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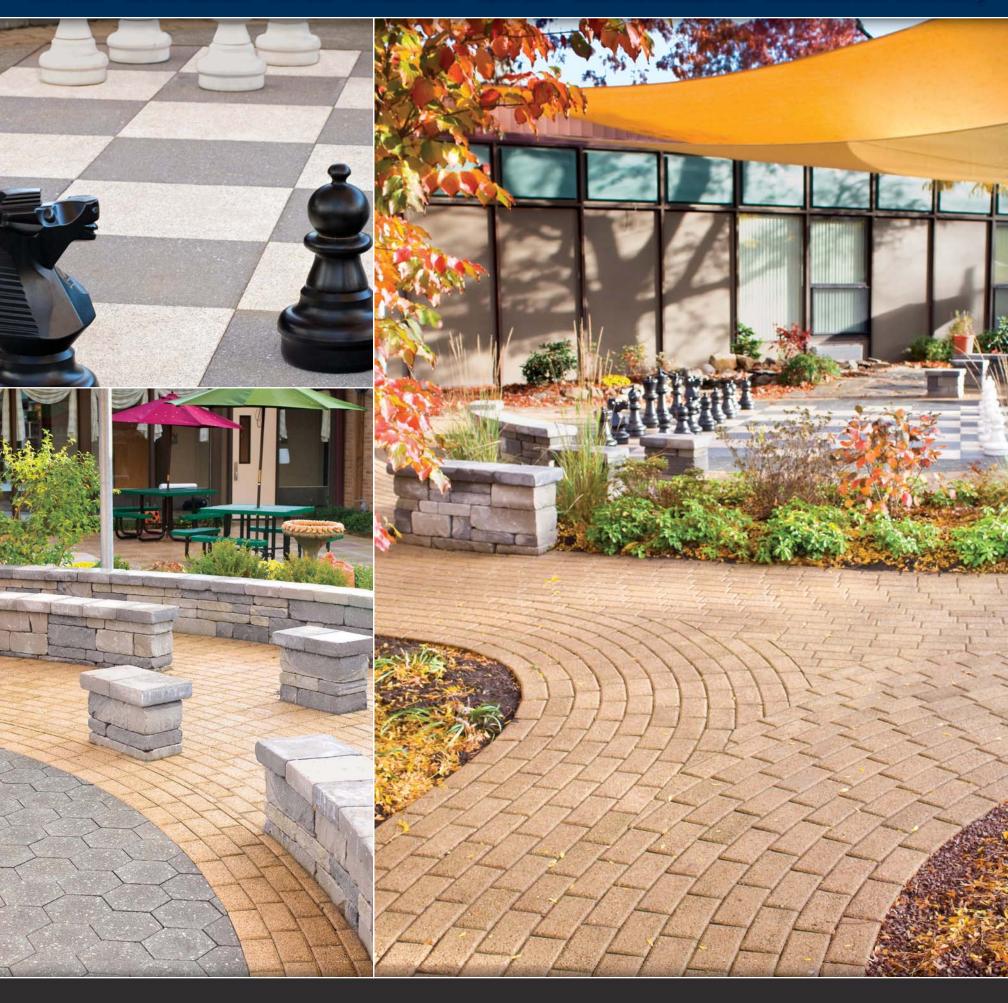
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The Indiana Univ. Cinema, with its restored Thomas Hart Benton murals, was originally constructed in the 1930s. It is an example of how MGA Partners blends the old with the new in university buildingrestoration projects. Learn more on p. 10.





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### Going With The Green Flow, p. 16:

When you go to the digital magazine and click on the Digital Extra icon for this article, you will download a pdf file that helps you better understand hydronic systems, how they're designed, and the energy savings they can provide.

### On The Job: Human Factors In Workplace Design, p. 22:

This Digital Extra is a zip file that contains an Excel spreadsheet you can use to calculate the ROI your client/company can expect from a new-flooring investment.

### **Building Power: In-Floor Cooling Evolves With Data** Centers, p. 28:

This Digital Extra download will show you the various options that are available with raised-floor air-handling systems, along with the energy savings that can be

### **Quality Construction Scores With SIPs, p. 32:**

Click on the icon in the digital magazine to download a brochure that details application of structural insulated panels in schools.

### Aluminum Composite Flies High At Children's Hospital, p. 34:

The brochure that you receive from this Digital Extra download will provide you with the basic specifications and structural details of aluminum composite material.

### Window Retrofit Makes Energy Savings Clear, p. 38:

The brochure you'll download with this article describes the specifications of the company's Renovate Platinum Series window retrofit technology.

### STI Exit Stopper specifications, p. 51:

In the digital magazine, click on the Digital Extra icon in the STI ad to download a specification sheet that details the company's Exit Stopper warning device.



s part of our variety of online editorial products, Commercial Building Products presents Commercial Conversation at http://www.commercialconversation.com. Commercial Conversation is a series of semi-monthly podcasts in which the editors speak with commercial-construction industry experts about issues that affect specifier decisions. Podcasts are supported by a resource page and are available for download from the website.

### Why NFPA 285 is Important with Herbert Slone

Herbert Slone returns to discuss the importance of NFPA 285 and the impact it has on exterior-wall-system design. Read his article on p.8, then listen to the podcast to learn more about NFPA 285, which is playing a significant role as part of an increased focus on energy-code compliance and fire testing.



### Vegetative Roofs with Herbert Slone

The sixth Commercial Conversation podcast looks at vegetative roof systems, including design and specification considerations. Guest Herbert Slone is a registered architect and technical manager of commercial building for Owens Corning, Toledo, OH. He has authored numerous professional articles in his more than 30 years in the construction industry.



### Match Education Technology with Education Design with Amy Stein

In our fifth podcast, we talk with Amy Stein, architect at MGA Partners, Philadelphia, about the design and renovation of higher-education facilities to provide dynamic learning environments that meet current and future needs and provide flexibility as education techniques embrace electronic tools.



### Make Business Noise When the Economy is Quiet with Chris Sullivan

In our fourth podcast, we talk with Chris Sullivan, principal at C.C. Sullivan Strategic Communications, Montclair, NJ. Chris tells you why it's important to be an aggressive marketer when the economy is slow so you'll have the best chance of earning new business and will be at the forefront when business improves.





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# LEDfair 2012

As I write this, Lightfair 2012 is a couple of weeks into history. It was, once again, an interesting show because lighting is one of the few areas in which technology is moving forward at a rapid pace and the movement is virtually all in LED technology. I chuckled when someone spoke much truth by referring to the show as LEDfair.

As I traveled the show floor talking with manufacturers (Out of curiosity, I carried a pedometer this year and found myself averaging 5 miles/day.), I think I saw just about every possible variation on the LED theme. Some developments looked/sounded promising and others had that "me too" sound to them. Collectively, very little stood out and I started to wonder, with so many companies touting LED technology, if we aren't headed for a rather significant consolidation. I'm seeing no indication that LED adoption in actual buildings is moving at a pace rapid enough to support so many companies.

What stood out for me?

The fact that EYE Lighting Inc., Mentor, OH, continues to develop and improve metal-halide lamp technology was encouraging. There are a lot of fixtures in service that aren't going away anytime soon and better, more efficient lamps are a welcome thing.

The Zipline product (p. 55), introduced by Leviton Mfg Co. Inc., Melville, NY, is a modular system that eliminates the rat's nest of wiring and allows you to quickly convert T12 fluorescent fixtures into two- or threelamp T8 fixtures and realize significant up-front labor savings and long-term energy gains. It's a slick product that even I could install.

There was an LED-technology development that commanded attention. I've always felt that, particularly in indoor applications, the Achilles' heel of LEDs is heat and that fixtures are rapidly reaching the point where heat sinks are too big and/or active cooling is required. While I don't believe it was a new introduction at the show, Nuventix Inc.'s (Austin, TX) SynJet technology looks to be a major step toward energy-stingy active cooling. According to their representative, the technology allows manufacturers to use heat sinks that are a fourth the size of those required with passive approaches.

In the support-the-little-guy category, I had the pleasure of meeting Nancy Wahl-Scheurich of LittleFootprint Lighting, Santa Cruz, CA. Her story is that she has, basically on her own, designed, developed, and sourced the HeronLED task light (p. 54). It's an elegant fixture that is manufactured using resin made from recycled plastic from discarded electronics. It's an attractive, functional fixture and I hope she sells a ton of them.

As for the 15-million LED "developments" that were offered at the show, I'll leave those nuances to the lighting magazines and wait until things get a little more consolidated.

Gary L. Parr

**Editorial Director** 

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# Firing Up Testing For Exterior Walls

NFPA 285 defines fire-safe building performance. Easier access to the data could increase compliance.

### Herbert Slone, RA, Owens Corning

Although continuous insulation (CI) has been part of the ASHRAE 90.1 standard for commercial buildings since 1999, we're hearing more about it within the building community these days due to the increasing focus on energy-code compliance and fire testing from the National Fire Protection Agency (NFPA), Washington. That provides a renewed opportunity to educate professionals about NFPA 285, which is used to evaluate and control the fire performance of foam plastic used as CI.

CI, which is prescribed in ASHRAE 90.1 for nearly every climate zone, is defined as "insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings ... or is integral to any opaque surface of the building envelope." Because CI covers framing elements, it limits thermal bridging that otherwise occurs when only stud-cavity insulation is used in the wall assembly. The CI concept applies to steel stud framing as well as to masonry or cast-concrete walls, where it completely covers the surfaces of masonry walls, creating a continuous-insulation envelope.

Many types of insulation can qualify as continuous. It is typically rigid-foam plastic, such as extruded polystyrene insulation, but it can be rigid foam-board expanded polystyrene (EPS) or polyisocyanurate, or even semi-rigid boards of fiberglass or mineral wool.

### **Running the tests**

The NFPA 285 test is required in the International Building Code (IBC, Section 2603.5.5) when combustible foam-plastic insulation is used in the exterior walls of multi-story buildings of construction types I, II, III, or IV. By code definition, buildings of those types have exterior walls constructed of non-combustible materials. The test is to verify that combustible foam-plastic insulation inside the wall, when exposed to fire on the exterior face of the wall assembly, does not spread flame excessively over the surface or through the core of the otherwise non-combustible wall assembly.

Some variation of test standard NFPA 285 has been mentioned in each edition of the IBC since its first edition in 2000, and in the three model codes that preceded it. The now-defunct

ICBO Uniform Building Code first included the concept in the 1988 edition, requiring testing in accordance with the UBC Standard 17-6, a predecessor of NFPA 285. The other two national model building codes of that era also required full-scale testing of this type for exterior walls.

The 30-minute test is conducted on the front side of a three-sided, full-scale, two-story test structure, built as it would be in the field. The test wall has a window in the center of the

This wall system has effectively contained the spread of fire

This wall system has effectively contained the spread of fire from the room of origin.

lower floor. The premise of the test is that a fire, unrelated to the insulation inside the wall, has occurred in the lower-story room. The test assumes that the fire has reached flashover condition and has blown out the window, thus exposing the window head and the wall above it to a fire plume emitted through the window. Early in the test, the fire plume wraps around the window head and heads up the exterior wall.

To pass the test, the wall assembly must limit fire spread vertically and horizontally from the window. The extent of fire spread is determined visually and measured in feet and by temperature throughout the wall assembly. The photo above shows a successful test with the brick veneer stripped away just above the lintel over the window opening. Note the very limited fire spread and melting of the extruded polystyrene foam.

### **Getting the data**

While awareness about the importance of NFPA 285 testing for CI is higher than ever, finding

information about compliant CI assemblies can be time- and labor-intensive for architects, specifiers, and contractors. Unlike the searchable online certification directories for Underwriters Laboratories, Northbrook, IL, or Factory Mutual, Johnston, RI, there is no public database of NFPA-285-tested assemblies.

Rigid-foam-plastic insulation manufacturers have conducted much of the currently published NFPA-285 assembly testing on systems that

include their insulation products and other companies' wall-system components. Some manufacturers publish very complete guides to their tested assemblies and make them available online, but finding the data is an unreliable process at best for professionals.

Unfortunately, the difficulty in locating compliant assemblies has prompted some organizations, such as the National Institute of Building Sciences and the American Institute of Architects, both headquartered in Washington, to try to change this portion of the code altogether.

NFPA 285 plays a significant role in helping define fire-safe building performance, and easier access to this information could promote greater

compliance. We know such access is available for other aspects of building design and construction, so why not for this? As design professionals, we should encourage the International Code Council, Washington, and accredited testing agencies to develop online databases for NFPA-285-tested wall assemblies. Having the information readily available will be good for everyone on the building team.

Herbert Slone is a registered architect and technical manager of commercial building for Owens Corning Insulating Systems LLC, Toledo, OH.



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# feature EDUCATION



- The College House projects added large casual spaces for studying, meeting with professors, or just relaxing by gazing at a courtyard and the Quad.
- While the architectural styles of the new and old buildings are separated by decades, if not centuries—the college was founded in 1787 with a donation from Benjamin Franklin—the transition between them is so smooth that it can be difficult to tell where one ends and the other begins.



# **Building On The Past** Saves Campus History

Universities are typically rich in tradition, so renovating their historical buildings for modern use makes sense, especially when it saves money.

### **Mary Keefe, MGA Partners**

s colleges and universities seek to upgrade their campuses for 21st-century academic life, many are deciding to revive the usefulness of their existing buildings with renovations and thoughtfully designed additions. This approach pays homage to a school's legacy, is often the more sustainable option, and creates interesting design opportunities.

MGA Partners Architects in Philadelphia has designed a number of renovations of historical buildings, as well as revivals of modernist buildings for prominent institutions across the country. Since 1991, Daniel Kelley, FAIA, and Mary Keefe, the firm's senior partners, have worked with Amy Stein, AIA, LEED AP, and the firm's other associates to complete nearly \$1 billion in constructed projects.

Many of those projects are for prominent colleges and universities, so there is a deep and broad understanding of collegiate missions and interpreting those missions in built form. Recent clients have included the Univ. of Pennsylvania, Philadephia; Princeton Univ., Princeton, NJ; Franklin & Marshall College, Lancaster, PA; Indiana Univ., Bloomington, IN; and Case Western Reserve Univ., Cleveland, among many

This article highlights three renovation projects: the master plan and College Commons at Franklin & Marshall; Dalton Hall at Bryn Mawr College, Bryn Mawr, PA; and the Lee Norvelle Theatre and Drama Center and the IU Cinema at Indiana Univ. The projects revive existing buildings and position existing or new programs and departments with prominent, exciting new identities.

