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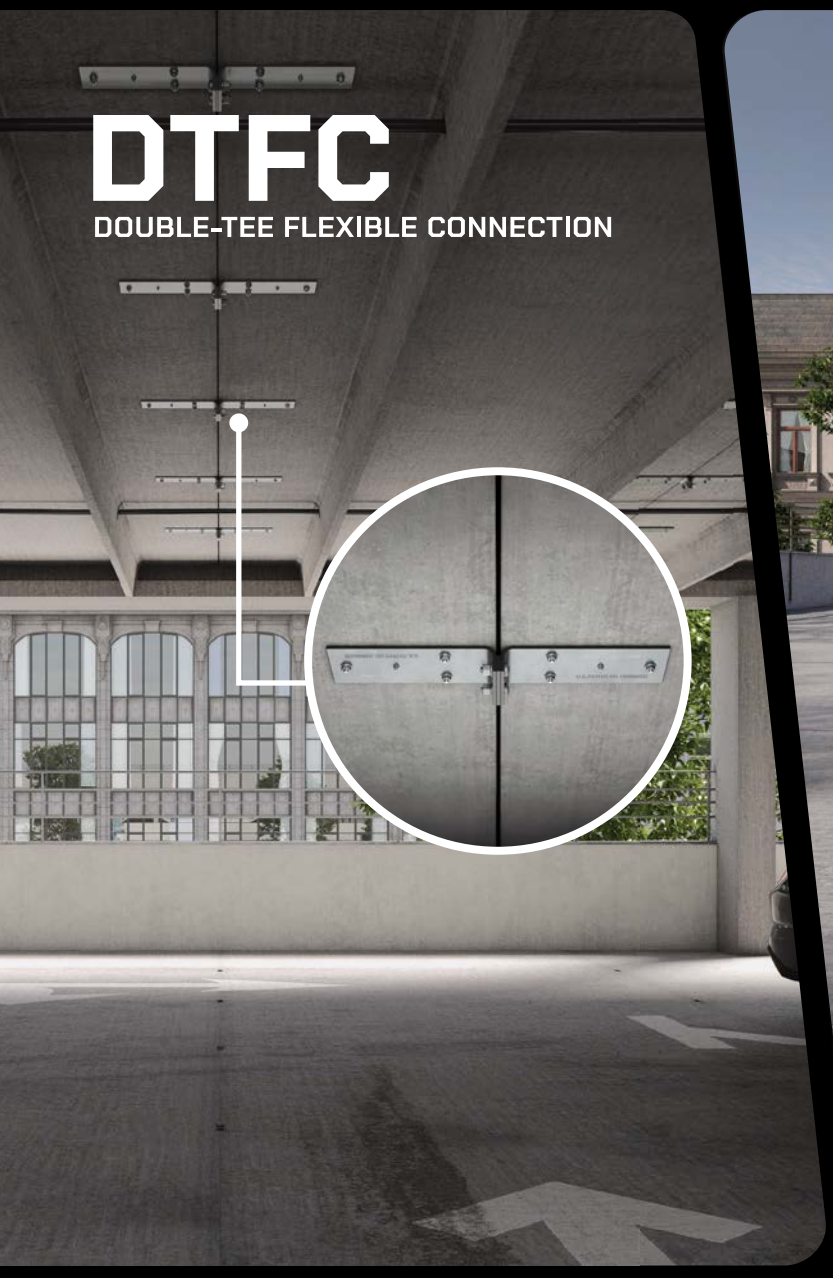

