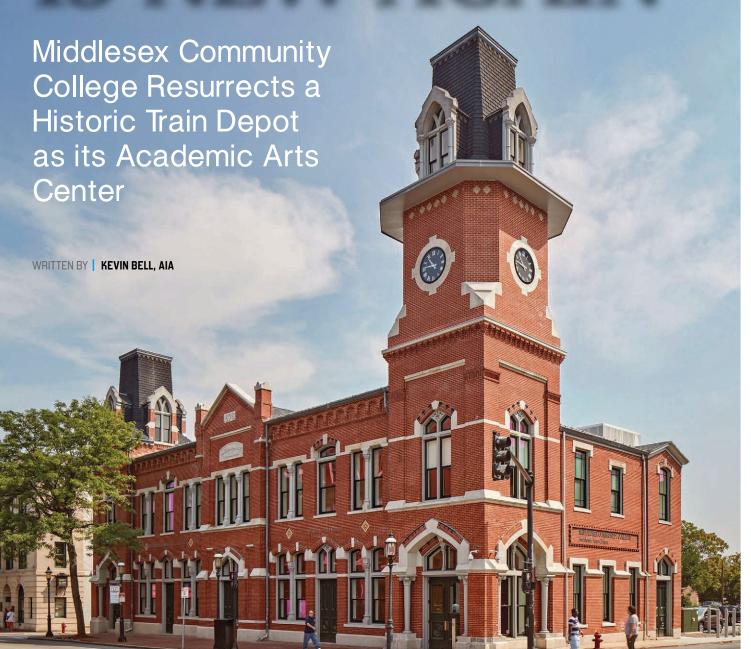
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WHAT IS OLD IS NEW AGAIN





he Richard and Nancy Donahue Family Academic Arts Center at Middlesex Community College (MCC) in Lowell, Mass., reimagines a 140-year-old railroad depot as a state-of-the-art performing arts venue. Twenty years in the making, the \$20 million center is a dramatic extension to the college's second campus. The realization of a structure stipulated in the campus' master plan but long left unrealized, it provides a new collection of spaces focused on the student and surrounding community in a technically intensive environment.

BRIEF HISTORY

The city of Lowell was founded in the early 19th century as a water-powered textile center and grew to become a symbol of the industrial revolution and the era's inherent commercial and social change. Opened in 1876, the city's distinguished Boston and Maine Railroad Depot was emblematic of its time, but burgeoning transit demands quickly made it obsolete, and it was supplanted by a larger terminal 20 years after opening. As the 20th century dawned, the building subsequently became a telephone exchange, theater, movie palace and, finally, a bowling alley. Through these transitions, it lost its impressive clocks, towers, and cornice detailing and, after a 1980s fire, its tenants. After sitting vacant for years, the Lowell National Historical Park, within which the building was located, officially recognized its significance and saved it from the wrecking ball. The Washington, D.C.-based National

Park Service (NPS) then embarked on a decade-long stabilization effort of the depot, reinforcing its structure and reconstructing its original storefront and towers. By the early 2000s, these efforts turned the depot into a viable redevelopment opportunity.

Well established on its nearby Bedford, Mass., campus—but seeking to expand— MCC recognized tremendous opportunity in downtown Lowell, both in its buildings and in the needs of its underserved community. Adding a second campus there in 1987, the school's core embrace of the integral relationship between student and community guided the college's lease, acquisition, and two subsequent decades of building restorations and renovations.

Searching for a home for its long-awaited performing arts center, the college recognized new life for the unique depot building as the headquarters for its theater, dance and music departments. In partnership with the Commonwealth of Massachusetts, it acquired the depot from the federal government and began a 10-year realization process.

CHALLENGES AND **OPPORTUNITIES**

The design challenges of the project were many. The proposed program far exceeded what the existing building could contain. Even with the NPS efforts, the building's age and three-decade vacancy took their toll. Daylight streamed in through holes in the brick wall; the roof and windows let the elements in: birds made their homes within: and the overall structural integrity of the masonry

Retrofit Team

CLIENT/OWNER // Massachusetts Division of Capital Asset Management and Maintenance, Boston, www.mass.gov

ARCHITECT // Leers Weinzapfel Associates, Boston, www.lwa-architects.com

- Josiah Stevenson, principal in charge/project manager
- Andrea Leers, principal
- Kevin Bell, AlA, project architect
- Seung-Jin Ham, designer

GENERAL CONTRACTOR // Consigli Construction, Boston, www.consigli.com

MEP/FP // Cosentini Associates, Boston, www.cosentini.com

STRUCTURAL // RSE Associates Inc., Watertown, Mass., www.rseassociates.com

CIVIL // Green International Affiliates Inc., Westford, Mass., www.greenintl.com

THEATER // Fisher Dachs Associates Inc., New York, www.fda-online.com

AV/ACOUSTICS // Acentech, Cambridge, Mass., www.acentech.com

LIGHTING // Lam Partners, Cambridge, www.lampartners.com

PRESERVATION // Preservation Technology Associates, Chestnut Hill, Mass., preservationtechnology.net