### **Super-dorms**

In 2003, Franklin & Marshall, a liberal-arts college on a historical campus, adopted a College House initiative to reinvigorate student life by integrating daily academic and residential activities. This called for a master plan to create six College Houses serving as many as 1,500 students.

Within the campus precinct defined by the existing residential quadrangle and an adjacent athletic field, the master plan resolved the demands of the program:

- to support the academic and social life of the
- to establish a variety of residential room
- to encourage house members to reside on campus during the length of their academic life
- to create outdoor spaces for each house that enrich the campus landscape.

Subsequent to the Franklin & Marshall master plan, MGA Partners completed the first four College House commons projects. The commons additions are designed to provide the social gathering space for each house and are the focus of the academic integration with space for seminars, colloquia, and guest speakers. Each contains a living room, a multipurpose room, a seminar room, house offices, a kitchen, and support spaces. Also included are exterior spaces of a courtyard and a terrace, which connect to the larger landscape of the Quad. MGA Partners is currently commissioned by the college to study the renovations for the student

Continued on next page.

# feature EDUCATION



- A view through the tower to a historical building across the lawn emphasizes the distinctions between old and new.
- At Bryn Mawr College, a new tower adds modern flair to Dalton Hall, which was built in 1893.
- The renovated laboratories would probably seem like the interior of a spaceship to the designers of the original Dalton Hall, designed in the Collegiate Gothic style that was very popular around the turn of the 20th century.

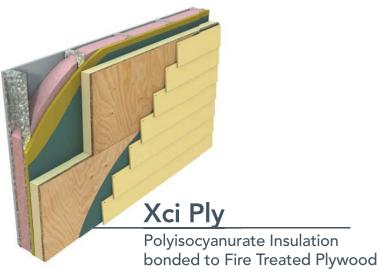
### Old labs go social

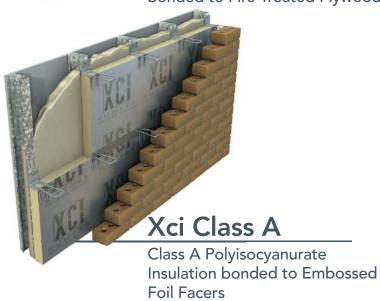
An innovative laboratory building when it was built in 1893, Dalton Hall is part of the National Historic District of Bryn Mawr College. MGA Partners' renovation re-established Dalton Hall as a technologically advanced academic building and transformed it from a campus backwater to the new home of the college's department of social sciences.

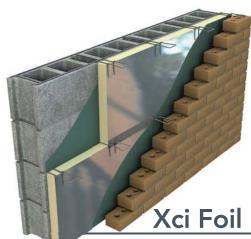
The original thirdfloor chemistry labs were restored for contemporary use, while an adjacent exhibit area was created to house the college's archives. A stair and entry addition, visible from the main campus green, provides a gracious publiccirculation route without sacrificing space inside Dalton. Its tower form, the most evident signal of the building's revival, allows views of the campus from the upper-story lounges. Its lower level houses two classrooms and a lounge and serves as a functional connector to the adjacent campus computer center, Guild Hall.

The building's revival included the full renovation of all floors and restoration of the exterior shell. The conversion to new office and support space maintained and updated the original industrial character of the interior's painted brick and wood walls. The original heavytimber and cast-iron floor system, which was not code-compliant, was replaced by an exposedsteel structure. New office and teaching spaces include classrooms with multimedia capability, meeting rooms, project workrooms, and faculty offices. Continued

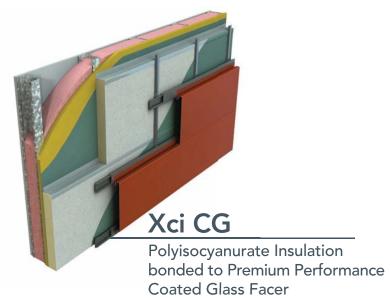
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# High drama for old buildings

The highly anticipated Indiana Univ. Cinema celebrated its grand opening in 2011. Together with the expansion of the department of theatre and drama, the 35,000-sq.-ft. project completes a 15-year master plan for the IU performing arts.

The existing University Theatre, an historical but obsolete 1930s-era building, was revived to house a new, high-tech cinema, performance spaces, and classrooms, launching the new venue to become one of the nation's top cinemas and the premier performance venue for the region. The renovation is technically complex and visionary in its reuse of space: While preserving the building's unique historic features, stateof-the-art acoustic parameters were met.

The design also accommodated the on-site restoration of historically significant murals painted by Thomas Hart Benton. The original backstage and flyloft areas were filled in with floor plates to house a new ensemble of classrooms, performance spaces, and an efficient connection to the adjacent Lee Norville Theatre and Drama Center.

Mary Keefe, MBA, is a partner at MGA Partners Architects, Philadelphia.

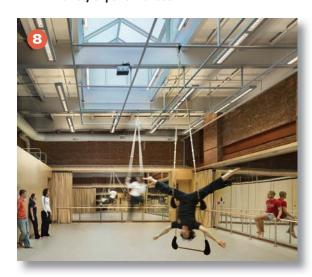


Hear Amy Stein, AIA, LEED AP, an associate at MGA Partners Architects, talk about renovating old buildings at educational facilities in a *Commercial Building Products* Commercial Conversation at http://commercialconversation.com/?p=124.

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- Part of the scope of the Indiana Univ. project was restoration of the Thomas Hart Benton murals, including this one at the back of the auditorium at the IU Cinema.
- The renovation of the drama and cinema complex includes dance studios for rehearsals and practice. This room also receives plenty of natural daylight, thanks to a large skylight.
- The theater features seating that permits the audience to be within five feet of the actors on the stage. The result is an intimate venue for a variety of performances.









# Going With The Green Flow

The key to designing large pumped-water systems is reducing flow to its essential need.

**John Vastyan, Common Ground** 

Il things great and small in the construction market have miraculously acquired the ubiquitous green moniker. In the business of mechanical work and building systems, HVAC-and hydronic-industry professionals too often fixate on a system's "engine" in their attempts to go green. It's natural that boiler manufacturers have greatly enhanced component efficiency. However, it's time to put the boiler in context with large distribution systems to get greater efficiency of thermal-energy transfer. And that, ladies and gentlemen, is what it's all about.

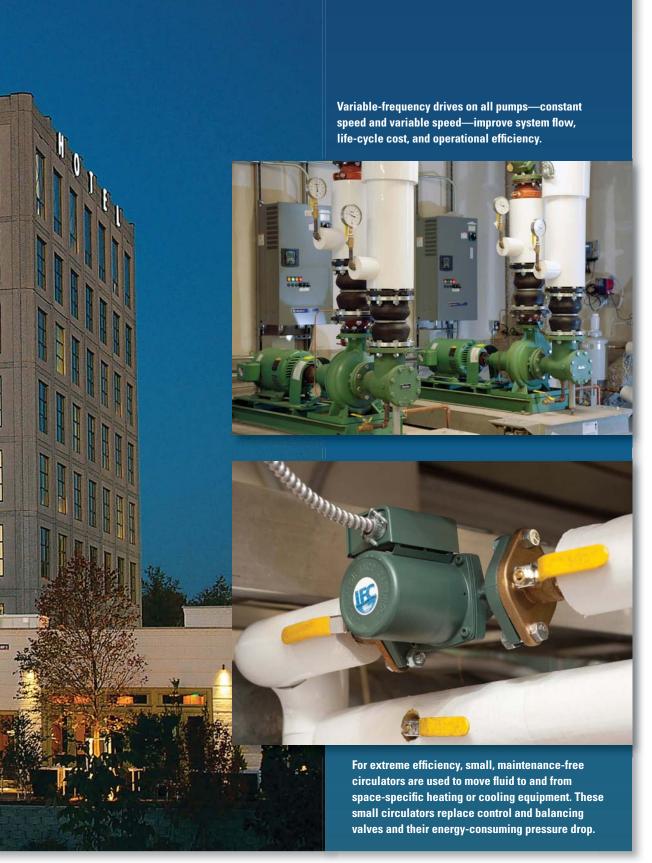
A complete system's capacity to efficiently deliver or dispel heat determines how effectively a boiler or chiller relates to a system, and piping and pumping are the key factors in designing an efficient system. The most efficient boiler or chiller in the world can't make an entire system efficient unless that system is piped and pumped

correctly. As a result, system designers must consider response to outdoor temperatures, water-storage temperatures, and system-loop temperatures, which all contribute to overall system performance.

### Big savings for big buildings

According to John Barba, training/trade program manager at Cranston, RI-based Taco, system designers who want to design larger buildings to an environmentally conscious standard are taking a new look at hydronics. "The technology provides ideal solutions by meeting two important goals: fewer materials used for the HVAC system itself and less energy consumed during operation," he said.

The single-pipe series-decoupled system meets both of these goals while providing superior comfort. A single-pipe hydronic



system, comparatively easy to design and install, uses fewer materials and is nearly selfbalancing. A conventional two-pipe system needs a supply pipe and a return pipe in the primary circuit, requiring more materials and taking up more space. A single-pipe system, however, has only one pipe to be installed, saving space and labor. A single-pipe primary loop typically is routed past a block of fan coils or hydronic panels. The loop(s) may be configured horizontally or vertically.

With its single-pipe primary main, this system uses terminal units configured with decoupled secondary circuits. Tied to a thermostat that governs each heat emitter, wet-rotor circulators direct water through the local-zone secondary system. Enhancements to these systems permit effortless function of individual zones, presenting many opportunities in the commercial realm.

With the use of circulators, control valves are unnecessary. The flow in all secondary circuits is independent of the flow in the primary circuit, so there's no need for balancing valves at heat emitters. By eliminating both types of valves and having only a singlepipe primary circuit, the system uses far less material: on average, 40% less pipe and 40% fewer fittings, no control valves, and almost no balancing valves.

According to Bryan Payne, Southeast commercial regional manager for Taco, the elimination of balancing and control valves in a single-pipe system results in lower head loss than in a conventional two-pipe system. "Chilled and hot water will flow continuously through the loops with pressure provided by central primary-system pumps," said Payne. "Multiple cooling and heating primary loops are configured in parallel to feed

separate buildings, floors, wings, or zones."

Governed by room thermostats, local unitmounted circulators cycle on and off. While operating during periods of demand, the pumps borrow some of the water from the primary loop, pass the water through fan-coil units or heat emitters, then return the tempered water to a downstream connection on the same primary loop. The used water simply blends with the primary water, which then goes to the next unit downstream.

### All about flow

Though the close inspection of operation and efficiency probably won't inspire a Mechanical Systems: CSI television series, there's certainly no lack of interest from commercial-system professionals. Experts are taking a hard look at commercial hydronic and domestic water systems. It's the sort of shake-up that invariably happens when new technology avails a better way of doing things. The purpose of a variable-speed distribution pump is to automatically adjust its speed based on heating load demands, or how many BTUs are needed within a structure. In this case, smart variable-speed pumping is the core of an exciting, burgeoning paradigm shift.

Why all the attention? Because the benefits are so numerous and affect overall systems, key components, operational efficiency, and performance. Some experts believe that what we're seeing now is the broad application of a technology whose time has finally come.

What's refreshing is the objectivity of the movement. It's not about electronically commutated motors that offer a small, cumulative advantage in energy use. It's not about a new pump-impeller design, or high-tech pipe lining, or pipe-joining technique. It's all about flow.

There's no more important, allencompassing facet to the design, installation, or retrofit of large pumped-water systems than to reduce flow to essential need. To move beyond the theoretical and into the practical application of new influences to system flow, I turned to two experts: John Sweaney, senior product and customer-support manager for Watts Radiant, Springfield, MO, and Taco's Bryan Payne.

### **Speaking hydronically**

Sweaney, who has studied large-system flow for nearly two decades, says that whether it's flow on the heat-source side or the load side, there's a huge focus on energy efficiency. "Many things can be done to minimize flow yet maintain or optimize comfort or performance," said Sweaney. "That's the key. We often look at Delta T's [or T: the temperature difference between supply- and return-water temperatures] from a design standpoint, especially if it's a commercial system like

# feature HVAC

a shop, warehouse, or snowmelt system. Installations like these call for larger Delta T's—30 F or more—to reduce system pumping requirements."

Cooler return-water temperatures also play nicely into the use of efficient heating systems such as modulating-condensing boilers, which purposefully harvest BTUs from condensation within the system, geothermal heat pumps, and water-sourced heat pumps.

Though ideal Delta T's for most hydronic systems is a comfort/consistency issue, targeting 10 F, 15 F, or 20 F, many larger systems can meet basic comfort or performance requirements while conserving energy across the board.

"With many properly designed commercial systems, we can ease up on flow requirements to the point where fuel use and pump size and type are substantially influenced, all leading toward enhanced system efficiency," said Sweaney. "The key exception is snow-melt systems where performance can't be compromised: systems to remove ice and snow in critical ASHRAE Class III areas such as emergency room entries, hospital steps, and helicopter landing pads. Typically, we do not recommend a design calling for a Delta T greater than 30 F. For critical areas, the Delta T should be 20 F."

When designing hydronic systems—whether for radiant, snow melt, or high-temperature fan coils or baseboards—there's a direct relationship between the Delta T and flow. "Double the Delta T, and cut the flow in half," explained Sweaney.

### Wider Delta-T reach

The benefits of a reduced Delta T stretch beyond the need for less fuel at the heat source. "It extends to pumps of lesser size meeting the need and the downsizing of piping, fittings, valves and other components," said Sweaney. "A change in Delta T for a snow-melt system could mean the ability to cut the flow rate from 40 gallons/minute to 20, so that instead of 2-inch distribution copper, it could be reduced to 1 1/2," he continued. "This could also mean a reduction in the size of the distribution manifold and smaller radiant tubing or, perhaps, a more frugal layout." Sweaney and Payne referred to two key trends:

**District heating and cooling with insulated PEX.** "This is one we're seeing more of as the green revolution has taken off," Sweaney said. "Central district-heating applications have grown substantially over the past couple of years with the use of super-insulated PEX distribution lines to carry the BTUs between a central plant and, say, living units. New military-housing developments are using this approach."