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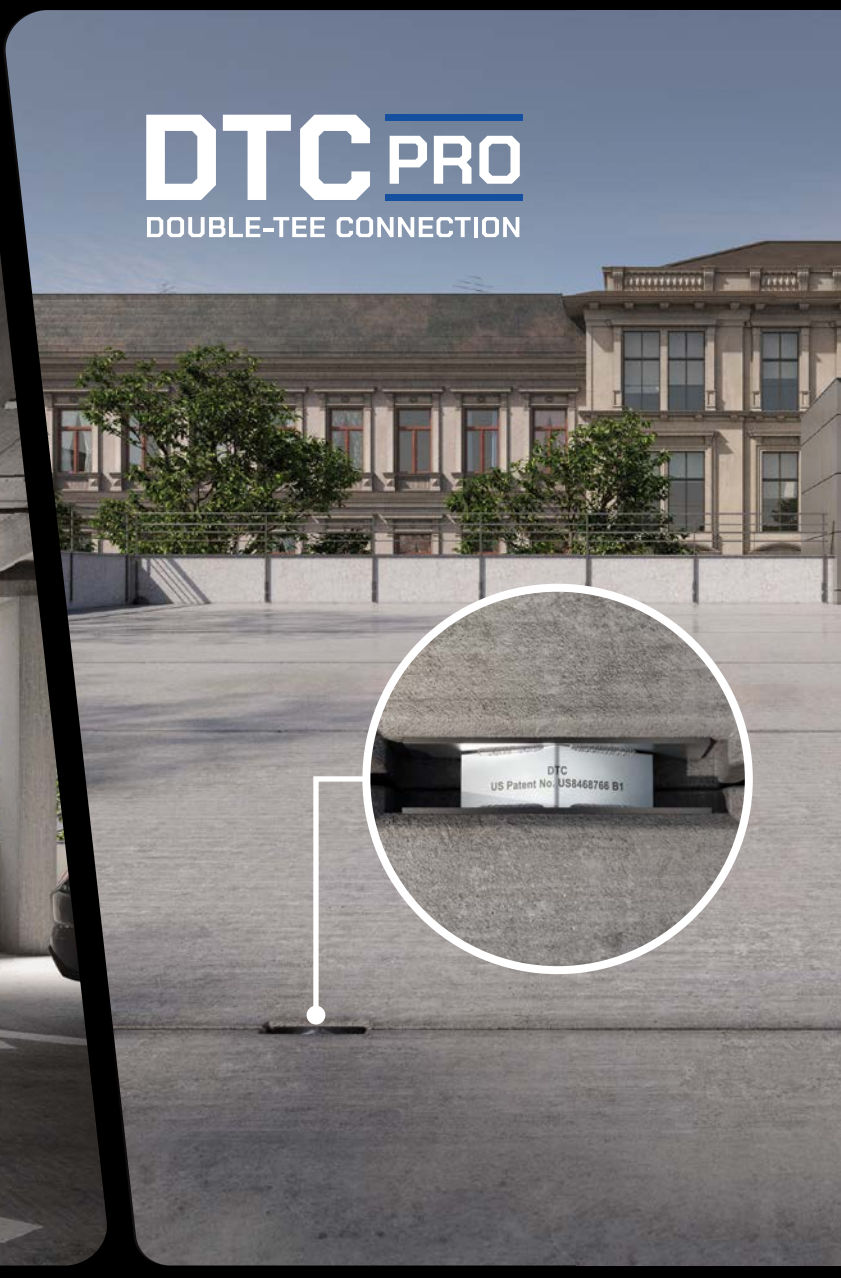