GEOTECHNICAL // GZA, Boston, www.gza.com



Materials

STANDING-SEAM ZINC WALL CLADDING //
Rheinzink, www.rheinzink.com

CUSTOM-PERFORATED ALUMINUM PLATE RAINSCREEN // DriDesign, www.dri-design.com

ALUMINUM CURTAINWALL AND STOREFRONT // Kawneer, www.kawneer.com

ALUMINUM-CLAD WOOD WINDOWS //
Kolbe, www.kolbewindows.com

SBS ROOFING // Soprema, soprema.us

ASPHALT SHINGLES // CertainTeed, www.certainteed.com

TOWER CLOCKS // Electric Time Co. Inc., www.electrictime.com

LARGE-FORMAT FLOOR TILE // Mosa, www.mosa.com

RESILIENT STAGE FLOOR // Robbins, www.robbinsfloor.com

LINEAR ACOUSTICAL WOOD CEILING //
Rulon, rulonco.com

THEATRICAL AND ARCHITECTURAL LIGHT-ING CONTROLS // ETC, www.etcconnect.com

LIGHT NODE ARRAY // ColorKinetics, www.colorkinetics.com

COLOR-CHANGING BUILDING LIGHTING //GVA Lighting, gvalighting.com

INDIVIDUALLY ADDRESSABLE RECITAL HALL LIGHTING // Lumenpulse, www.lumenpulse.com

FIXED AUDITORIUM SEATING // Series Seating, seriesseating.com

MOVABLE THEATER SEATING // Wenger, www.wengercorp.com was substantially degraded. Given its historical import as a city gateway and the desire to preserve its presence on seminal Towers Corner, opportunities for building expansion were limited on a building sitting atop bedrock with no site extension possible.

The design for the new center needed to address these challenges while creating an expressive and identifiable home for the students who would bring it back to life. It needed to be program efficient—making new space within the existing building and through a careful addition on a sliver of land next to the building—to preserve the prominence of the original. Structurally, the solution had to go beyond retrofit and embrace the existing masonry exterior's qualities. Architecturally, the building needed to transcend restoration and express its new use and role in the community. The result is a crafted modern insertion into the original building that meets these goals.

The new center places scholarship in context, revealing deepened connections to history and community. Each space within the building is shaped and scaled to student performance. Systems and tools are designed into the building for teaching the craft of performance and expanding learning opportunities.

The completed design accommodates a proscenium theater, music recital hall and dance studio in a simple ovoid shear-wall volume—essentially an "egg" theater— inserted within the 1876 brick shell. The theater's shape is metaphorical, symbolizing the building's rebirth and the burgeoning talent of student actors, dancers and musicians. The efficient curved shape of the new insertion serves as the structural core of the building, supporting new spaces and buttressing the restored and reconstructed historic envelope. New additions nearly double the area available within the building. A new basement, carefully mapped to bedrock below the original building's dirt floor, surrounds the core. A thin metal-clad mechanical addition, in the spirit and tradition of nearby additions to historic masonry mill buildings, redefines a beyond-repair building edge.

The "new" is placed in an interconnected balance with the historical, revealing the life inside the building to differing degrees depending on the time of day, tenor of activity and position of the viewer. The addition's service towers are clad with custom-perforated imagery that highlights the historical and renewed performances within. The wood paneled "egg" is revealed through the unexpectedly diaphanous façade. The









THE DESIGN OF PERFORMANCE TEACHING SPACE IS CLOSELY TIED TO PEDAGOGY, TO THE STRENGTHS AND ABILITIES OF STUDENT PERFORMERS, AND TO INSTITUTIONAL GOALS, ACCOMMODATING DIVERSE EXPERIENCE LEVELS AND AN OPENNESS TO ALLCOMERS IN MALLEABLE SPACES.







THE COMPLETED DESIGN ACCOMMODATES A PROSCENIUM THEATER, MUSIC RECITAL HALL AND DANCE STUDIO IN A SIMPLE OVOID SHEAR-WALL VOLUME—ESSENTIALLY AN "EGG" THEATER— INSERTED WITHIN THE 1876 BRICK SHELL.

reinstalled tower clocks have an ingenious secret—as day turns to night, the historical details recede and the façade becomes a frame. The clocks invert and shine as beacons. The volume within glows in stark relief, highlighting the students' place and inviting the community in.

SPACE DETAILS

The design of performance teaching space is closely tied to pedagogy, to the strengths and abilities of student performers, and to institutional goals, accommodating diverse experience levels and an openness to all-comers in malleable spaces.

The major space in the "egg" is a 177-seat flexible studio theater—the shear walls of which support the building. The space descends from the first-floor lobby into the basement to create an intimate audience chamber with excellent sight lines in an off-Broadway style. The overall volume of the space is limited, by external

factors and by design. The stage is shallow—the audience is pulled in tight to the performer—and the surfaces are treated acoustically to accommodate diverse student voices.

The audience chamber's shape is intended to always feel full; the curving sides pulling attendees to the center within view of the performer. The front rows are reconfigurable and sit on the flat-floor stage to allow the space to transform from a traditional proscenium-style space to a thrust stage to an in-the-round. Additional rows can be added to increase capacity in a lecture configuration.

The recital hall, a 101-seat room designed to accommodate solo and small ensemble groups, is embedded at the second floor. A floated floor system isolates the recital hall from the theater below. Support spaces and vestibules further separate the room. Within the space, acoustically considered clear-finished maple finishes adorn

the walls, ceiling, floor and seats, paired with lighting to make a visually intimate space. Above the plane of light and wood, the volume continues to the underside of the roof. The volume and surfaces combine to enliven the space while variable acoustical curtains at the upstage wall allow for tuning. The result is a space set away from the surroundings, intimate yet accommodating, ready for teaching and performance.