The use of insulated lines often accompanies the application of alternative

energy sources such as biofuel, biogas, geothermal, and solar at prisons, universities, and apartment complexes. In Alaska, a military installation heats all housing units hydronically with waste heat recovered from the on-base electric power plant. A similar application is the use of underground insulated PEX to carry injection-loop BTUs to remote locations.

Variable-speed pumping to enable variable flow. According to Taco's Payne, the application of variable-frequency drives (VFDs) to constant-speed pumps is now the fastest-growing segment of the commercial-pumping industry, a trend that improves the performance and efficiency of large domestic-water and



For some commercial installations, hydronic equipment can be small and compact, not necessarily requiring a large mechanical room and valuable floor space.

hydronic heating and cooling systems.

Since many states adopted ASHRAE 90.1 as their energy code in the early to mid-'90s, the shift of applying drives to system-distribution pumps has been significant. "The pumps most commonly retrofitted by upgrading to VFDs are larger horsepower, serving loads that vary," said Payne. "The benefits are dramatic, so we're now seeing quick response in the industry to make the improvements. It's the low-hanging fruit."

### Big bang for the buck

In the past eight years, according to Payne, two other trends have greatly affected the adoption of VFDs into more applications: The cost of drives is decreasing and manufacturers have rushed to add features and functionality.

The advantages to retrofitting constantspeed pumps with VFDs include:

- greater energy efficiency
- more precise flow control
- soft-starting and -stopping of motors to prolong pump life
- integration of BMS communication
- better balancing with speed control versus imposing false head

• installing the ability to easily adjust flow to rerate energy plants when system flow gets out of balance or experiences reduced Delta T.

"Most people tend to relate the energy savings of drives and pumps with variable-speed system pumps," added Payne. "But there's a key opportunity in the savings found by balancing constant-speed pumps with a drive instead of balancing by controlling flow with a discharge-balancing valve. In very general terms, most pumps are designed with a safety factor of 10% to 20%. This is a legitimate, useful practice that allows flexibility to accommodate a different mix of equipment or future expansion."

For example, a pump selected at 1,750 rpm with a safety factor on the design head over-pumped the system because it was designed with a "little extra

"At this point the test-andbalance contractor would take the discharge balancing valve and throttle it back—imposing false head—to move the pump back to design flow,"

capacity," Payne said.

he added.

The newer industry best practice is to use a drive to balance the pump while using the discharge valve as a flow-measuring point instead of a throttling point, according to Payne. "Other benefits for constant-speed

pumps installed with drives are that they're now running at reduced speed, which extends their lives. They're also soft-started as a function of the drive. This puts less wear on pump and system components."

"With the focus on first cost, green construction, and energy optimization, our industry needs advantages like these," added Payne. "The decisions we make about design Delta T and flow balancing can have a significant positive impact on system performance."

A 60-HP, constant-speed primary pump with a drive can be set up to pump exactly what the chiller needs without having to induce false head. At a hospital where the cooling load is 24/7/365, the use of a drive could result in very substantial annual energy savings. Typically, the energy savings can pay for the drive in the first year of operation. That's a smart investment.

John Vastyan is president of the trade communications firm, Common Ground, Manheim, PA. Vastyan specializes in the geothermal, hydronic, solar, radiant heat, plumbing, mechanical, and HVAC industries.

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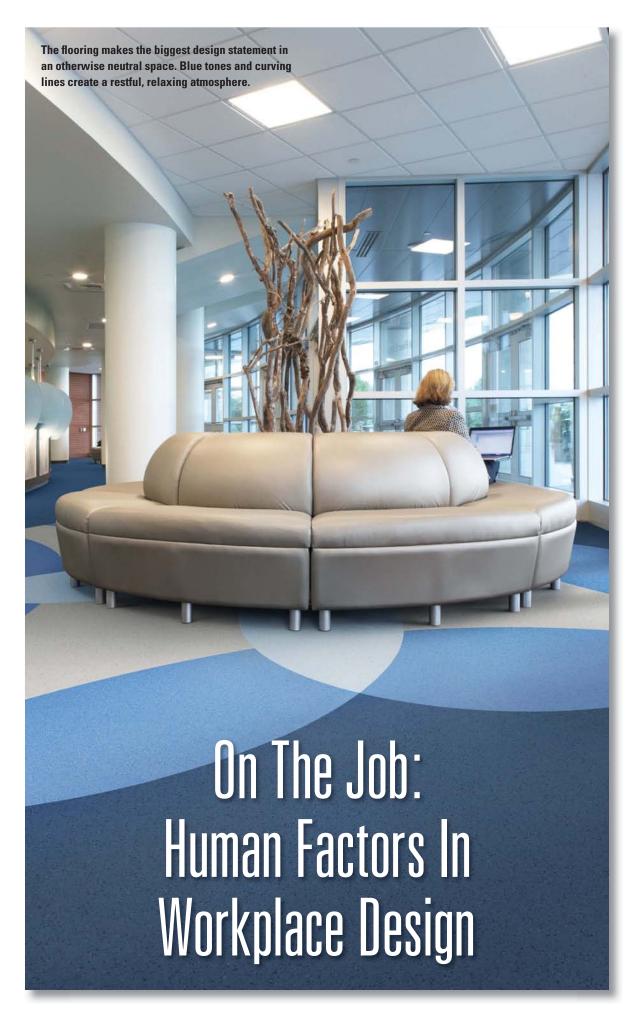


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# feature FLOORING



People-friendly spaces are a major component of the commercial interior-design process.

**Diane Martel, Tarkett North America** 

e often hear the term people friendly when we're discussing the topic of human factors in interior design. This phrase, however, refers to more than the effect of a product on overall human health. The philosophy also includes company labor practices, community impact, human rights, and product responsibility. The role of creating peoplefriendly spaces—from the products used in a building to the layout of space and facility maintenance—is a crucial part of the design process from beginning to end.

According to the Environmental Protection Agency (EPA), Washington, people spend 90% of their time indoors: homes, offices, retail spaces, and educational, medical, and government facilities, among others. It is the responsibility of manufacturers, product specifiers, architects, interior designers, contractors, and facility managers to take all possible steps to create spaces that are safe, healthy, and productive. Flooring typically covers about a quarter of every square foot of surfaces in a building, so flooring and carpeting manufacturers must ensure that their products meet these criteria from product development and manufacturing through the products' lifecycle. When they are successful, the flooring contributes positively to the building occupants' health and productivity as well as that of employees who maintain the look of those products.

### Something's afoot

By deconstructing the evolving humanitarian impacts of the building-product manufacturing industry—an industry committed to innovation in environmental design—conscientious manufacturers demonstrate how a particular finishing product affects the happiness, productivity, health, and safety of building occupants and maintenance workers. Analysis of the product's manufacturing process, installation, maintenance requirements, lifecycle, and aesthetic effects promotes understanding the relationship and interactions between the building occupants and their environments.

Using individual experiences and group surveys, we can compare the direct knowledge of occupants, facility managers, and maintenance workers regarding how their interior environments affect them, as well as the unbiased ways they function in a given space. The final analysis will be about which group has the most knowledge of the effects of interior building products, compared with which group has the most control over the products chosen.

### **Breathing easy**

Everything in an indoor environment, including the building products, furnishings, and occupants, contributes to the indoor-air quality

# Very impr – Ray Fischer, Design Engineer









Bob Stiens of Cincinnati Air Conditioning with Ray Fischer, the project's Design Engineer

Developer Bloomfield/Schon + Partners recently converted the abandoned 180,000 sq. ft. American Can factory in Cincinnati's Northside into a 110-unit apartment complex. Residents enjoy efficient indoor comfort from an HVAC delivery system comprised of Climate-Master® heat pumps and a Taco Load-Match® system.

### No strangers to LoadMatch

The developer chose Turnbull-Wahlert as its GC; the firms had worked together previously on a 98,000 sq. ft. LoadMatch project in Ithaca, NY. Bob Stiens of Cincinnati Air Conditioning was brought on board, too, bringing his wealth of LoadMatch experience to the job.

### **HS2 and LoadMatch save time**

A very tight construction schedule gave design engineer Ray Fischer just five weeks to design and size the system. Ray was introduced to LoadMatch and to Taco's Hydronic System Solutions® software. "That HSS tool saved me a lot of time," says Ray, "I was very impressed. As for LoadMatch, I'd use it again!"

### Taco through and through

The rooftop mechanical room was small, requiring close coordination of

mechanical equipment and Taco products. Twin gas-fired condensing boilers were supported by four Taco KV and KS Vertical In-line Pumps, a Taco Plate & Frame Heat Exchanger and a 4900 Series Air Separator. Despite the space limitations, Bob Stiens says it was a "turn-key install."

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# feature FLOORING



(IAQ). Poor IAQ in a general workplace can trigger asthma attacks, spread disease, and expose occupants to sick-building syndrome. Other health risks posed by IAQ include drowsiness, headaches, and dizziness, which affect morale and have a direct relationship with productivity and the overall health of occupants in a facility. In hospitals, poor IAQ can pose a significant risk to patient recovery. In educational or office environments, poor health can inhibit occupant participation in routine activities.

Inferior indoor-air quality can be caused by several factors, including inadequate ventilation, insufficient or improper cleaning, and excessive emissions of volatile organic compounds (VOCs). While VOCs are also present in nature, people's potential exposure level rises as much as ten times while indoors. The EPA advises the most effective and energy-efficient way to improve indoor-air quality is to control the sources of pollution, including building materials and interior design elements, and to install an efficient HVAC system.

As an example, consider allergies. According to the American Academy of Allergy and Immunology, Milwaukee, allergies affect more than 60 million people in the United States. What's more, the chemicals used to clean facilities—chlorine, laundry detergents and softeners, and ammonia—contain toxic ingredients that affect the health of the occupants. Studies suggest that nurses who spend long hours at a hospital have among the highest rates of environmentally induced asthma of any profession. To further improve the way products affect IAQ and the health of building occupants, some companies have moved to measuring TVOCs, or total volatile organic compounds.

To remedy the risks of building products contributing to bad IAQ, third-party certifiers can test products such as flooring to ensure a healthy composition and eco-friendly manufacturing. For the manufacturers who develop these products, the best way to positively affect the IAQ of the buildings where their products are specified is to make a product that requires minimum maintenance. Low-maintenance products typically use less water and fewer chemicals in ongoing upkeep.

### Low maintenance, high performance

Maintenance workers benefit most directly from high-functioning, low-maintenance interior products, such as flooring, because of their reduced exposure to chemicals used in cleaning during daily or weekly upkeep. In spaces where upkeep is constant, such as schools and hospitals, the necessary maintenance also affects building functions and, thereby, occupant productivity.

In hospital facilities, low-maintenance flooring is crucial because it keeps occupants from being disturbed by elaborate cleaning procedures, allowing patients to rest and recover free from noise and chemicals. Hospitals can never fully close for maintenance and because their occupants are some of the most vulnerable to the effects of IAQ, harsh chemicals, and the risks of improper upkeep, the maintenance requirements for hospitals have a large effect on the immediate health and safety of their occupants.

Reducing or alternating the type of product used for maintenance has also had a positive economic impact on several hospitals, according to a study by the international advocacy group Healthcare Without Harm, Reston, VA. New Jersey's Hackensack Univ. Medical Center's pediatric-oncology center switched from using traditional toxic-chemical-laden cleaners to custom-made natural products, which dropped cleaning costs by 15% and, more importantly, improved IAQ for employees and patients. Another

hospital chain in Winnipeg, Canada, has specified that only high-functioning, low-maintenance flooring be used in all of its hospital facilities, a policy it has upheld for more than 35 years.

### **Design considerations**

Human-factor experts show that colors and patterns affect building occupants. These aesthetic considerations have the capacity to enhance the purpose and experience of a building by

influencing motivation, creativity, and mood. Knowing this, many companies who design indoor products that incorporate color and design guide customers toward the most intelligent and integrated choice for their projects by providing advice and assistance from the planning stage of a project through post-installation maintenance.

The correct use of color in healthcare facilities has shown reduction in hospital stays by approximately two and a half days. In schools, color and patterns help improve test performance by 20%, and in offices, pleasing aesthetics can increase office productivity rates by as much as 16%. Research shows that today, building occupants work more effectively in brighter, more occupant-friendly buildings, and they understand the effect that the building and its interior-finishing products have on their productivity and demeanor.

In a survey reaching more than 200 office workers across the United States, 98% of respondents felt that their work environment had an impact on their productivity and demeanor. Of those, 60% were aware that the products in their building contributed to the air quality of the building, and 67% felt that the air quality in their building was good. Two-thirds of respondents said that it mattered if the products in their work environment were sustainable or sustainably maintained. Possible contributors to these attitudes could be the ongoing discussion in the media about

environmental responsibility and the fact that products from food and clothing to paint and plywood have logos and labels declaring them organic, green, and sustainable.

### **Designs for safety**

Specific to the flooring industry, there are many features that can directly or indirectly affect the safety of building occupants. Resilience can reduce leg and foot fatigue. The floor can offer

thermal control and noise minimization. Welding rods decrease bacterial growth. In addition, preventive measures, such as raised treads on stairs, help prevent slips or falls and improve traction for the visually impaired, which can help reduce the nearly 3 million disabling accidents that occur on stairs every year. Manufacturers have designed products that meet requirements for hygiene, static control, water and chemical resistance, acoustics, and heavy traffic. Addition-

Better soundproofing is on the wish list of many occupants of commercial buildings. Acoustical flooring muffles the sound of footsteps and helps minimize other noise.

> ally, industry experts have studied the sensorial aspects of the healing process, learning which colors and patterns help people heal faster and alleviate anxiety.

Whether in a healthcare facility, school, office, or another building, the type of flooring specified has an impact on the health and safety of occupants and employees. Unfortunately, decisions about flooring are based largely on building-specific requirements and the project

budget. While human factors may not be the main consideration in choosing building products, a responsible product choice will benefit each group of occupants in their day-to-day work lives and in their continued health and safety.

### The horse's mouth

To better understand the human impact of interior spaces, we conducted individual interviews and broad surveys, assessing three main groups with

> separate degrees of agency in relation to their interior building products: occupants, building owners/facility managers, and maintenance workers. Whether working in a hospital, school, office, or mixed-use facility, each subject group had a different understanding of how their workplace affects their creativity. Due to the sensitive nature of discussing one's workplace, all survey respondents and interviewees remained anonymous.