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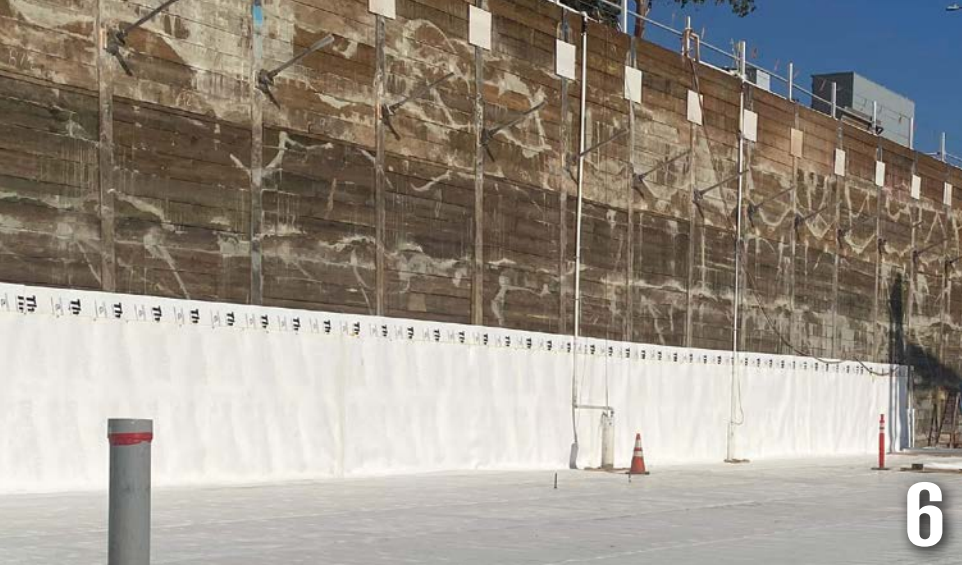

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In this issue:

On the cover:

Rainscreens are versatile and can be applied beyond traditional building types—even in stadium design. At the University of Iowa's Kinnick Stadium, the facade features glass panels alongside more than 557 m^2 (6,000 sf) of fiber-cement panels, all seamlessly integrated into the architectural envelope. Explore how glass rainscreens enhance both aesthetics and performance, highlighting recent advancements in system design, material options, and installation techniques that make them a compelling choice for a wide range of building types.

See article on page 27.

PHOTO BY CAMERON CAMPBELL

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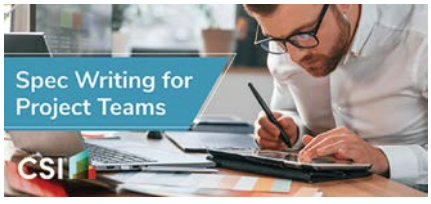

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Blindside Waterproofing and At-grade Transitions

By Scott Schendel

PHOTOS COURTESY EPRO

Waterproofing is a critical component of the building envelope, a comprehensive system protecting structures from environmental elements. Site-specific conditions, including subsurface drainage, groundwater levels, and building use, dictate the type and extent of waterproofing required. Sheet membranes, bentonite-based systems, and multi-layered composite systems each offer appropriate and effective solutions for different project conditions and performance requirements.

Selecting the appropriate waterproofing system for any given site presents inherent challenges, but these complexities intensify with zero lot line construction, where structures extend directly to property boundaries. In these constrained environments, both installation methodology and product selection become critical success factors, particularly at foundation levels and at-grade locations where proper terminations and transitions determine long-term system performance.

This article examines the unique challenges of blindside waterproofing in zero lot line construction, explores solutions for different shoring systems, and emphasizes the critical importance of proper transition design and execution—areas where most waterproofing failures originate.

Understanding zero lot line construction and blindside waterproofing

In dense metropolitan areas such as New York City, Seattle, Los Angeles, and Washington, D.C., zero lot line construction is often necessary to maximize available space. These projects bring buildings directly to the property line, sometimes on multiple sides. While building codes for zero lot line construction differ by municipality, one constant remains: installing a waterproofing system properly in these conditions is inherently challenging.

Zero lot line projects require blindside waterproofing, a technique in which the waterproofing system is installed before foundation wall concrete placement. Blindside waterproofing systems can be difficult to design and install, primarily due to their placement sequence and the fact that the drainage and waterproofing systems are installed against the site support of excavation (SOE) or against a neighboring building's below-grade structure.

Above: First course of blindside waterproofing applied against soldier pile lagging.

Left: Example of wide gap between successive lagging boards.

Blindside waterproofing is also common in infrastructure applications such as cut and cover tunnel design or any construction site where it is necessary to minimize excavation or what is dictated by site constraints. Blindside waterproofing also allows the building owner to maximize the building footprint by reducing setbacks.