The dance studio is the third major space within the "egg." The resilient maple-floored room matches the stage dimensions and proportions for flexibility. Similar to the recital hall, a plane of light makes the space feel intimate while the volume of the space continues above to balance room acoustics. Together with a practice room, seminar space and classroom, the dance studio provides additional rehearsal and teaching space in a varied scale to accommodate diverse use.



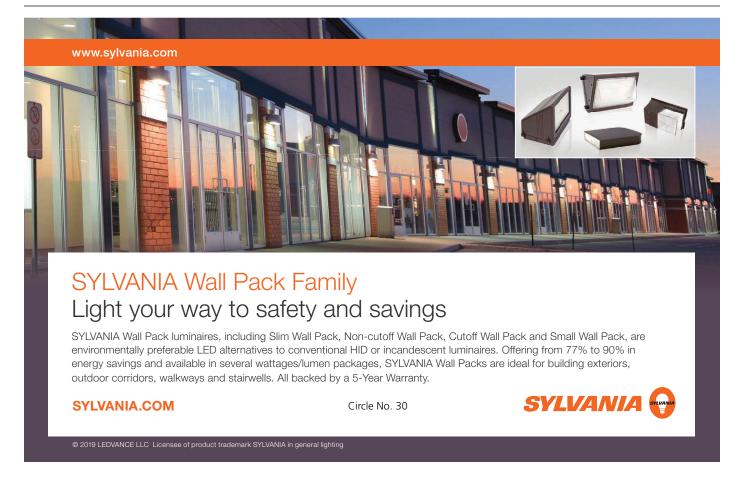
21ST CENTURY PERFORMANCES AND INSTRUCTION

The center provides students the opportunity to work with state-of-the-art equipment, controls and software typically reserved for professional environments. The three performance spaces have tailored

audio/video, lighting and technical theater systems, which are as much teaching tools as building equipment.

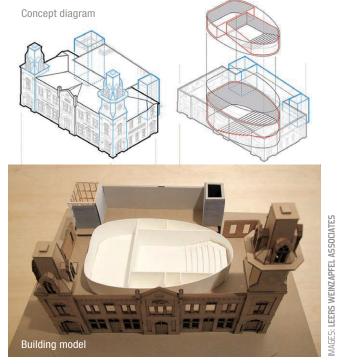
The college desired diversity in the theater as a teaching space. Although small, the theater is equipped with easily accessed catwalks, galleries and line sets hung from the floor above. These allow

OPENED IN 1876, THE CITY'S BOSTON AND MAINE RAILROAD DEPOT WAS EMBLEMATIC OF ITS TIME, BUT BURGEONING TRANSIT DEMANDS QUICKLY MADE IT OBSOLETE. AS THE 20TH CENTURY DAWNED, THE BUILDING SUBSEQUENTLY BECAME A TELEPHONE EXCHANGE, THEATER, MOVIE PALACE, BOWLING ALLEY AND, BRIEFLY, A STORAGE FACILITY.









students to safely work with variable lighting and rigging positions accessed from above and below. Motorized line sets allow pipe to be lowered to the stage for ease of access and large group instruction. The theater has a full theater lighting and audio system to provide foundational training, as well as experimentation. Beyond traditional theatrical lighting, the theater extends the integration of sound and light control to house lighting and video. An array of individually addressable color-changing light nodes transforms the house lighting into a cutting-edge theatrical lighting element that envelops the audience. The dance studio uses sophisticated lighting controls, custom touchscreen interface and individually addressable color-changing light fixtures for an immersive, student-directed experience. The recital hall's motorized projection equipment, audio/video controls and addressable lighting into scenes make technology visible at the touch of a button.

The building is also a canvas. The lobby incorporates networked LED signage panels capable of acting as informational kiosks or displays for student-generated content. The maple-panel-clad "egg" and historical building towers are lighted by color-changing, wallwashing light running scenes that change based on the time of day or events within the building.

Each lighting system, audio system, and video system is open to student study and experimentation. These technologies serve as the foundation for a new technical certificate within the performing arts departments, meant to prepare students for diverse career paths.

As the gateway to the historic section of Lowell, the repurposing of a deteriorating 1876 structure now links the rich past of the old city with the programmatic needs of a modern performing arts center. Embracing old and new is critical to ensure that the richness and timelessness of history can live amongst our fast-paced technological world.