> **Occupants.** Of the building occupants surveyed, the majority were full-time employees who worked in traditional office buildings. An overwhelming 98% felt that the specific elements of their building's environment affected their productivity and demeanor. Factors such as natural and artificial lighting, interior color scheme and decor, overall workplace cleanliness, and office layout were all seen as design elements that affected the employees' everyday demeanor either positively or negatively. Flooring and wall color were the least pleasing elements of interior decor, while furnishings were the most pleasing.

Of the 60% of respondents who said they were aware that interior products contributed to the indoor-air quality of their building, 67% thought the air quality in their workplace was good or satisfactory. Of the building features surveyed, which included windows, flooring, furnishings, and wall color, windows were valued by 63% of respondents to be the most pleasant feature of

a space. Respondents spoke of enjoying light, and windows provide a natural relief from

Meanwhile, 43% specified that flooring was the least pleasant office feature next to wall colors. When asked what things could be changed about their workplace to make it a more pleasing or healthy environment, respondents said more color, a cleaner floor, better soundproofing, and a better smell, among other things. Continued

# feature FLOORING

Maintenance workers. Unlike building occupants and many building managers, maintenance workers are often employed as contractors, where they are responsible for cleaning many kinds of facilities, all requiring vastly different products and procedures. Although many maintenance employees are not aware of how the product or cleaning materials affect occupants in the long term, they all were acutely aware of how maintenance procedures and requirements affected their own productivity and that of those who worked in or accessed the building on a day-to-day basis.

For this group in particular, the interior environment affects not only the actual productivity of maintenance workers but also the *perceived* productivity. According to one interviewee, the age of the flooring and how it has been maintained affects job and demeanor, as older buildings or floors never look as clean as newer ones, which in turn affects clients' satisfaction with their cleaning work.

While the flooring and the maintenance required affects this group most directly, they often have little to no input on which floors are used. Once the client is established, contracted maintenance workers are given some control over which cleaning products

are used on the floor, but this depends largely on the type of facility, the type of flooring, and the budget, rather than the preference of the employee. In terms of maintaining the look of flooring, the interviewees agreed that daily traffic was the most damaging and inevitable aspect of the building's function but requires the least work to clean if done on a regular basis. In facilities such as schools and hospitals, maintenance workers, who are often a part of the building's staff, have less control over each aspect of the facility, from the products used to the kind of flooring. But these are also the facilities that require the most specialized interior furnishings relative to the buildings' use.

**Facility managers.** Every building owner and facility manager surveyed thought that the interior of a building affected the building occupants, including themselves. Though facility managers do not always have the final say in what products go into a building's construction or renovation, they have the most control of the three survey groups. Two-thirds of respondents said they are involved in product decisions, but they do not have the final call.

A separate recent study by Tarkett found that 86% of respondents who do have some

input on product specification, including owners, architects, and designers, stated that they consider the effect of indoor-air quality on building occupants when specifying products. Of the building features surveyed, including windows, flooring, furnishings, and wall color, windows were valued by 6% of building managers as the most pleasant feature of a space. After furnishings, the second most displeasing element was flooring. When asked what things could be changed about their workplace to make it a more pleasing or healthy environment, primary responses included better airflow, updated carpeting, more color, a cleaner floor, better soundproofing, and a better smell, among other things.

### **Looking forward**

It is clear that each building-occupant group is aware of the effect that their surroundings have on their morale and productivity. Occupants know and care the most about their interior environments, likely because they spend the most time there. Occupants also have the least control over the products, the facility design, and the maintenance.

Maintenance workers are the most directly affected by the kind of chemicals and procedures needed to clean, but since these factors are dependent first on the type of facility, then on the maintenance budget, there is little room for flexibility or choice. Unlike occupants, facility managers are more concerned with temporary interior elements, such as furnishings, but are still aware that larger elements—lighting and air flow—would be the most beneficial changes to any work environment.

In any building, the type of flooring specified has a wide-reaching effect on the health and safety of occupants and employees. Despite such irrefutable evidence, unfortunately, the choice of flooring is based largely on building-specific requirements and budget. A responsible product choice will benefit each group of occupants in their day-to-day work lives and in their continued health and safety. Only shortsighted specifiers could ignore such long-term benefits and focus on short-term savings.

Diane Martel is vice president, environmental planning and strategy, for Tarkett North America, Whitehall, PA. She is responsible for driving the company's sustainable messaging, programs, initiatives, education, training, and industry awareness.



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# In-Floor Cooling **Evolves With Data Centers**

Multiple control options eliminate hot spots and effectively manage diverse, variable loads.

Daniel Kennedy, Tate Inc.

s data centers evolve, data-center designers, owners, and managers strive to ensure that their facilities meet four important design criteria. First, the center must accommodate a large volume of services, including data, power, and water lines. Second, it must incorporate a system capable of efficiently cooling high-density rack loads that are variable and diverse throughout the facility. Third, the data center must be flexible enough to adapt quickly and easily to client, organizational, and technological changes. Finally, it should provide a platform for future scalability.

For years, raised-floor systems have met these criteria as the preferred method of cooling data centers. The most common data-center design uses a perimeter computer-room air-conditioning (CRAC) unit to deliver cool air under a raised floor and distribute that air through airflow panels in front of IT equipment. The raised-floor environment manages and segregates large volumes of wires, cables, water lines, and other distribution systems. As equipment is updated and technology changes, additional services can be added or relocated without abandonment or structural changes. The build-out of a raised floor can easily stop and start for a phases approach. Raised floors provide

a platform to easily implement any current or future cooling strategy for optimal energy efficiency.

### Raised floors and heat loads

Just as importantly, raised-floor systems address the challenges of cooling high and often variable heat loads associated with data-center equipment, virtualization, and cloud-computing strategies. In the past decade, IT technology has increased in density to the point where individual racks can now consume more than 30,000 W. As density increases, so does the amount of power that is dissipated into the data-center environment as waste heat. As a result, data-center cooling infrastructure must be capable of supplying sufficient airflow to meet new demands when and where cooling is needed.

In addition, heat loads within data centers are now variable over the short and long term and on a rack-by-rack basis, affecting airflow requirements from one rack to another. To further complicate datacenter cooling requirements, individual loads within a rack fluctuate throughout the day due to the processing demands of IT hardware.

Given these circumstances, the key to success in



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a data center is the ability to control the amount of air entering a rack and directly match it to airflow requirements of the IT hardware at any given moment. To meet such needs, new technologies are emerging for raised-floor designs, including local and dynamic airflow-delivery technology and high total-aircapture airflow products. These innovative devices allow sufficient airflow delivery to the IT load while ensuring the delivery of the precise amount of air to the IT equipment, which also ensures reliability and lower energy costs.

### Directional airflow saves energy

Directional airflow panels angle airflow toward the face of the rack, nearly eliminating bypass air while increasing cooling capacity and energy efficiency. These panels can achieve a 93% total air capture (TAC) rate, significantly reducing the amount of bypass air—air that is delivered into the data center but not consumed by the equipment and finally exhausted as waste heat. Delivered through the panel, TAC is the amount of air that directly enters the face of the server rack in front of that panel. Using a directional panel can save more than 40% in fan energy by enabling a rack with equal load to be effectively cooled with approximately half the cubic feet/min. required with a conventional panel.

With less air required and higher Delta T's, or larger differences in the temperature of water flowing into the system and water flowing out, fewer computerroom air-handling (CRAH) units may be needed in a new data center, reducing initial capital expenditures

as much as 40%. In retrofit applications, CRAH units with fixed-speed fans can be set to standby mode, or variable-fan drives can be adjusted to operate at a lower static pressure, saving energy.

In a legacy data center with only one accessible airflow panel, directional-airflow panels can split airflow evenly and angle it in two directions, sending directional airflow to racks on either side of a cold aisle. For applications where less airflow is required but directionality is needed to match cooling with heat loads, perforated directional panels are available.

### Flowing with the changes

Although directional airflow improves the distribution of air to all points of a rack face, minimizing bypass air and improving efficiencies in the process, it does little to address the issues posed by diverse loads. Data centers today rarely present a homogeneous load profile. In fact, it would be difficult to find any two racks in a large data center that consume exactly the same amount of energy. While some racks have yet to be deployed, others may be fully deployed but with equipment that requires very little airflow. Still others may support high-density equipment that requires 10 to 20 times the airflow of the rack directly beside them. Efficient cooling requires that the airflow delivered to each rack be matched to that rack's demand.

For IT hardware with fixed airflow requirements, single- and multi-zone opposed-blade dampers ensure accurate airflow balancing. When installed beneath a directional-airflow panel, the dampers allow technicians to adjust airflow to a single zone or

as many as three zones (top, middle, and bottom) in a single rack without removing the directional panel. The multi-zone opposed-blade damper also can shut off or dampen airflow to different sections of a rack with large portions left empty, especially important in data centers where co-location operators are unable to install blanking panels in their customers' racks, or IT managers are unable to keep blanking panels installed in their own racks. Zoned dampening can allow IT managers to optimize the airflow quantity far more accurately.

The matter of diversity is further complicated when the load in the rack changes due to processing demands at any given moment. This fact, coupled with the increasing use of cloud computing, only serves to drive increased load variability in the rack on a minute-by-minute basis, making manual tuning of the airflow at the panel level impossible.

### VAV for specific needs

One of the newest solutions to the challenge of variable demand at the rack level is an automatic variableair-volume (VAV) device installed below each airflow panel. Temperature sensors mounted on the front of the rack control the VAV damper and, therefore, the airflow amount, maintaining the proper user-programmable inlet air temperature on a rack-by-rack basis. This helps data-center managers implement strategies for virtualization, cloud computing, and servers with idle standby modes while saving energy.

Furthermore, a system coupled with a directional panel nearly eliminates bypass air and accounts for local temperature fluctuations. The system also provides indirect feedback to the air-handling equipment. As the VAV damper closes, the underfloor static pressure increases, and pressure transducers installed in the raised-floor plenum signal the air-handling unit to slow its fan speed.

This ability to reduce fan energy contributes to lower energy consumption, particularly during periods of non-peak computing demand. The amount of energy savings varies based on the utilization rate. For example, a VAV damper can save more than 50%

in fan energy for a 10-kW rack with a 10% utilization rate that is equipped with servers that use only 5 kW in idle mode.

### Spot cooling

New technologies also meet demands for spot-cooling areas of a data center where airflow is low due to insufficient raisedfloor height or other underfloor restrictions. Fan-assist modules effectively manage the cooling requirements for dense server racks and blades by providing a blast of cooling through an individual airflow panel. Using temperature sensors mounted to the front of the rack, the module automatically turns on when conditions require additional cooling without over-cooling other racks and significantly degrading a facility's energy efficiency.

Equipped with a variablespeed fan drive, a fan-assist module can be throttled up or down based on heat-load requirements, making the module the ideal solution for cooling the toughest hot spots in a data center. As a best practice, these units should be installed with a directional airflow panel to control bypass air as it throttles up or down. When combined with CRACs and CRAHs that

use variable-frequency drives or electronically commutated fans, the fan-assist module contributes to savings through the ability to deliver higher volumes of air at lower static pressures.

Multiple control options for fan-assist modules and VAV dampers eliminate hot spots and effectively manage diverse and variable loads. Client-sensor options provide the most control flexibility and are ideal for clients with existing sensor networks, tapping into data already being collected and using it to drive these devices.

Single-sensor options offer a temperature probe to monitor inlet-air temperature. Typically, the probe

is mounted near the top of the rack face to monitor the recirculation path over the top of the rack. For racks that are not fully loaded, equipment should be loaded from bottom to top and the probe placed as high as the equipment in the rack.

Finally, multiple-sensor options offer three temperature probes for full-rack-height monitoring of inlet-air temperature. Full-height monitoring ensures monitoring of air recirculation paths and works best with stand-alone racks or on racks at the end of aisles. Devices with this monitoring option can be equipped

to work for people working in environments where temperatures exceed acceptable working conditions, including data-center-contained hot aisles. By allowing cool plenum air to enter the hot aisle on demand, dampers decrease temperatures to comfortable levels, allowing technicians to work as long as necessary to complete their tasks.

### Stay cool

Recent years have seen the introduction of dramatic changes in the ways data centers are built and oper-

> ate. Loads have increased and become more variable. Many of these changes affect demands on data-center cooling systems. Fortunately, new in-floor cooling solutions, including directional panels, VAV dampers, and fan-assist modules, are keeping pace with the evolving design and demands of the data center. As a result, raised-floor systems continue to provide data-center owners and operators with a variety of benefits:

- enhanced cooling capabilities and control
- increased efficiency and heatload capacities
- ability to adapt to technological changes over the life of the data center
- easy distribution and segregation of water, power, and cable
- flexible and adaptable plat-
- neat interior space that ensures proper air migration in and out of the equipment
- scalability.

It should come as no surprise that the raised-floor system will continue to support data-center design with new, cost-effective, and energy-efficient in-floor solutions that provide data-center owners with compelling returns on invest-

ment and lower operating costs in new construction and retrofit applications.



with cards that allow the devices to interface with the existing building-management system, retrieving current inlet temperatures and damper positions or fan speeds and adjusting individual unit temperature set points.

Some new technologies directly affect datacenter technicians. For example, in-floor dampers provide on-demand cooling in contained hot aisles, allowing technicians to comfortably work on equipment in those aisles for extended periods of time. The Occupational Safety and Health Administration, Washington, sets exposure limits for working environment temperatures with a specific ratio of rest

### **AUTHOR**

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panels provide energy efficiency, strength, and fast installation even in tough climates. t its best, building design and construction operates like a professional sports team. In the same way players collaborate to score more points than the opposing team, savvy architects, contractors, and building owners cooperate closely to achieve a well-constructed building on time and on budget. Likewise, various building components should integrate well for energy-efficient, durable, and cost-effective construction.

The development of the Little Big Horn College (LBHC) Health and Wellness Center in Crow Agency, MT, demonstrates how individual project-team members, as well as building elements, can work together effectively for a common win.

### Sizing up the game

The Health and Wellness Center project involved three key challenges:

- create an energy-efficient building envelope in a demanding climate
- meet the structural loads for the shell of a large, open interior space
- complete the project within a very tight construction deadline.

Completed in fall 2011, the 35,000-sq.-ft. Health and Wellness Center is a major addition to the college campus, located on the high plains of southeastern Montana. A central feature of the building is a 1,300-seat NCAA gymnasium—home to the Little Big Horn College Rams. The center also serves the nearby community with spaces for physical fitness, pow wows, dances, and other events.