Varying SOE types, including soldier pile lagging, sheet piling, or shotcrete soil nail walls, can create challenging substrate conditions for waterproofing systems. Combined with many varying SOE conditions and the necessity to transition or terminate at grade, there are numerous critical design and installation considerations surrounding zero lot line construction.

Hidden waterproofing

Successful blindside waterproofing presents more challenges than the more straightforward, post-applied application of waterproofing directly to the positive side of an existing concrete foundation wall. With blindside scenarios, structural concrete is applied to the waterproofing membrane, meaning damage or improper installation becomes hidden and inaccessible once concrete is placed.

The SOE type used in blindside construction significantly affects waterproofing detailing and at-grade termination methods. Each approach presents different substrate conditions for the membrane and varying obstacles for waterproofing system continuity.

The two most common shoring construction approaches are soldier pile lagging (wood lagging with steel H-piles) and shotcrete shoring.

Soldier pile and wood lagging

For soldier pile and wood lagging shoring construction, wood lagging boards are installed between steel pile flanges, resulting in a relatively planar surface. Different waterproofing systems have a range of requirements, but most require substrates to be relatively smooth, continuous, and free from voids and protrusions. The substrate should be prepared to prevent potential membrane punctures or ruptures, especially in shotcrete applications where concrete is literally shot directly against the in-place waterproofing membrane. Here, a drainage composite is often used to help create a smooth, uniform surface for the waterproofing system's application, regardless of water table conditions. Extruded polystyrene insulation (XPS) foam board insulation and plywood are also commonly used.

It is best to provide specific language within the specification that addresses substrate requirements for these conditions. The following language is excerpted from a blindside waterproofing manufacturer's guide specification:

Blindside substrate preparation: Wood lagging shoring should extend to the lowest level of the waterproofing installation with any voids or cavities exterior of the lagging timbers filled with compacted soil or cementitious grout.

Right: Waterproofing termination detailing at the back flange in back-lagged support of excavation (SOE) configuration.

Middle: Blindside waterproofing application against shotcrete shoring.

Below: Waterproofing installed in backlag support of excavation (SOE) configuration. Note the interruption of waterproofing between piles.

The interior surface of lagging boards should be planar, with no greater than 25.4 mm (1 in.) variance in a 300-mm (12-in.) plane, and fit tightly together with gaps less than 25.4 mm (1 in.). Gaps greater than 25.4 mm (1 in.) should be completely filled with cementitious grout, compacted soil, wood, XPS (138 kPa [20 psi] min.), or manufacturer approved polyurethane sprayfoam. Ensuring the void is filled, plywood or other surface treatment may be used over large lagging gaps up to 150-mm (6-in.). XPS protection board (138 kPa [20 psi] min.) or manufacturer approved drainage composite may be installed over gaps up to 50 mm (2 in.). Gaps greater than 50 mm (2 in.) should be completely filled with cementitious grout, compacted soil, wood, XPS (138 kPa [20 psi] min.), or manufacturer approved polyurethane sprayfoam. All lagging board nails and other mechanical projections shall be removed or flattened. Install a protection material over all soldier piles with raised lagging hanger bolts, form tie rods, or other irregular surfaces; protection material should extend a minimum of 150 mm (6 in.) to both sides of the steel piling. A base drain system should be connected to an operative water discharge system.[1]

Back-lagged configuration challenges

The most common soldier pile lagging configuration is a "front-lagged" condition. However, to maximize property footprint or to accommodate for mis-driven piles or buried obstructions, lagging is sometimes installed on the back flange of piles, closest to the soil, creating a "back-lagged" configuration.[2] Here, the steel pile flanges protrude, interrupting the plane of the blindside membrane. In back-lagged conditions, designers have two options:

(a) Contour the waterproofing system around each soldier pile by infilling gaps around flanges with manufacturer-approved filler such as tapered XPS foam material; or

(b) Terminate the membrane at each pile flange and restart on the opposite side of the pile

Option (a) maintains continuous barrier protection across the pile but requires close coordination with the structural design team to ensure added filler does not conflict with rebar placement. This option is often impractical due to structural conflicts.