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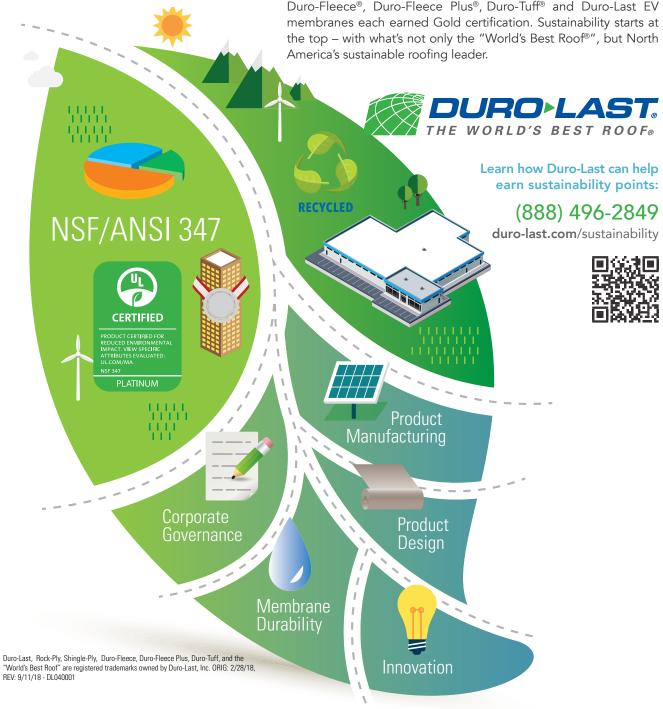
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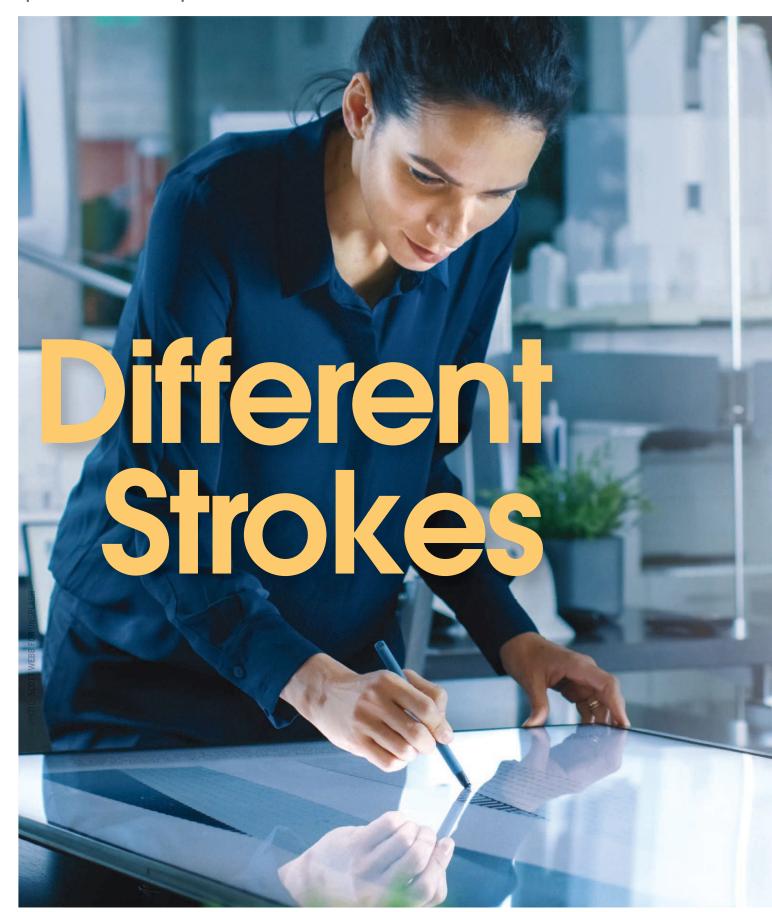
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Sustainability starts at the top. It's often the largest surface also be a major contributo

It's often the largest surface area on a building. So shouldn't a roof also be a major contributor to its sustainability? Duro-Last® is the industry leader in certifications under NSF/ANSI 347 for product durability, reflectivity, recyclability and sustainable manufacturing. The flagship Duro-Last membrane, as well as the Rock-Ply® and Shingle-Ply® membranes, earned Platinum certification and the Duro-Fleece®, Duro-Fleece Plus®, Duro-Tuff® and Duro-Last EV membranes each earned Gold certification. Sustainability starts at the top – with what's not only the "World's Best Roof®", but North America's sustainable roofing leader.





Hand Sketching IS EXPERIENCING A RESURGENCE. HOWEVER, ANALOG AND DIGITAL ARE NOT COMPETING BUT COMPLEMENTARY TOOLS THAT RESULT IN RICHER BUILDING DESIGNS WHEN COMBINED.

WRITTEN BY | ROBERT NIEMINEN

n his 2014 book, Why Architects Still Draw, Paolo Belardi posed a rather poignant question: Why would an architect reach for a pencil when drawing software and AutoCAD are a click away? The question of whether it's better to do things by hand or rely on automation reveals a kind of tension in architectural circles about the way in which buildings are designed today versus in the past.

With technology advancing at breakneck speed, it seems there's a renewed interest in drawing and making things by hand, as evidenced in part by the Maker Movement in recent years (see retrofit's "Trend Alert" in the May-June 2018 issue, page 82, or bit.ly/2GqyMvz). There's no doubt architects have more tools at their disposal than ever before, but does that mean today's designs created on a computer are better than those meticulously drawn out on paper? Are old-school methods of drafting and creating physical models inherently more thoughtful than

digitally produced ones? Does anyone really care how a building is conceived anymore, or does the end justify the means, so to speak? We're glad you asked.

A Different Way of Thinking

Belardi's defense of sketching by hand is less about trading a digital device for a measuring tape, as the book's publisher notes, but rather that drawing represents a way of thinking that serves as the interface between the idea and the work itself. In other words, he suggests drawing "is not a pas-

sive recording but a moment of invention pregnant with creative possibilities."