Consistent with the center's role in supporting healthy living, the college (of the Apsàalooke Nation, Crow Tribe of Montana) wanted an environmentally conscious, energy-efficient building targeted to LEED Platinum standards. Green construction also reflects the tribe's historic, cultural, and artistic way of life.

"Energy savings is a big part of getting to the LEED Platinum goal," said Ben Mitchell, project manager with general contractor Fisher Construction, Billings, MT. "It's hard to get a gym to meet any energy code, let alone LEED Platinum." Montana's frigid climate exacerbated the energy-efficiency challenge; the average daily low temperature in Crow Agency is 6 F in December, 4 F in January, and 11 F in February. On the flip side, the average daily high

temperature in July and August is 88 F.

In addition to the problem of achieving energy efficiency under such weather extremes, the large open areas of the gymnasium and community-gathering spaces created structural challenges. Many parts of the building required high walls and long-span ceilings with minimal columns.

A primary difficulty with the project was a demanding schedule for rapid completion. To meet the college's short time window for leveraging a government development grant, the project team had to begin construction (earthwork and pouring the foundation slab) even before they completed the building design. Further, snow and wind make construction in Montana challenging, and the Health and Wellness Center was built during one of Montana's coldest winters in several decades.

### Moving the ball downfield

Although projects can easily go sideways when design and construction occur simultaneously, the Health and Wellness Center project team had the advantage of using an integrated project delivery (IPD) approach. Unlike the traditional method of separating the design and construction contracts, under an IPD the players all sign one contract focused on project completion, rather than on their separate practice areas. IPD provides all parties with a clear stake in a successful outcome. As Scott Moore, project manager with BNIM Architects, Kansas City, MO, said regarding the LBHC project, "IPD allowed every team member to bring their best ideas to the table and collaborate on solutions."

To meet the triple challenge of energy efficiency, large open spaces, and need for fast construction, the project team came together in selecting Premier structural insulated panels (SIPs) from Insulfoam, Tacoma, WA, for the exterior walls and roof. "SIPs meet a number of needs with just one system," said Doug Morley, principal architect with Springer Group Architects, Bozeman, MT. "They install fast, insulate well, and are strong. Other than in the large gymnasium, this reduced the need for a secondary support structure in the building and saved a bunch of time and money."

### A shot and a score

Because SIPs come in large sizes (typically as large as 8-feet by 24-feet), there are fewer gaps to seal than with other building methods. Additionally, the insulation is integrated with the structural elements and is continuous across each panel's height, width, and depth. SIPs help

create a tight, well-insulated building envelope and reduce thermal bridging—all of which can reduce a building's heating and cooling energy consumption by as much as 60%, compared with traditional construction methods.

"The SIPs provided a super energy-efficient envelope—much better than we could get from other products for the same labor and material costs," said Ben Mitchell, Fisher Construction's general contractor for the Health and Wellness Center.



SIPs help create a tight, well-insulated building envelope for superior energy efficiency in any climate. Photo courtesy of BNIM Architects.

With high shear and diaphragm values, SIPs work well in long spans for large, open indoor spaces, such as gymnasiums, auditoriums, and cafeterias. Photo courtesy of BNIM Architects.



"Plus, SIPs are strong and provide great design flexibility," added Matt Anderson, owner of Compass Consulting Engineers, Boseman. "They work well in long spans and have high shear and diaphragm values. This was especially crucial to help create the wide-open space in the project's gymnasium."

Reflecting on the development timeline, several of the project team members noted how SIPs speed construction. "SIPs really helped us meet the accelerated project schedule,"

# project Building envelope

Anderson said. "SIP shop drawings were done concurrently with design, so by the time we released the foundation package, the SIPs were being fabricated in the shop. The erection was extremely fast, and in no time at all we were dried in."

"With the pre-built panels, you just have to piece the building together like a puzzle," said SIPs contractor Glen Kamerman, partner with Kamerman Construction, Manhattan, MT. "The SIPs were accurately constructed

> and went together well. Using Premier SIPs probably saved about 15% to 20% or better on the installation time. It also eliminated the need to heat the walls during winter construction, as would have been necessary with concrete masonry units." In total, crews installed 70,000 sq. ft. of SIP wall and roof panels in the LBHC project.

### Taking home the trophy

An energy-efficient building envelope is a primary green attribute of the Health and Wellness Center. Other environmentally aware features include on-site rain-

water detention, and systems such as prismatic skylights and sun-shading devices to reduce reliance on artificial lighting and mechanical heating and cooling systems. The SIPs work well with these other components to help create an environmentally responsible building that supports community health in the short

and long terms.

The win at Little Big Horn College is only one example of education projects in harsh and temperate climates that rely on SIPs. Other recent buildings of note include the Portland Community College Newberg Center, Newberg, OR, and Finn Hill Junior High, Kirkland, WA, which have SIP walls and roofs as part of net-zero-energy-ready designs. In Las Vegas, contractors for the 70,000-sq.-ft. Jacob E. Manch Elementary School used SIPs to reduce the building's framing schedule by 60%-from 121 days to 47 days.

When building-project teams work together as a cohesive unit and use materials that provide multiple

advantages, as SIPs do, the problem of developing cost-effective, high-quality buildings is easier. Similar to the precise, powerful, and coordinated work of a championship sports team, people and products come together to create something exceptional.

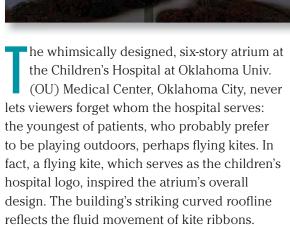
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# Aluminum Composite Flies High At Children's Hospital

An extraordinary entrance to a children's hospital soars with creativity and color.



The \$29-million, 65,000-sq.-ft. atrium is the front door to the hospital and the OU Children's Physicians Office Building. Described as one of the most unique buildings in the state, the atrium's undulating roofline profile, which has been compared to water slides or ski slopes, features cladding that is a combination of glass skylights, standing-seam metal roofing, and Alucobond aluminum composite material (ACM) by 3A Composites USA, Statesville, NC. Alucobond comprises two sheets of 0.02-inch aluminum thermobonded to a polyethylene

free product information at www.cbpmagazine.com

core and provides extraordinary flatness and rigidity, excellent formability, low weight, and outstanding weather resistance.

The kite-ribbon concept provided a foundation for interior building elements, too, including furniture, floor patterns, and wayfinding components. Two large, child-inspired, commissioned pieces of art by internationally recognized artists complement the kite theme. Mackenzie Thorpe's "Skipping Together" sculpture celebrates the joy of children, and Shan Shan Sheng's "Imagination Flying"—a set of 28 multi-colored polycarbonate butterfliessymbolizes transformation and hope. Another artistic focal point is an interactive bubble wall, which vertically intersects three floors with continuously changing colors and bubble intensity that are motion-activated by visitors' movements.

Miles Associates, Oklahoma City, designed the atrium in collaboration with the St. Louis office of HOK through schematic design of the

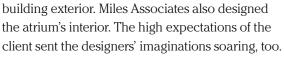


# project Interiors

- The atrium of the hospital is home for 28 brightly colored, polycarbonate butterflies created by San Francisco artist Shan Shan Sheng. Photo courtesy of University Hospitals Authority & Trust.
- ▼ The second level of the atrium brings the creative designs up close. On the left is a motion-activated interactive bubble wall with continuously changing colors and bubble intensity. Photo courtesy







"The University Hospitals Authority & Trust [the building's owner] wanted to make a statement with the entry," said Jorge Charneco, AIA, senior vice president for health, science, and technology at Miles Associates. "They wanted it to be inviting and serve as a distraction for kids entering the hospital. They wanted it to take their breath away. There's a lot of art installed in the atrium, which is a pretty big draw. I've never worked on a project where people come in just to take pictures and leave, but it's happened here. You also know it's special when contractors start taking pictures during construction."

### **Versatility soars**

Architectural Fabricators Co. (AFC), Bartlesville, OK, fabricated 46,739 sq. ft. of 6-mm-thick Alucobond ACM in Silver Metallic and installed





The atrium's curved skylights, the topiary-like benches, and the fanciful butterflies evoke the sense of a park instead of a hospital. Photo courtesy of University Hospitals Authority & Trust.



# project Interiors

the panels, primarily with Alucobond's Structure-Lock RS system, which features an enhanced gutter system that helps keep rain away from the building while processing it to clean panels naturally. The building also features Alucobond's AFC-200 Dry System.

In addition to cladding the curved roof, AFC installed Alucobond throughout the building: on the exterior columns, soffits, entryway canopy, glazed-in curtainwall, interior wall columns, beam wraps, and even as trim on the revolving door.

The fabricator also created custom coverings for everything from lights in the terrazzo floors to recessed lighting, mechanical boxes, and return-air enclosures. In all, more than 2,000 individual Alucobond panels were fabricated for the project.

"Every configuration of Alucobond can be found on this job," according to Mike Proctor, AFC president. "Each panel was a custom shape; nothing was typical. We had to measure and build each panel to fit."

Added Shane Hand, project manager for AFC, "This is the only job I've been on where I've maintained an office on-site. We were able to design on the fly, responding to changes every day."

### **Fast solutions**

Miles Associates' architects were so impressed with AFC's responsiveness to design changes that, when they ran into a glitch with the original consultant's design, they turned to the fabricator to develop trim for the three-story, granite water feature. Hand suggested constructing trim pieces from Alucobond naturAL material. With its brushed finish and FEVE clear coat, naturAL maintained the original design's stainless-steel look. AFC fabricated and installed approximately 200 sq. ft. of 4-mm-thick naturAL for the trim.

"When we walk up to the water-feature panels, people are surprised when I pull them open," said Charneco. "It was a great decision. We got quality trim when we installed Shane's custom-measured panels. It provided a crispness that wouldn't have been achieved with the previous design."

AFC recommended Alucobond for this project not only for its ability to easily be formed into unique architectural shapes but for its durability, according to Proctor, who praised Alucobond's tensile strength and core. "The Children's atrium has turned into quite a wonderful reception area with the butterfly sculptures overhead. It's a very clear and open space. I don't think another material could have

produced the sleek look that they wanted."

"We had worked with Alucobond previously," said Charneco. "There's a certain assurance going with the Alucobond brand name versus 'Brand X'. The product is great. One of the strengths of this project was being able to collaborate on designs with Shane and his crew."

The success of the exterior application was what inspired architect Charneco to use it indoors, too.

"Alucobond has a crispness that you don't get with other materials," he said. "Inside, the Alucobond design elements are reminiscent of the outside. Adding the panels inside allowed us to blur the line between inside and outside."

A hospital is likely to be the last place any child wants to be, but entering a hospital through such a fantastic atrium makes the medicine go down a little more smoothly. Thanks to the creativity of so many designers and the versatility of Alucobond, at least some of the memories of staying at OU's Children's Hospital might bring a smile to the patients' faces.

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# Leaving Gaps in Your Sustainability Efforts?

### Gaps under doors compromise HVAC efficiency and waste energy

Out of position and settling floors are common problems that create gaps under exterior doors. Surface-applied sweeps are an ugly and ineffective stopgap fix, but now there's a better solution—the concealed Adjustable Bottom Brush from Special-Lite. It's available for all Special-Lite® Doors, either installed in new doors or as an easy to install retrofit kit.

Reduce energy usage, improve occupant comfort, and keep out unwanted pests by tightening up your building envelope designs with Special-Lite Doors.

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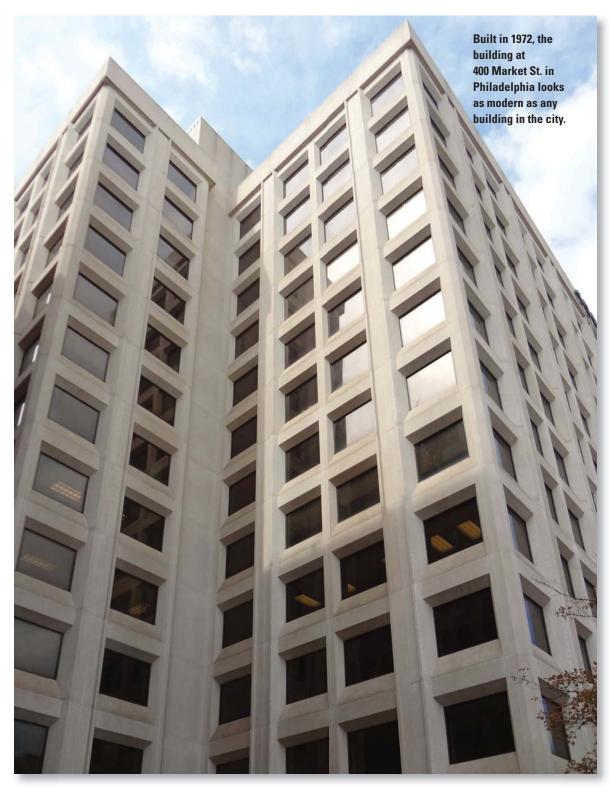


# Window Retrofit Makes Energy Savings Clear

An innovative window system adds to occupant comfort and energy efficiency.

ike hundreds of aging high-rise buildings throughout North America, 400 Market St. in Philadelphia was in need of a major upgrade to help it compete with newer buildings in a hyper-competitive commercial real-estate market. Fast forward to 2012: The 40-year-old, 12-story, 200,000-sq.-ft. building is dramatically cutting energy use and increasing tenant comfort while becoming a national model for the Better Buildings Initiative. Launched in 2011, the initiative is a \$4-billion partnership between private industry and the federal government to improve the energy efficiency of commercial office buildings by 20% by 2020.

Because of the energy savings associated with its unique window-retrofitting project, 400 Market St. also is part of a \$1.6-million study funded by the U.S. Department of Energy (DOE), Washington, to measure the potential of low-e



retrofit glazing systems to improve the energy efficiency of existing commercial buildings.

### Old windows waste energy

While expansive windows and views are attractive selling points for any commercial building, older structures such as 400 Market St. were typically constructed with single-pane windows. That makes them big energy wasters, according to the federal government.

DOE estimates that inefficient windows account for as much as 25% of a typical building's heating load in cold climates and 50% of the cooling load in warm climates. Upgrading these windows on hundreds of high-rise buildings, particularly throughout the Northeast and Midwest, represents a significant opportunity to cut America's energy use.