Option (b) essentially treats each bay between piles as its own waterproofed panel. This approach relies more heavily on careful detailing since it creates membrane terminations at every pile. The membrane must be carefully sealed and terminated to each steel beam face with tape, sealant, mastic, or some combination thereof, which can then introduce additional risks dependent on installation quality and proper adhesion of the waterproofing system to the steel flange. Enhanced waterproofing detailing and onsite inspection of the in-place waterproofing system are recommended to ensure proper installation when this SOE configuration is used.

Shotcrete shoring systems

More commonly used on Canadian projects, shotcrete shoring involves spraying concrete directly onto native excavated soil with reinforcement mesh to create a continuous concrete retaining wall. Soil nails are often used in conjunction to reinforce the retaining wall. The advantage of shotcrete shoring lies in installation speed. However, shotcrete surfaces can be uneven or non-planar, and rebound aggregate can create voids or rough areas. It is

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Inconsistencies in shotcrete shoring.

often necessary to scrape or broom the shotcrete surface to remove high spots or apply a skim coat to fill depressions, thereby achieving a suitable substrate for membrane installation. Further, membranes must conform to the shotcrete shoring substrate to prevent voids that could potentially compromise the system when the structural foundation wall concrete is placed.

Adjacent structure complications

Blindside waterproofing in zero lot line conditions, constructed directly against adjacent structures, can present multiple challenges. Special care is required during the waterproofing system application. It is typically not acceptable to use an adjacent structure's foundation wall as a substrate for the blindside waterproofing system. Rigid XPS foam board, rockwool insulation, or other suitable filler materials can provide appropriate substrate conditions. The blindside waterproofing system then uses this buffer material as the application substrate. The substrate must be structurally sound to support the installed waterproofing system's weight. In these instances, the use of mechanical fasteners on adjacent structures may be limited or prohibited entirely.

Detensioning and tie-back system

Post concrete wall placement, tie-back, or soil nail detensioning requires blockouts to be constructed around the anchor heads. These blockouts create access "windows" for post-tensioning operations. After waterproofing detailing is done, they are filled with concrete to complete the structural wall. Typically, blockouts are limited in size to avoid interfering with reinforcement placement, which complicates waterproofing patch application. It is imperative to protect the installed blindside waterproofing membrane within any blockouts from overspray or concrete contamination.

Tie-back waterproofing detailing requires installing a suitable cover that cleanly transitions and integrates with the in-place blindside waterproofing membrane. Some waterproofing manufacturers provide pre-fabricated tie-back covers for this purpose, potentially eliminating the need for field-fabricated sheet metal or plywood covers. Due to the complexity and inherent challenges of tie-back detailing, some manufacturers require injection tube waterstop installation as secondary protection.

SOE bracing challenges

Horizontal struts spanning across excavations, walers distributing loads along the shoring wall, and inclined rakers transferring loads to foundation elements all create additional detailing requirements and potential water ingress points.