Unfortunately, the art of hand drawing is becoming a rarity, and many notable architects (including the late Michael Graves, per his op-ed in *The New York Times*, nyti. ms/2Mk7X35) believe something has been lost in the translation between analog and digital.

"Hand drawing is almost a lost art," says Nathan Gillette, AIA, LEED AP O+M, CEM, director of Natura Architectural Consulting LLC in Grand Rapids, Mich. Gillette also is a **retrofit** advisory board

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THERE'S A TIME AND PLACE FOR EACH TOOL. BIM DESIGN, COMPUTER VISUAL-IZATION, HAND SKETCHING-THESE ARE ALL TOOLS. AND THE MORE TOOLS YOU HAVE AT YOUR DISPOSAL, THE BETTER DESIGNER YOU WILL BE.

-Nathan Gillette, director, Natura Architectural Consulting



member. "They don't teach it or encourage it much anymore."

Gillette notes most students enrolled in architecture and design programs have never taken an art or drafting class—a statistic unheard of 25 years ago. As a result, there's a sense of apprehension among more seasoned professionals about students and young architects who have never learned to draw by hand because they lack an understanding of how buildings are put together, which is revealed in their renderings, according to Thomas W. Hutchinson, AIA, CSI, Fellow-IIBEC, RRC, principal of Hutchinson Design Group Ltd., Barrington, Ill.

"There's always been a concern with people who learned to draft by hand that—especially in the second or third generation now—people who have never drafted by hand, they just draw

randomly or they copy and paste things and don't understand the implications of what they're drawing," Hutchinson says. Because many young professionals have never drawn a two-by-four to scale, for example, they lose a sense of feel for what they're creating, he explains.

"I do a lot of peer review of architectural drawings and oftentimes they are so lacking in detail. The drawings are just basically scope documents, relying on the manufacturer and/or contractor to work out the details," Hutchinson adds. "The drawings basically communicate 'Oh, we want a roof, or we want a wall'—but there's very little detail or understanding of how it's constructed. And I think that's the downside of always using CAD; lines are drawn without knowing what they are and then copied for the next project."

(continues on page 80)

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10 DIGITAL SKETCHING & DRAFTING TOOLS



and sketching and drafting doesn't necessarily require paper anymore. Thanks to advancements in digital design tools and apps on the market, architects and designers can put pencil to screen to express their ideas by hand, blending the best of traditional and modern methods. Following are a few notable digital sketching and drafting tools design professionals have at their disposal (in no particular order):

- 1 ISKN'S SLATE AND RING For the purists who love to sketch with actual paper and pencil, iskn's Slate and Ring transforms a user's drawings with his or her favorite pen or pencil on paper to the computer screen. www.iskn.co
- **2 APPLE PENCIL 2 WITH IPAD PRO** Responsive and precise down to a single pixel, the Apple Pencil 2 can be used to sketch, jot down notes, paint a watercolor or design a building onsite. www.apple.com/apple-pencil
- **3 AUTODESK'S AUTOCAD MOBILE** AutoCAD mobile is a DWG viewing application with drawing and drafting tools that allow construction professionals to view, create, edit and export AutoCAD drawings on mobile devices. www.autodesk.com/products/autocad-mobile/overview
- **4 PROCREATE** With more than 130 handcrafted brush types, this application gives design professionals the power to create sketches, paintings and illustrations on the go. procreate.art
- **5** MORPHOLIO TRACE PRO This drawing tool allows users to create sketches and drawings on top of PDFs, maps, photos, images, drawing sets, background templates and more with high resolution while using designer tools, brushes and pens. www.morpholioapps.com/trace
- **6** PAPER BY WETRANSFER Paper's tools make it easy to draw, outline, write, color, diagram, collage, cut and fill. Snap rough sketches into straight lines and crisp shapes or use one of the built-in templates. paper.bywetransfer.com
- **7 CONCEPTS** Concepts is a flexible space to think, plan and create. Sketch plans on the infinite canvas; write notes and doodle with tilt + pressure; draw storyboards; produce sketches and design plans; then share with friends, clients and other apps. concepts.app/en
- **8** AUTODESK SKETCHBOOK From quick conceptual sketches to fully finished artwork, SketchBook maximizes the drawing space of every device. Pencils, inks, markers and more than 190 customizable brushes can incorporate textures and shape while a scan function utilizes the device's camera to import line art on paper into digital format. This tool is free. sketchbook.com
- **9** ADOBE ILLUSTRATOR DRAW Draw puts designer's favorite vector drawing tools and features into a modern interface to turn any idea or inspiration into a finished design. Choose from five built-in vector brushes and never lose perspective thanks to built-in graph and perspective grids that allow users to sketch the 3D world in a 2D drawing. www.adobe.com/products/draw.html
- **10** Shapr3D Shapr3D is a professional, mobile CAD app on iPad made for Apple Pencil that offers a quick but precise way to create 3D models. It allows architects, engineers and industrial designers to turn their hand sketches into complex technical drawings that can be exported to desktop CAD programs. www.shapr3d.com

Gillette says the ease of rendering on the computer requires much less effort to produce a photorealistic rendering of a project than it did just a few years ago. "But slick renderings and fancy computer graphics aren't everything," he points out. Rather, there's something to be said for the architect who can sit down with a client and on the back of a napkin design a house or a complex architectural detail. "It's beautiful and instant. His clients love to watch the process and see his creativity," Gillette says of a local architect who still draws by hand. "No taking sketches back to a computer technician to CAD draft and then turn it into a visualization. It's right there in front of you."