The most dramatic example of this

potential energy savings is New York's newly renovated Empire State Building. In 2010 the iconic building received more than 6,500 replacement windows as part of an extensive, multi-phase renovation project. Building officials predict the window upgrades will help reduce energy consumption in the 102-story landmark more than 38% and save \$4.4 million in annual energy costs. A further testament to the improvement is the fact that the building has earned LEED Gold certification from the U.S. Green Building Council, Washington.

### A less-costly solution

400 Market Street is one of the first buildings in the country to install Renovate by Berkowitz (RbB) from J.E. Berkowitz LP, Pedrick, NJ. RbB is a window retrofit system that converts old, single-pane windows into highly efficient, triple-

# project WINDOWS

glazed insulating glass units, enabling owners to avoid the inherent expense and disruption of traditional "rip out and replace" window-upgrade projects.

The RbB window-retrofit system features Cradle-to-Cradle-certified lites of Solarban and Sungate 600 low-e glasses from PPG, Pittsburgh. The lites are separated by an argon-gas-filled cavity. A custom-formulated warm-edge spacer hermetically seals the new unit to the existing glass, creating a permanent, no-maintenance attachment. After installation, the upgraded triple-pane windows offer heat-trapping R-values in the winter that are as much as six times greater than the original windows', while insulating U-values in the summer reduce solar heat gain coefficients by as much as 65%.

The RbB system was selected after extensive research into more traditional renovation options, according to Carolyn Pfeiffer, property manager for Philadelphia-based Kaiserman Co., which owns 400 Market St.

"We were looking to upgrade the efficiency of the building envelope to improve our Energy-Star rating, reduce operating expenses, and improve the comfort level for our tenants," she explained. "We previously used window film, but it would lose its effectiveness and was subject to scratching and color changes, and it would keep the building only slightly cooler in the summer. It wouldn't help keep the building warm in the winter. We also considered full window replacement, but the cost was prohibitive even without the supplemental cost of temporarily relocating tenants and disrupting their businesses."

Pfeiffer said the RbB system helped mitigate all of those concerns. "The new system was about half the estimated cost of a traditional windowreplacement project and helped make us eligible for a tax deduction of as much as \$0.60 per square foot," she explained. "The contractor was able to replace more than 18,000 sq. ft. of glazing (525 windows) in 50 working days, which was two to three times quicker than the estimates for the traditional replacement scenarios."

Because 400 Market St. remained completely enclosed, occupants encountered minimal disruptions to their work areas throughout the retrofit project, which was another factor in deciding to implement the system. "Overall, our tenants were pleased with the installation," Pfeiffer noted. "We were able to avoid the time, cost, and hassle of temporarily relocating them. Now that the renovation is complete, we've heard comments about how much more comfortable the building is, and tenants on the lower floors have mentioned a decrease in street noise."

As part of the renovation, Kaiserman Co. also installed a high-efficiency boiler system and has reported a significant reduction in running times since the window retrofit was completed.



### A shining Energy Star

Given the potential of the RbB system to improve energy efficiency in high-rise buildings, 400 Market St. now serves as a research case study for the DOE, the NAHB Research Center, Washington, and Quanta Technologies, Malvern, PA, which are monitoring energy performance throughout the building. They are concentrating their technical analysis on two pairs of unoccupied offices facing different orientations—north and east. One room in each pair has been retrofitted with RbB, while its twin will be left in its original, single-pane configuration until the end of the yearlong study.

The three organizations will use the energy-modeling data to compare actual energy consumption at 400 Market St. with pre-project projections and past usage. Calculations made with the eQuest energy-simulation program from DOE project the building will save 25% in annual energy costs. "While our study has just started, preliminary observations are very encouraging," said Thomas Culp, project manager for DOE.

In addition to improving energy efficiency and tenant comfort, the RbB system will help 400 Market St. earn a minimum of four LEED credits. "After collecting hard data for a year, we hope to achieve an Energy Star rating and LEED Silver certification, which few buildings have achieved in Philadelphia," noted Pfeiffer. "The RbB system made transforming 400 Market St. into an energyefficient, competitive building a cost-effective reality. We anticipate the renovation will be a key factor in retaining and acquiring tenants." 🛅

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# products HVAC & PLUMBING

# Duct-free system

Art Cool duct-free system is available with a range of options to provide a green HVAC system. Wall-mounted models include a 12K unit with SEER as high as 26. A 9K model provides as much as 28 SEER. Both units have four-way-swing airflow, providing a six-step vertical vane, five-step horizontal louver, and a 16-degree horizontal current to disperse air effectively in any environment. The unit also offers heating options with as much as 39 feet of airflow and a 70-degree vertical airflow to complement the three-column heat exchanger, which uses tubes of varying diameter to reduce heat loss. A redesigned fan adds a 15-degree angle to the blades to reduce surface pressure and noise levels.

LG Electronics
Englewood Cliffs, NJ
Free information: Circle 111



- Duct-free heating/cooling system
- Range of models and options
- Quiet operation





### **Commercial water heater**

Armor X2 condensing water heater uses stainless-steel heat-exchanger technology with modulating/condensing combustion to deliver thermal efficiencies reportedly as high as 96%. Available in models with 1.0, 1.3, and 1.5 million BTU/hr inputs, the line offers an efficient solution for a range of applications.

Lochinvar Lebanon, TN

Free information: Circle 112

### Duct and pipe wrap

Foil-backed duct and pipe wrap is an addition to the Mr. Insulate Cotton Armor line. Made from 85% recycled content, the wraps provide an eco-friendly solution for sweating pipes and heat loss from air ducts and water pipes. Cotton reportedly will not cause irritation or itching associated with fiberglass wraps. The wrap also provides sound attenuation.

Applegate Insulation Webberville, MI Free information: Circle 113



### Retrofit AC indoor system

EZ-Fit is an indoor modular cooling system designed to overcome the problems of replacing old air-conditioning systems without site demolition, special lifting, or use of rigging equipment. Each module ships in three sections, reportedly capable of fitting through standard doorways and most elevators. Available in cabinet sizes of 10 to 15 tons and 20 to 25 tons, the cabinets can be ganged together to provide 100 tons or more of cooling capacity. Heat removal is standard water-cooled with an option for chilled water or water-source heat-pump configurations.

United CoolAir Corp.

York, PA

Free information: Circle 114



### **VRF** systems

The company's R2-Series outdoor units cool or heat as many as 50 zones, using Inverter compressor technology. The series is available in 208/230-V three-phase or 460-V three-phase units and has an outdoor temperature range of  $-4\,\mathrm{F}$  to 60 F when heating and 23 F to 115 F when cooling. The units have a capacity ranging from 6 to 24 tons, are available in three module sizes, and can be used with the VRF Y-Series heat pump in the same building.

Mitsubishi Electric & Electronics USA Suwanee, GA

Free information: Circle 115

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(nondispersive infrared) principle to measure gas levels. Sensors have an auto-calibration function. Measuring range is 0 to 40,000 ppm with an operating range of 0 to 122 F.

**Rotronic Instrument Corp.** Hauppauge, NY

Free information: Circle 118

## products HVAC & PLUMBING

### Shower pan

Redi Trench pre-formed, one-piece shower pan can be used with any size Redi Base (52 to 72 inches), plank pitched, molded-in trench, and put in any trench or drain location with a choice of tile-able or grate top.

Tile Redi

Coral Springs, FL

Free information: Circle 119

### **High-efficiency** flushing systems

A line of high-efficiency toilet-flushing systems is reported to conserve almost a third of the amount of water used by a standard toilet. The system combines FloWise watersaving technology and hands-free Selectronic controls to clear the bowl using 1.1 gpf.

**American Standard** Piscataway, NJ Free information: Circle 116



### Scroll compressor

Performer SH295 scroll compressor for air conditioning has a capacity of 25 TR. With a small footprint and reported 25% less weight than other compressors, the unit has a 3.25/W coefficient of performance and cooling capacities that range from 183 to 374 kBtu/h/53 to 110 kW at 60 Hz and 150 to 310 kBtu/h/44 to 90 kW at 50 Hz. The unit uses lead-free bearings and other environmentally friendly materials.

**Danfoss** 



# products HVAC & PLUMBING

### Natural-gas engine-driven system

InVerde Ultra 100 is a UL171-certified, naturalgas engine-driven module that delivers scalable, distributed power generation at low emissions levels. A built-in black-start capability ensures grid independence, and a simple interface makes installation easy. The unit combines a small footprint with

plug-and-play, utilityfriendly operation.

Tecogen Inc. Waltham, MA Free information: Circle 120





### **Energy-recovery modules**

Rapid energy-recovery modules for direct- and indirect-fired heating or cooling units use an air-to-air plate exchanger to capture heat and transfer it to the incoming air at a reported efficiency of 60%. The plate-style design has no moving parts. Standard airflows are 2,000 to 60,000 cfm. During summer ventilation, when using a mechanical cooling section, or when frost prevention is required, face and bypass dampers may be used to divert outside or return air around the module.

Rapid Engineering Comstock Park, MI Free information: Circle 121



### Noise-prediction software

AIM acoustics-information-model software is a free noise-prediction tool. Designed to model the amount of noise that reaches individual spaces within a building through the mechanical systems, the software uses sound data projected through HVAC-system components, noise-control accessories, and architectural elements to predict background noise levels. The software includes a built-in library function that lets users create acoustic-information databases.

Dynasonics Fort Worth, TX

Free information: Circle 122



### **Hydronic** boilers

The NH150-DV and NH199-DV tankless hydronic boilers provide constant room temperature for a variety of heating choices, including panel radiators, baseboard flooring, and radiant floor heating. Significantly smaller in size than conventional hydronic boilers, the direct-vent units appear similar to tankless water heaters and weigh only 66 pounds. The units offer nine temperature settings from 140 to 180 F.

Noritz

Fountain Valley, CA Free information: Circle 123



### **Spiral duct liner**

ToughGard Ultra Round duct liner for spiral duct applications is a fiberglass duct liner overlaid with a fireresistant, black, composite air-stream surface that is scored to allow easy installation in spiral air ducts. The product has improved acoustical performance and may eliminate the need for pins and adhesives in most straight duct sections. The liner also contains an antimicrobial agent.

CertainTeed Valley Forge, PA

Free information: Circle 124



### Water-conserving faucets

The 3500 series water-conserving metering faucets are made of Ecast brass and provide a sleek, modern look. The faucets have a 1/2 gpm output and a self-closing MVP metering cartridge that shuts off automatically. Pre-installed, flexible, stainless-steel hoses connect to standard water supplies.

Chicago Faucets
Des Plaines, IL

Free information: Circle 125



### Variable-speed, wet-rotor circulator

Magna variable-speed, wet-rotor circulator pump has a permanent magnet motor, said to reduce power consumption by 50% or more. An AutoAdapt feature controls pump performance within a defined range. A 10-foot-long line cord connects the circulator to a wall outlet, with no wiring required. When in operation, the noise level of the pump is said to be less than 35 dB.

Grundfos North America

Olathe, KS

# Collection for collaborative spaces

Motivate is a series of tables, seating, and presentation tools for a variety of applications, including classrooms and office meeting rooms. Tables are available in a variety of shapes including rectangular, half-round, and trapezoid. Leg choices are defined by functionality with options that allow fixed or adjustable height, with folding legs or a nesting option. Table undersides incorporate a power-management system. A wide variety of seating options, in a range of colors, is available. Presentation tools include marker boards and carts on casters.

The HON Co. Muscatine, IA Free information: Circle 81

### Motivate:

- Collection of tables, seating, and presentation tools
- Wide product variety
- Tables include power-management system





### Porcelain, wood-look tile

Alpine glazed-porcelain tile adds a modern touch to a classic rustic-wood appearance. Available in a wide range of sizes, the tile is offered in five authentic colors.

**Emser Tile** Los Angeles

Free information: Circle 82



### 3-D wall panels

Eco-Dimensions bamboo wall panel is available in six silhouettes. The lightweight, flexible panels are made from pressed bamboo pulp and can be painted or stained. Panels measure 18 inches by 18 inches and have a Class A fire rating. The material is waterrepellent and sound-absorbent.

**Architectural Systems New York** 

Free information: Circle 83



### Write-on paint

Exclamation paint rolls on like conventional paint while covering a smooth surface to create a writable/ erasable dry-erase area. Covering 70 sq. ft., the paint cures in about five days, is low-VOC, and meets LEED indoor-environment criteria. It can be painted over should room configurations change.

InPro Corp. Milwaukee

Free information: Circle 84

### Negative-impact flooring

The company is certified as a Negative Carbon Footprint provider, reflecting a sustainability-based manufacturing model with verified adherence to ISO-14000 series standards. The company also is registered on the Collaborative for High Performance Schools, and its products contribute toward LEED credits.

**Action Floor Systems** 

Mercer, WI

Free information: Circle 85



### Wood-look ceiling panels

Solo-T natural-wood-veneered, lift-and-shift ceiling panels enhance interior spaces through the warmth of natural wood. Panels use a perforated, mediumdensity, fire-rated fiberboard with a ribbed veneer laminated to the face and an acoustically transparent mat laminated to the back. With a reported noisereduction coefficient of 0.65, the panels absorb sound from multiple angles. Panels mount to a 15/16-inch T-bar grid system. Available in three-plank or six-plank configurations, veneer choices include beech, cherry, maple, and ash. Panels can be painted.

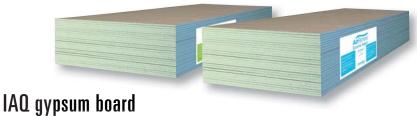
**Decoustics** Valley Forge, PA

Free information: Circle 86

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# products INTERIORS



AirRenew Extreme Impact and Extreme Abuse gypsum board are additions to the company's product line. The abuse-resistant gypsum boards are said to actively improve indoor air quality. The impact model contains fiberglass reinforcement that provides resistance to hard impacts and penetrations. The abuse model is designed for areas prone to surface abrasion and indentation. Both use M2Tech technology, which consists of 100% recycled paper treated to prevent mold growth.

CertainTeed Gypsum

Tampa, FL

Free information: Circle 87



### Laminated glass

Free information: Circle 88



Boing series graphic-patterned glass provides eye-catching focal points. Applications include glass paneling or partitions in hotel, retail, or office spaces. According to the company, patterns can be produced in any color, opacity, or graphic concept. Multiple interlayers are sandwiched between separate sheets of glass to read as a single design. Glass is available as clear, low-iron, or mirror-backed.