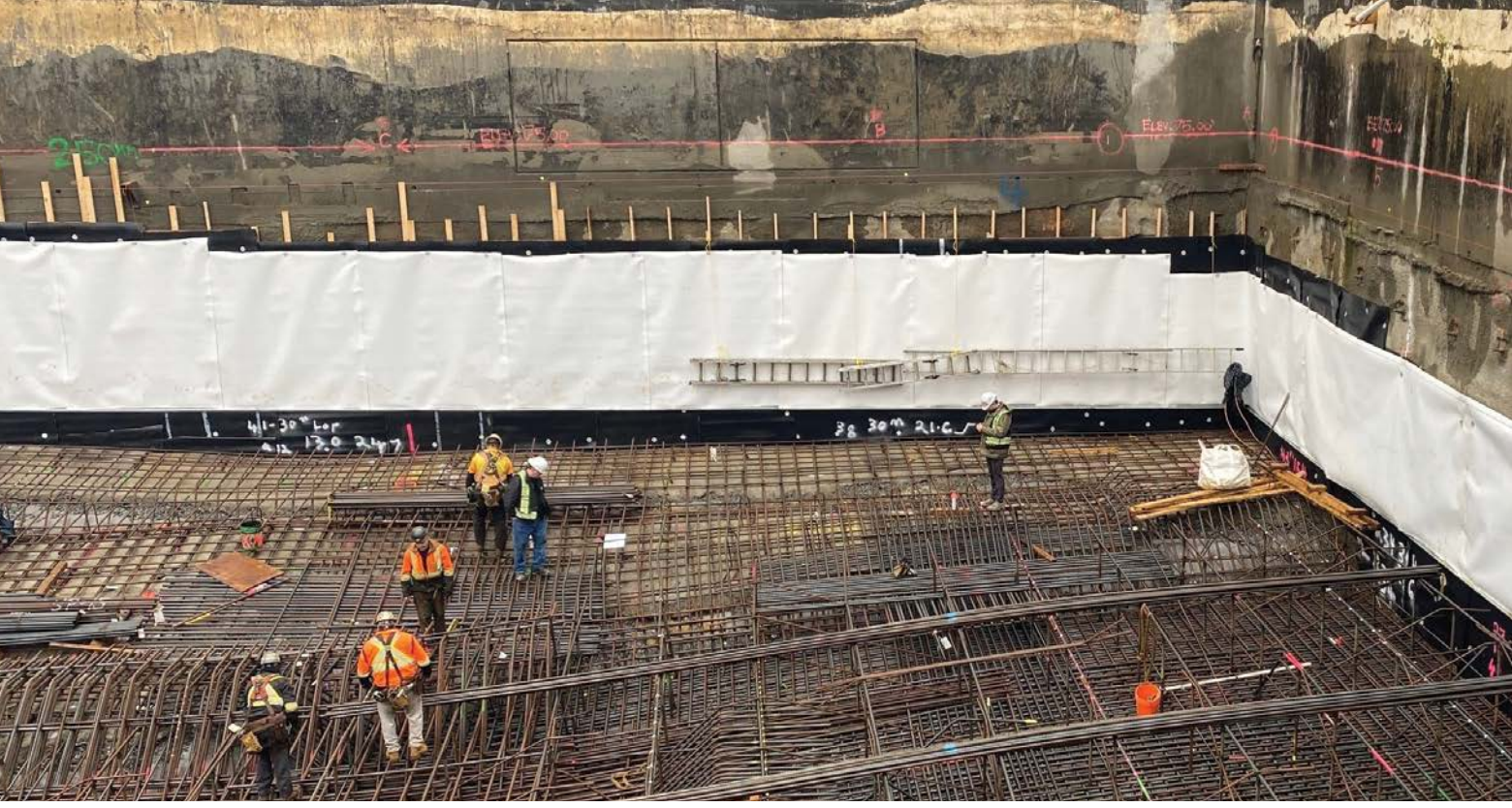
Struts, which resist lateral earth pressures through compression across the excavation width, must be carefully detailed where they penetrate or interface with the waterproofing membrane. Walers, running parallel to the excavation wall to distribute tie-back or soil nail loads, create linear obstructions that require continuous membrane transitions. Rakers, extending at angles from the shoring wall to stable foundation elements, present complex geometric challenges for membrane detailing where it interfaces with the shoring.

Some bracing elements may be removed during various construction phases. Struts are typically removed during concrete placement, while rakers are often removed after concrete placement. This phased removal sequence introduces the potential for damage to installed waterproofing and requires waterproofing details that accommodate both the presence of these elements and their subsequent removal without compromising membrane integrity. As a result, careful detailing and coordination are required at these structurally complex locations.

Rebar placement and concrete forming

Ideally, the number of penetrations through blindside waterproofing systems should be limited, especially in below-water-table conditions. Reducing the number of nelson studs, dowels, rebar support elements, and form ties decreases complexity and labor-intensive detailing where proper execution is critical.