Hand sketching certainly offers a sense of immediacy and creativity, but as Andrew Furman, M. Arch, BAA, ARIDO, IDEC, NCIDQ, associate chair and associate professor at Ryerson University's School of Interior Design, Toronto, points out, the evolution of technology and the profession as a whole have enabled design practitioners to blend the best of both worlds. "I think people have realized that there is so much more that can be done by combining the two, using hand skills and traditional crafts and bringing them back into the fold with all the latest technologies that are out there."

For example, Furman says even the best 3D-printed models require hours of trimming and cutting by hand to clean them up to perfection—so the hand is still involved in the process even if it may not always be on the front-end of it.

Sharpening Skills

Proponents of computer-aided design might suggest going back to doing things by hand is archaic and a waste of time, especially given how much efficiency technology affords. However, Gillette suggests there are some critical-thinking skills that are missed when architects completely let the computer take the wheel in

design. "Too many young architecture students don't have a lot of time in the field to effectively translate the 2D paper world to 3D real-life construction applications," he says. "Just because you can draw something on paper doesn't mean you can build it in real life. Sketching out details and working them out in your head is still a very effective problem-solving method."

Furman notes some universities, like Ryerson, still have a philosophy that values drawing and may evaluate an incoming student's portfolio to determine whether or not he or she can express ideas by drafting because "we really hold [to the notion] that it's still a fundamental kind of communication tool." But not everyone agrees. Some schools and colleagues value sketching by hand but don't believe it's essential to one's education.

Hutchinson argues skills like perspective drawing ultimately can help people become more effective at what they do. "I think architects in general would become better if they could utilize hand skills in association with CAD," he says.

Gillette supports the thought and says drawing and building physical models are skills that are just as relevant and important today as ever. "Visualization and communicating what's in your head to paper for your client or employee to understand is a key skill of a good architect," he says. "If I can't communicate something effectively to a client or a contractor, time and money is lost."

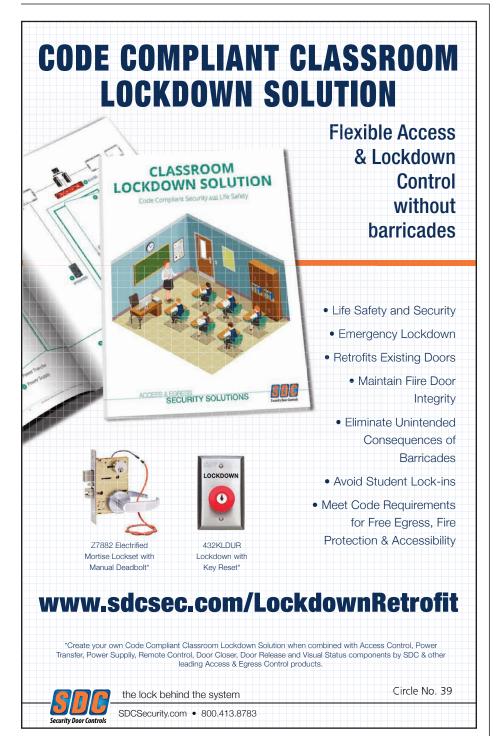
Ironically, Furman says while many universities expect students coming into design and architecture programs to have some knowledge of traditional skills, such as drafting, painting, sketching, measuring, etc., in their toolbox, "you have to do it on your own time. We don't have time to teach you that stuff."

The Right Tool for the Job It's easy to romanticize the idea of drawing and making models by hand or lamenting the death of traditional architectural practices over computerized approaches. But that misses the point.





SKETCHING BY HAND ISN'T ABOUT TRADING A DIGITAL DEVICE FOR A MEASURING TAPE, BUT RATHER THAT DRAWING REPRESENTS A WAY OF THINKING THAT SERVES AS THE INTERFACE BETWEEN THE IDEA AND THE WORK ITSELE.



No one is suggesting we ditch the computer altogether in favor of paper and pencil—or vice versa. The message is that technological drawing shouldn't replace hand sketching completely; they aren't necessarily competing but complementary tools at an architect's disposal.

"Like any decent tool in a craft person's toolbox, you use the right tool for that particular thing you're trying to do at the moment," Furman explains. Like a woodworker who might use a hammer and chisel for one task and a miter saw for another, each one serves a specific function in the process of creating the end-product.

Each tool is unique and requires different trains of thought, according to Gillette. "Hand drafting is different than CAD drafting, which is different from BIM design," he says. Gillette notes, for the most part, hand drafting and CAD drafting are exercises in the 2D space while BIM takes it to another level and forces the user to design in 3D. "When you hand draft, you have to constantly think about line weight and how you convey depth, whereas CAD drawing starts to make a lot of that automatic. BIM design makes you consider all three dimensions—that window you just put in a wall has a height, a width and a thickness. If you alter one of those dimensions the information changes the entire database of information."

Ultimately, the question isn't whether architects should use one method over another to design buildings. "In the end, you have to use the right tool for job," Gillette says. "There's a time and place for each tool. BIM design, computer visualization, hand sketching—these are all tools. And the more tools you have at your disposal, the better designer you will be."