**Pulp Studio** Los Angeles





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### **Upholstery** fabric

Tryst is a horizontal-stripe design by Dorothy Cosonas that uses a weaving method in which polyurethane yarn is tacked on the surface of the fabric to create a floating effect. The fabric is said to have an almost liquid surface, contrasting a high sheen on a dry ground. Twelve colors are available.

**KnollTextiles New York** 

Free information: Circle 89



### Green ceiling panels

Optima Open Plan ceilings are available with a fiberglass substrate made with a plant-based binder that contains no formaldehyde resins. Available in lay-in and tegular panels for 15/16- and 9/16-inch grids, sizes are 2 by 2-, 2 by 4-, and 4 by 4-feet. The panels also provide excellent sound absorption and light reflectance.

**Armstrong Ceiling & Wall Systems** Lancaster, PA

## products INTERIORS





### Contemporary table lamps

The company's spring collection of ceramic lamps features cheery colors and intriguing shapes. Cartman, shown here in Poppy Petal, is 27 inches by 17 inches by 10 inches. The sheer organza and white shade measures 10 inches by 17 inches. Other styles include Frangelica, Spiral, and Juicy. The lamps are all made in the U.S.

**Thumprints** Little Rock, AR

Free information: Circle 91



### Angular carpet tiles

The Straight Talk 2.0 carpet-tile collection offers a clean, streamlined, and sophisticated approach to creating meaningful interiors. The collection has straight lines and right angles that offer rhythmic movement and a seamless transition from one pattern to another. Two new patterns, Jive and Connection, have joined the line with 26.1% total recycled content in tufted, textured-loop, modular carpet tile for monolithic installation, bringing the total in the collection to 24 colors and four patterns.

Milliken

Spartanburg, SC

Free information: Circle 92



### Panel LED

The company's Panel-LED illuminates photos and displays using only 4 to 26 W. The ultra-slim design has a snap frame to allow easy photo installation. The aluminum frame is available in black, white, gold, and silver finish and in color temperatures of 6,500 and 9,000 K. The panel can be mounted vertically or horizontally with custom sizes available.

Hera Lighting Norcross, GA

Free information: Circle 93



### **OLED luminaires**

Luminaires Canvis and Trilia explore the advanced design and performance of OLED technology with unique configurations to create mood and movement in a space. The Canvis collection features luminous surfaces expressed through multiple shapes. Its angles, curves, and movement convey mood while providing serene, volumetric light. The Canvis Twist luminaire can dynamically change shape by interacting with building occupants through gestural control. The Trilia luminaires are modular units that allow designers to shape single luminaires into unique, organic networks of comfortable, uniform light. Trilia, which mounts at less than 3 1/2 inches below the ceiling, can be used for multiple applications, such as accent or functional.

**Winona Lighting** Winona, MN

Free information: Circle 94



### **Updated traditional textiles**

Robert Allen introduces Williamsburg Classics II, a distinctive textile collection rich in color, pattern, and style. Inspired by the most graceful, classic looks of the 18th century, the collection features modern colorations mixed with couture-like details. In many cases, patterns are direct reinventions of motifs popular in colonial homes and fashions of early-American society. Inspirations are as varied as colonial dresses and lace caps, pottery and dishware, and copperplate engravings. A variety of design constructions and layouts includes large-scale and chair-scale patterns. All prints feature 100% linen grounds and are appropriate for accessories, light upholstery, or window treatments. The wovens, soft to the touch with intricate detailing, include designs appropriate for heavier upholstery projects.

**Robert Allen Fabrics** Foxboro, MA

Free information: Circle 95



Designers specifying the Monolite Booth as teaming alcoves or alternating high-back sofas now have a new table to get maximum use from a space. The stacking Monolite LapTop table can nudge productivity to an all-time high. The compact table is easy to move and store. Standard finishes are mirror chrome and whitelaminate top with black edge. Also available are white and silver powder. The table is about 23 1/2-inches wide by 12 1/2-inches deep by 26-inches high.

**HighTower Group** 

# Multi-stream HD video delivery



Ocularis-X server software enables Web and mobile clients to access live and playback HD video streams from multiple megapixel cameras over limited bandwidth networks such as 3G/4G, broadband, and the Internet. Video streams are sent to users at their original high-frame rate. According to the company, this results in much smoother video, and users can zoom into an image without losing detail. Compatible with all recent versions of the company's Ocularis program, the software also allows VSaaS video-surveillance service providers to deliver high-speed, high-resolution, multi-camera video to their clients.

**On-Net Surveillance Systems Inc.** 

Pearl River, NY

Free information: Circle 50

### Ocularis-X:

- Multi-stream HD video delivery
- Works on 3G/4G, broadband, Internet
- Compatible with all recent versions of Ocularis



### Dome network cameras

P33 fixed-dome network cameras use Lightfinder color-at-night technology and P-Iris control. Eight models include indoor models streamlined for cost efficiency, along with indoor and outdoor models with features including vandal resistance, audio, I/O ports, and integrated IR illumination. The cameras provide SVGA or HDTV 720/p/1/3 MP resolution based on a 1/3-inch image sensor. Two varifocal lens options are available. Wide-angle models offer an angle of view of more than 100 degrees.

**Axis Communications** Chelmsford, MA

Free information: Circle 51

### Hauppauge, NY

Free information: Circle 53

Vicon



### Electronic server-cabinet lock

E-Plex electronic server-cabinet lock prevents unauthorized access and tracks attempted or granted access. The device can be integrated with a building's access-control system and is said to

Network video-management software

ViconNet 6 is a fully scalable VMS solution, said to

customization and compatibility with a wide range of

ONVIF-compliant COTS network video and computer hardware. Distributed architecture allows the system

to support an unlimited number of cameras, locations,

and users with no single point of failure.

deliver enterprise-level performance with system

be compatible with Lenel access-control systems, E-Plex Enterprise software, and FIPS 201 software. The lock can be scheduled to require card only, PIN only, or PIN and card.

**Kaba Access Control** Winston-Salem, NC Free information: Circle 54



### Fire-retardant spray foam

FR two-component Class 1 fire-retardant foam is a thermal-insulating and sound-attenuating polyurethane spray foam. The foam meets ICC-ES listing and also meets the flammability test requirements of Acceptance Criteria 377 Appendix X, which assesses the fire performance of spray-applied foam-insulation materials for use in attic and crawl spaces without a prescriptive ignition barrier. The foam has a fast cure and is said to reduce energy loss by as much as 40%.

**Convenience Products** 

St. Louis

Free information: Circle 55

### Infrastructure software

The company's 2013 software and services for building-design, construction, civil-infrastructure, and plant-design professionals include enhancements, expanded cloud services, and improved collaboration and data-management tools. The portfolio includes access to Autodesk 360, a platform that offers secure access to project data anytime, anywhere.

Autodesk Inc. San Rafael, CA

# products building technology

### Occupancy sensors

A line of wall- and corner-mount passive-infrared occupancy sensors has self-adapting sensors to provide complete, no-gap coverage. Detecting motion from heat-emitting sources, the products use a segmented Fresnel lens. Some

models include a daylighting feature that prevents additional light sources from activating when the room is already adequately illuminated by natural light.

Other features include a self-adjusting auto-off delay of 5 to 30 minutes and an ambient light level adjustable from 0 to 300 foot-candles. Products have a white finish and are available in coverage patterns of 90 linear feet or as much as 1,200 sq. ft.

Cooper Wiring Devices
Peachtree City, GA
Free information: Circle 56



### Power supplies and accessories

AccuPower switching power supplies and accessories are said to provide clean, filtered, and accurate low-voltage DC power, protecting the performance of all

types of access-control devices. The products minimize noise and interference to better support contactless card readers and radio-frequency devices.

Assa Abloy New Haven, CT

Free information: Circle 57



### Access module

CyberLock Flex system door and I/O module door controller expands the capabilities of legacy hardwired systems. The company reports the product installs at a

lower cost than replacing all or part of an original system. The unit can also activate relay-based devices from electric door strikes to security cameras and remote alarms that prompt a security response.

Videx Corvallis, OR

Free information: Circle 58



### Hybrid fire-alarm system

IntelliKnight 5600 version 2.0 is a 25-point fire-alarm control panel said to provide small applications with the same intelligent detection and maintenance



features as larger, addressable systems. Designed for applications where two- to five-zone conventional fire alarms are installed, the system uses JumpStart software, which performs basic system programming. Features such as detector drift compensation and maintenance alerts are said to greatly reduce nuisance alarms and repeat service calls.

Silent Knight Northford, CT

Free information: Circle 59

# Who Says You Can't Please Everyone?

Fujitsu's new Hybrid Flex Inverter line provides individual comfort to up to 8 zones at once.

Let's face it, one temperature does not please all, which is why Fujitsu's new line of Halcyon Hybrid Flex Inverter (HFI) models allows up to 8 indoor units to be connected to one outdoor unit, providing 8 individual zones of heating or cooling.

- Up to 17 SEER energy efficient operation lowers utility bills
- Flare connections make HFI models easier to install
- One Group Remote Control can control all 8 zones
- Long piping lengths of up to 230 feet increase installation options
- Inverter technology regulates the compressor speed to its optimum energy usage, producing higher refrigerant performance with less power consumption

With Fujitsu's line of Halcyon Hybrid Flex Inverter systems, you really CAN please everyone.



### products EXTERIORS



# Architectural woven-wire mesh

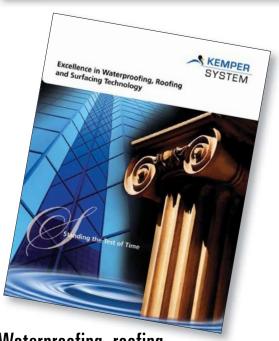
The company offers a fully customizable line of mesh designs in a range of depths and textures. Applications for exterior and interior use include sunscreens, wall cladding, ceiling panels, railings, and signage. The woven stainless steel is durable and requires no maintenance. Systems mount to an existing building with minimal structural support. Materials are made of 100% recyclable materials and can contribute to LEED credits.

St. Catharines, Ontario Free information: Circle 60

W.S. Tyler

### **Architectural woven-wire mesh:**

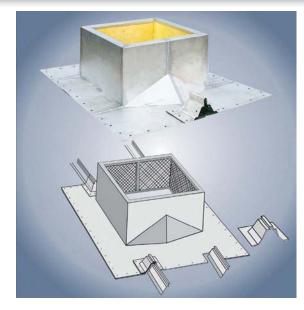
- Custom designs in a range of depths and textures
- Exterior and interior applications
- Contributes to LEED credits



Waterproofing, roofing

Excellence in Waterproofing, Roofing, and Surfacing Technology brochure details the company's solvent-free/odor-free products that are self-flashing, cold-applied, monolithic reinforced membranes. The 8-page brochure includes applications for new roof assemblies, green roofing, metal roofing, balconies and terraces, plazas and IRMA roofing, fountains and water features, interior and industrial uses, gutterways and flashings, and existing-roof recovery. The material highlights environmentally safe systems that can be installed in occupied buildings without disrupting operations.

Kemper System America Inc. West Seneca, NY Free information: Circle 61



### **Roof curbs**

Retro-Curb has an oversized, flat, pre-punched base flange that can be cut to align with roof seams. The insulated curb provides unrestricted positioning on standing-seam roof systems and is custom designed to accommodate any roof slope for rooftop equipment. Made with 18-gauge Galvalume, the curb provides watertight installation.

Thybar Corp. Addison, IL

Free information: Circle 62

### Fade-resistant finish

Chroma Finish colorant for EIFS, stucco, and air/water-resistive barriers produces strong, intense colors for projects that require intense colors and high color

retention. With the colorant, the company reports colors such as deep blues and bright reds can be produced with a fade-resistance warranty. The finish uses low-VOC and APEO-free technology.

CHOICE

BASF Wall Systems Jacksonville, FL

Free information: Circle 63

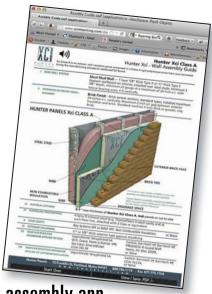


### Air barrier and adhesive

ExtraSeal is a single-component air barrier and continuous-insulation adhesive for use on vertical, abovegrade concrete; concrete masonry units; and glassmat, gypsum-sheathing wall surfaces. It can also be used as continuous insulation adhesive for EPS, XPS, or PI rigid insulation boards on CMU and GMG. Product features include reduced energy consumption, resistance to damage by wind and stack effect, and no air leakage between substrate and air barrier.

Sto Corp.

### products EXTERIORS



Wall-assembly app

The Wall Assembly Guide iPad app (also available as a browser-based tool), helps specifiers build a complete exterior wall system using the company's polyisocyanurate wall-insulation products. The app is available at no cost from the iPad app store. When the three primary wall components (base wall, insulation, and cladding) are chosen, the app builds the entire wall system, including necessary vapor-barrier and sheathing materials, and creates a full wall specification. The specification can then be saved as a pdf file. Unlike most apps of this type, the only products in the system that are specific to the company are the company's polyisocyanurate insulation products. Suggested products for all other components are from other manufacturers.

Hunter Panels Portland, ME

Free information: Circle 65

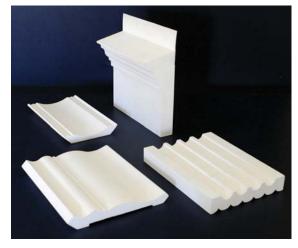


### Self-draining floor panels

Edge Gold flooring panels use Down Pore self-draining technology that channels water from the panels' surfaces and drains it off the joists below. Three specially shaped drainage grooves on one of the narrow ends of each 4-foot by 8-foot panel resist clogging from sawdust or adhesive and allow water to drain. An edge-seal formulation is said to also reduce edge swell.

Weyerhaeuser Federal Way, WA

Free information: Circle 66



### **Architectural mouldings**

The company's line of low-maintenance trim includes four profiles for ornate, classic, or historical designs. Crosshead pediment consolidates trimboard, rams crown, and drip edge profiles. Cove crown, 8-inch crown, and fluted/reeded casing are also available.

**Azek Building Products** 

Scranton, PA

Free information: Circle 67



### Plug-and-play solar

Instant Connect solar panels eliminate panel-to-panel wiring for commercial DC systems and residential AC systems. UL-approved electrical connectors are integrated directly into the sides of the panels, allowing the panels to plug together. The frames provide connector alignment.

Westinghouse Solar Campbell, CA

Free information: Circle 68



### Louvers

Stationary and adjustable louvers are available in a range of blade types and custom capabilities. From acoustic to sightproof and combination to storm class, the company provides a range of products to meet a variety of airflow, sound, and water-penetration requirements. Louvers are available in a range of enamel and fluoropolymer coatings.

Airolite Co. Schofield, WI

Free information: Circle 69



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- Options include immediate trip or arming delay
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Safety Technology International, Inc.

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2012 ST

# Floor-to-ceiling curtain wall



**6250i-HRX curtain-wall and window-wall system provides enhanced condensation performance and low U-factor, along with floor-to-ceiling views.** Matching the system's narrow, 2 1/2-inch vertical mullion sightlines, the company offers the 4250i-V multi-lock, out-swing, zero-sightline operating vent companion series. According to the company, the HRX wall combines energy efficiency with natural light, ventilation, and views. The aluminum systems are manufactured with a high percentage of recycled content, helping to contribute to LEED credits. The curtain walls are factory-assembled and factory-glazed and shipped to a job site in units that are typically one lite wide by one floor tall. Interlocking frame members are weather-stripped to horizontally and vertically seal to one another.

**Wausau Window and Wall Systems** 

Wausau, WI

Free information: Circle 70

### 6250i-HRX curtain wall:

- Floor-to-ceiling views
- Low U-factor
- Can contribute to LEED credits





### Bi-fold door/wall system

The B-F series bi-fold door/wall system combines folding aluminum-frame glass panels to create a transparent, moveable, yet secure wall system for large openings. The system uses top-hung panels connected by hinges that fold in alternate directions, accordion style. Panels are guided by top and bottom tracks to slide and stack to the side, providing a clear opening. Individual middle panels also open independently to provide traditional door access. The system is available with narrow, medium, or wide stiles. The series can be configured with as many as eight panels spanning a maximum opening of 24 feet.

Gamco Corp. Flushing, NY

Free information: Circle 71

### **Online directory**

The company's online product directory provides full descriptions of all products, explanations, and applications. All brochures are available for download, and the website also includes an interactive project-references section.

Pilkington North America Toledo, OH

Free information: Circle 72



### Electronic cylinder

GEO global electronic-opening cylinder provides wire-free access control for most doors. The IP66-rated unit is an addition to the company's 360-degree wire-free locking solution and is compatible with most RFID technologies in all weather environments. Users can manage access credentials and add, restrict, or delete privileges. With an open architectural design, the unit can be connected to an existing security system.

Salto Systems

Free information: Circle 73



### Tempered color-effects glass

Narima thermally tempered, weather-resistant, color-effects safety glass offers six color variations that change according to the sun's angle and where a person is standing. In an insulated window configuration, the product can be used for the exterior panel to create color effects. Other applications include façade glazing and interior glazing such as doors and accent panels where safety glass is required.

Schott North America Inc.

Elmsford, NY

### products WINDOWS & DOORS



### Folding window system

This folding window system is more than 8-feet wide and has four panels. The exterior is clad in recycled aluminum and finished in a Gingersnap color. The system uses ogee casing with double-pane insulating glass with LoE3-366 coating. The interior finishing is fir with a chestnut stain and hardware in matte black. Used with the company's folding door systems, the windows complement oversized openings.

Kolbe Windows and Doors Wausau, WI

Free information: Circle 75

### Wood door design

The company's Inspiration Book provides users with design and performance attributes for most door designs. Information is included on the company's exotic veneers, A and AA veneers, inlay capabilities, custom laser marquetry, and one-of-a-kind sketch face possibilities. Doors comply with STC, fire-rating, and sustainable product codes.

VT Industries Holstein, IA

Free information: Circle 76

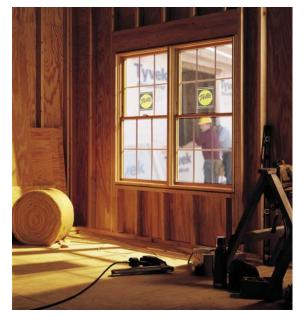


### **Energy-efficient dynamic glass**

The company and Soladigm, Milpitas, CA, are working together to market Soladigm Dynamic Glass. The product uses electrochromic technology to switch from clear to tinted on demand and allows heat and glare control in buildings while reportedly providing greater comfort, uninterrupted views, and natural daylight. The product will be incorporated into the SunGuard architectural glass line.

Guardian Industries Auburn Hills, MI

Free information: Circle 77



### Protective film

Protective glass film is an extra safeguard to ensure that the company's wood windows and patio doors arrive at a jobsite in top condition. The factoryapplied film is standard on interior and exterior glass surfaces of lines including ProLine, Architect Series, Designer Series, and custom wood products. The film is reportedly easy to remove and leaves no residue.

Pella Corp. Pella, IA

Free information: Circle 78



### **Decorative levers**

Reflections decorative levers include the Niagara collection, available in 14 finishes. The levers blend with the company's YH collection, allowing design flow across an entire facility. Applications include hospitality, multi-family, and mixed-use buildings.

Yale Locks & Hardware

Lenoir City, TN

Free information: Circle 79

### Fire-rated glazing website

The company's fire-rated glass and framing website is said to allow easy navigation and contains an updated SpeciFire specification tool. An enhanced image gallery and case-study section provide information on how to use fire-rated glass and framing systems to enhance building aesthetics.

**Technical Glass Products** 

Snoqualmie, WA

Free information: Circle 80

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- Made of recycled rubber combined with color flecks of new rubber
- Available in roll goods, glue down or interlocking tiles in a variety of colors







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# products LIGHTING & ELECTRICAL



# Second-generation downlights



Evoke 2.9 G2 LED downlights are available in round and square profiles. The new generation offers an array of compact, architecturally styled luminaires for a wide variety of applications. According to the company, the 12-W Evoke combines energy efficiency and superior aesthetics with a miniature 2.9-inch aperture for general, accent, task, and wall-washing ap-

plications. The line includes warm 2,700-K, crisp 3,000-K, bright white 3,500-K, and cooler 4,000-K LEDs that can be used in highly switched areas or applications requiring dimming capabilities. The downlights combine conduction, convection, and radiation elements to divert damaging heat away from the LEDs with a multi-faceted thermal-management system. The module produces more than 670 lumens in a beamspread range from 15 to 60 degrees. A variety of trims is available.

Amerlux Fairfield, NJ

Free information: Circle 97

### **Evoke 2.9:**

- G2 LED downlights
- Round and square profiles in a variety of finishes
- Provides 670 lumens at 12 W





### Recycled-materials task light

HeronLED personal task light is made from recycled materials. Using only 4 W and providing 220 lumens, the lamp provides warm white light. The lamp body is made of recycled plastic from discarded electronics and the metal base from recycled scrap metal. It contains no mercury and can contribute toward LEED credits in several categories.

**LittleFootprint Lighting** Santa Cruz, CA

Free information: Circle 98

### LED lighting controller

Lumentone is an LED lighting controller for white light or colored light installation. The wall-mounted DMX unit allows users to dim the lights, change colors, modulate color temperature, add effects, or alter the rate of change. The device has 13 pre-programmed

shows and 8 color-changing scenes, including three that use RGBW technology. Five scenes provide white-light control. The dial illuminates to reflect the chosen effect. White, black, or custom finishes are available.

Lumenpulse Inc. Montreal

Free information: Circle 99



### LED floodlight/highbay

Appleton Areamaster LED floodlight/highbay is a 15-inch-square fixture rated at 127 W and is said to deliver 13,000+ lumens of cool-white light in a 131by 134-degree beam spread. An architectural bronze polyester finish protects the unit. The lens is made of thermal-shock, impact-resistant glass. The unit is said to be instant-on even in cold weather.

**EGS Electrical Group** Rosemont, IL

Free information: Circle 100



Decorative, open-top LED sconces use 6-W, GU-24based LED lamps with an integrated internal driver. The LED option is available in several ADA sconce collections including Anna, Chelsea, Kaile, Lina, Tomas, Mistral, Tamburo 7/8/11, and Torre 14/18/22. Each collection includes a wide range of handcrafted decors.

Besa Lighting Co. Blacklick, OH

### products LIGHTING & ELECTRICAL



Zipline is a linear-fluorescent-fixture retrofit solution. The system uses an integrated ballast and lampholder in a self-contained assembly to reduce installation time. Mounting into an existing lighting fixture, the unit is available with snap-in reflectors that improve lighting efficiency. The system fits most 2-foot by 2-foot and 2-foot by 4-foot troffers and is available in two- and three-lamp configurations in high, normal, and low ballast factors.

Leviton Melville, NY

Free information: Circle 102



### Line-voltage dimmable drivers

LED20W line-voltage drivers for LED dimming control have a 100% to 10% dimming range. Models include 14, 16.8, and 20 W, available in leading-edge (incandescent) and trailing-edge (ELV) versions. Input voltage ranges from 100 to 277 VAC with output voltages from 7 to 40 V. The drivers can be used indoors and outdoors.

Thomas Research Products Huntley, IL

Free information: Circle 103





### **NEMA** enclosures

Type 1 and Type 3R NEMA enclosures are an addition to the company's line. More than 80 models are available in a selection of sizes and finishes in plated steel or 12-, 14-, and 16-gauge steel. Covers include flush mount and flat with keyholes. Standard concentric knock-outs are positioned on all sides. Enclosures without knock-outs are also available.

Orbit Industries
Los Angeles

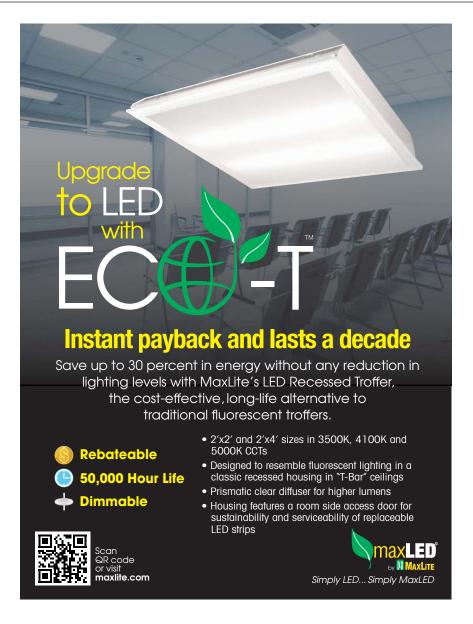
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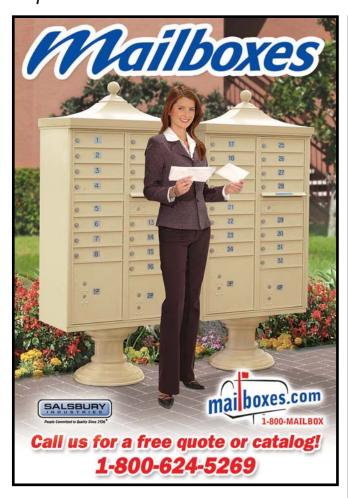
### Compact-fluorescent downlight

Halo Commercial line of recessed downlights offers high optical efficiencies and includes Energy Starqualified compact fluorescents that meet Eligibility Criteria Version 1.1. Available as 6- and 8-inchaperture downlights and 4- and 6-inch directional downlights, the products have an assembled and pre-wired housing frame using a No Fuss Bar Hanger system. Trims include torsion springs aligned with the line's universal 180-degree mounting positions.

Cooper Lighting
Peachtree City, GA



# I products lighting & electrical



For free information, circle 220



Tetra EdgeStrip and miniStrip LEDs replace T8 fluorescent tubes and use the company's OptiLens technology, which captures wasted light and redirects it toward the illuminated surface. Applications include cabinet signs with 3- to 6-inch depths.

GE Lighting Solutions
East Cleveland, OH
Free information: Circle 107



### LED recessed troffer

Eco-T LED recessed troffer is available in 2-foot by 2-foot and 2-foot by 4-foot sizes for installation into T-bar grid ceilings. The luminaire is said to provide a CRI of 84. Available in correlated color temperatures of 3,500, 4,100, and 5,000 K, a dimming driver and clear diffuser are standard. Designed with the look of a traditional fluorescent fixture, the troffer provides a classic housing with LED strips that resemble fluorescent lamps.

MaxLite

West Caldwell, NJ

Free information: Circle 108

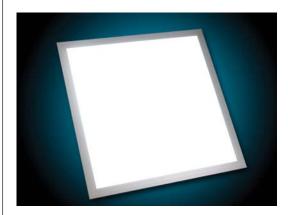
### Floor box

Resource RFB4E series floor box accepts 6-inchround Evolution series Poke-Thru covers available in

three styles and five colors. The box is said to provide ample capacity where a larger box is not required. Available for on-grade and above-grade construction and fully adjustable before and after the concrete pour, 26 knockouts provide maximum flexibility. A conduit hub accepts 2-inch conduit. Four internal compartments support power, communications, and audio/video applications.

Legrand/Wiremold West Hartford, CT

Free information: Circle 109



### Flat-panel downlight

The company's 2-foot-square, edge-lit, LED-based flat-panel downlight is reported to provide more than 70 lumens/W with a CRI greater than 80. Using 100 LEDs, the panel provides an increase in brightness of as much as 3,250 lumens at 4,000 K, compared with the previous version.

Global Lighting Technologies Brecksville, OH

Free information: Circle 110

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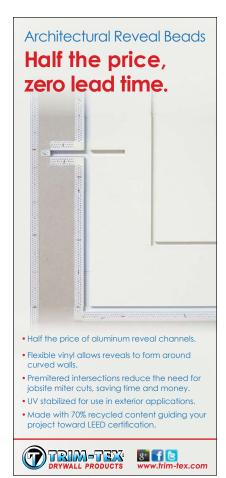
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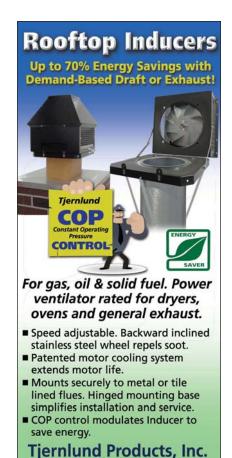
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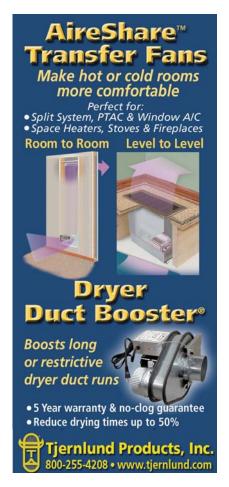


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