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TLIMESTONE VENEER IS ROUGHHEWN INTO ASHI AR PROFILE

Eldorado Stone has released its Grand Banks Limestone collection, which adds accents of rust and gray-green balanced with cream and silvery blue hues. The profile is hand-dressed to provide a chiseled, textured stone shape roughhewn into a rectangular ashlar profile. The architectural stone veneer ranges from 2 to 8 inches in height and 4 to 17 inches in length with an average stone size of 6 by 12 inches. In addition to Grand Banks, Limestone is available nationwide in San Marino, Savannah and York color palettes.

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Learn more about the Limestone profile via short video.

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blocks. Each block is 9 by 9 inches with a depth of 1 1/2 inches. The doors measure 38 by 83 inches, and each door has a four-block-across by nine-block-down configuration. Architectural-grade vinyl frames surrounding the units are available in white and bronze. The Barn-Lite doors are supported by durable steel hardware overhead in a black satin color. The doors are backed by a 10year limited warranty.

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Viega LLC's Automatic Recirculation Balancing Valve ensures a balanced domestic water recirculation system by dynamically changing with

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perature sensor. Threaded ends allow it to be used with Viega ProPress or Viega PureFlow fittings systems. The valve includes a bypass for thermal disinfection. Additional accessories include a thermometer, drain valve and optional insulation sleeve.

viega.us // Circle No. 47

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In the 18th century, Japanese woodworkers discovered a method of preserving wood by charring the surface with fire. Commonly known as "yakisugi" or "shou sugi ban", its real-world practicality can be problematic. Enter Ignite cladding from Thermory, which combines the yakisugi aesthetic with the performance of thermally modified wood. Ignite



mimics the traditional "dragon scale" appearance with a torch-free process of embossing. tinting and brushing, resulting in a cladding that appears charred yet has no messy residue. The thermal modification process uses heat and steam to create real-wood products that combine durability and moisture resistance without sacrificing strength. The result is an allnatural product with a Class 1 durability rating, 25 years or more. Ignite cladding is made of Scots pine and available in a brushed or "dragon scale" texture, in a 1- by 6-inch grooved profile and lengths of 8, 12 and 16 feet for installation via standard blind screw.

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bendheim.com/glass type/mouthblown-art-glass // Circle No. 46



Glass artist Nancy Gong showcases Bendheim's mouth-blown Lamberts glass and a lead-free lamination technique in a new bespoke art glass window. The 10 1/2-foottall abstract artwork defines the street-facing façade of a private residence, located in the historic district of Rochester, N.Y.



Learn how mouth-blown glass is made.



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Mitsubishi Electric Trane HVAC US (METUS) has introduced two MSZ/MUZ-JP Model 115 Volt Heat Pumps. Part of the METUS M-Series product lineup, each 115-volt heat pump system utilizes one breaker spot in an electrical panel versus the typical two breaker spots. A single zone system, the MSZ-JP model indoor unit and corresponding MUZ-JP model outdoor unit are suited for residential and light-commercial applications, such as hotels and restaurants. Available in 9- and 12-kBtu/h capacities, the system is SEER 17.0, HSPF 9.3 to 11.00, and EER 9.9 to 12.0. The outdoor unit heat exchanger has been treated for slow corrosion caused by airborne salt and sulfur in coastal and high sulfur areas.

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STONE VENEER IS 36-INCHES LONG

Oldcastle APG's Echelon brand has introduced Aria Slim Stone full-depth veneers, which deliver a modern aesthetic, durability and reduced installation times. Available in five colors and four finishes, Aria Slim Stone's linear profile enables the application of the same veneer on façades and in corners. The 36-inch long veneer design offers a solution to the labor shortage by reducing installation times while a full 3 5/8-inch bed depth enhances durability.

www.echelonmasonry.com // Circle No. 51



PLUMBING DELVES INTO IOT

Zurn Industries LLC has expanded its Connected Products portfolio, advancing IoT for commercial plumbing. The company is rolling out two product lines, Zurn Connected Flush Valves and Zurn Connected Faucets. It also will release an enhancement of its connected backflow preventer with the new Zurn Wilkins Connected Flood Control System (Model FCIS). In addition to product innovations, the company has made enhancements to its connected web and mobile tools. The secure and mobile-friendly web portal, plumbSMART, powered by Zurn, provides real-time data on usage patterns, water consumption and preventative maintenance. It features dashboard-style product trends and live alerts, organized to match facilities' footprints. Users can choose to receive real-time product alerts via email or mobile text message, helping them to respond faster to potentially disruptive plumbing system issues.

zurn.com // Circle No. 52



View a video about Zurn's Connected Products.



← SKYLIGHTS BRING DAYLIGHT INTO COMMERCIAL SPACES

With the acquisition of Wasco Products Inc., VELUX America now offers an expanded commercial skylight product line. Structural skylight systems offer limitless design possibilities with sizes and shapes to fit any architectural vision. Many of the framing systems support spans of up to 40 feet with glazing options, including energy-efficient glass, hurricane-rated glass and polycarbonate. Structural skylights are available in Cluster and Extruded Gutter Systems, Continuous Vault Systems, Double Pitch, Extended Pyramid, Lean-

To, Low Profile, Octogonal Pyramid, Single Pitch, Square Pyramid and Structural Ridge. In addition, the Dynamic Dome commercial skylight is engineered to capture more daylight in the early morning and late afternoon. This design allows a building's lights to stay off nearly an extra hour per day.

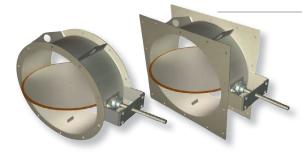
www.veluxusa.com/professional/commercial // Circle No. 53

→ MODULAR FRAMEWORK CREATES SPACES WITH PURPOSE

Array, a collaborative design from Structureworks Fabrication and Gensler, is a modular framework that can stand alone or be arranged in a group. A range of wall and ceiling panels are configured within the frame to create an enclosed or semi-enclosed space with defined purpose. Wall panels can extend beyond the frame to offer additional gathering areas and work zones. Five wall styles offer flexibility in look and function. Ceiling panels can be configured to create more intimate spaces. Different panel styles and finishes can be combined to create different moods. A cantilever option—in solid, slat or screen—extends beyond the frame to create transitions. Electrical options include recessed lighting and convenience receptacles.

arrayworkspace.com // Circle No. 54





DAMPER IS SUITED FOR CONTAINMENT AND DECONTAMINATION

The Ruskin BTR-250 heavy-duty isolation damper is suited for system containment or decontamination applications found in laboratories, medical facilities, clean rooms and federal buildings. Designed to provide bubble-tight airflow leakage performance in systems with up to 10 inches water gauge pressure, the BTR-250 meets the requirements of the bubble test as described in AMCA Standard 500-D. Available in sizes ranging from 4 to 36 inches in diameter, the product includes a flanged channel frame for easy installation. Although the BTR-250 built to standard construction includes round flanges, Ruskin offers this model with an optional square flange design to support job-site mounting challenges. Additional options include factory-drilled mounting hole patterns in flanges, factory-supplied and mounted actuators, and switches.

www.ruskin.com/model/btr-250 // Circle No. 55

GAS WATER HEATER MEETS CRITICAL LOAD REQUIREMENTS

A. O. Smith has launched the Cyclone LV, a large-volume commercial water heater that rounds out the company's Cyclone family of high-efficiency gas products. A. O. Smith created the LV model to serve the needs of facilities that require large storage for jobs with critical load requirements. The model's modulating process adjusts the burner's firing rate to a specific demand, which allows for performance of up to 96 percent thermal efficiency while lowering operating costs. Available in 220- and 250-gallon capacities, these units allow engineers to specify two Cyclone LV units where they would have previously needed four Cyclone Mxi units. Cyclone LV products feature advanced electronic control with built-in diagnostics and free iCOMM remote monitoring. LV models' lightweight design eases maneuverability and installation.

www.hotwater.com // Circle No. 56



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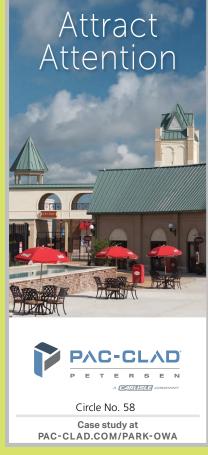
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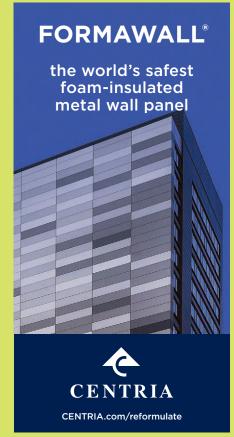
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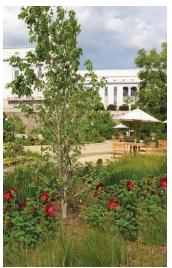
GREEN THUMB

Sustainable Gardening Is Showcased at Renovated Bartholdi Park











he renovation of Bartholdi Park at the United States Botanic Garden (USBG), Washington, D.C., is a showcase of sustainable gardening. Created in 1932, Bartholdi Park has served as a demonstration garden for more than 80 years and until 2016 had not undergone a complete renovation since its original construction. The renovation provided an opportunity to increase accessibility, showcase the Sustainable SITES Initiative principles in action and demonstrate USBG's

commitment to sustainability.

Bartholdi Park is the first project in Washington to be certified under SITES version 2. SITES is a comprehensive system for designing, developing and maintaining sustainable land. It serves as a guide for sustainable landscaping and land development in a similar way to the U.S. Green Building Council's LEED green building program.

"We are excited to now have Bartholdi Park as a living example of a sustainably designed garden right in the middle of

Washington, D.C.," says Saharah Moon Chapotin, executive director, USBG. "This allows us to showcase how sustainable gardening can be beautiful, as well as provide benefits for both humans and the environment."

Renovation plans focused on SITES' key areas: water, soil, plants, materials and human health. The story of Bartholdi Park's renovation is shared through new interpretive signage throughout the park. An interactive booklet also was developed to explain the park's plants and

sustainability. It can be picked up free-of-charge at the Conservatory's Information Desk.

The United States Botanic Garden is open to the public, free of charge, every day of the year from 10 a.m. to 5 p.m. The Conservatory is located at 100 Maryland Ave. SW, on the southwest side of the U.S. Capitol. More information is available at www.USBG.gov.

View how Bartholdi Park has become a model for sustainable landscape design and development.





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