In all instances, penetrations must be securely positioned and immobile during concrete placement, particularly for shotcrete wall applications, to prevent damage to the installed blindside waterproofing system. Rebar supports should not



Note the addition of 2x4s as additional means of support for the blindside substrate against the adjacent structure.

create point load on the installed blindside waterproofing system; when necessary, concrete spacers or dobies with flat surfaces should be used against the membrane.

Following concrete reinforcement installation, close inspection of the installed waterproofing membrane should be performed to ensure no punctures, tears, or damage. Any damage should be noted and repaired according to manufacturer guidelines prior to concrete placement.

Drainage system integration

When sites require a drainage composite, it is applied first to the SOE substrate, with the blindside waterproofing membrane applied over the drainage composite. A subslab drainage system must be designed to accommodate water collection once installed. Drain outlets must be connected to the drainage composite and cast through the base of the foundation wall or through the footing to the interior subgrade where sumps or other water management systems discharge collected water from the wall drainage composite. Traditional base-of-footing drain tile systems cannot be implemented since the footing aligns with the SOE.

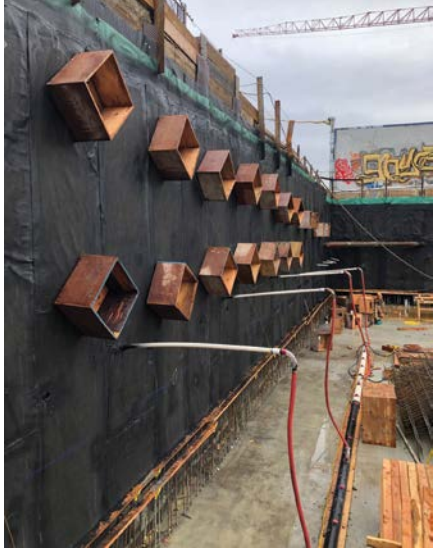
Concrete placement challenges

Shotcrete foundation wall applications are increasingly prevalent in the United States and Canada as an alternative to traditional cast-in-place concrete foundation walls. Shotcrete eliminates the need for form board erection and can typically be accomplished quickly and efficiently. However, this concrete placement method creates unique challenges for blindside waterproofing systems, particularly considering that aggregate impacts the installed membrane at velocities exceeding 27 m per second (60 mph).[3]

In cases like this, waterproofing membrane seam performance becomes essential, as does adequate puncture resistance ratings that can accommodate shotcrete application forces. Proper substrate preparation is critical to prevent voids behind the membrane, which can lead to system rupture during concrete placement, and to eliminate sharp protrusions that can cause punctures during concrete placement.

Shotcrete placement techniques must prevent shadowing behind reinforcement since blindside waterproofing membranes are designed to function with structural concrete fully consolidated against the installed membrane. Voids in shotcrete from improper placement can cause the installed system to rupture under positive-side hydrostatic pressure. Further, if waterproofing system breaches occur, areas with poor shotcrete adhesion allow water migration within the wall assembly, which may ultimately reach cracks, joints, or penetrations and result in water ingress.

Concrete overspray presents a significant challenge during shotcrete installations, particularly at lift terminations. To prevent contamination of adjacent waterproofing, contractors must implement adequate protection measures and ensure proper installation methods. When overspray does occur, it can compromise the bond of the waterproofing membrane. If contamination occurs, consult the membrane manufacturer for proper repair procedures, which typically involve cleaning (if possible) or patching the affected areas.



Right: Multiple tie-back blockouts.

Middle: A detensioned tie-back ready for application of blindside waterproofing patch.

Below: Example of installed pre-fabricated tie-back cover.

Numerous waterproofing failures have resulted from improper shotcrete application practices. To address this issue, projects should establish minimum qualifications for shotcrete nozzlemen and implement enhanced quality control/quality assurance procedures. Many waterproofing manufacturers now require shotcrete applicators to hold ACI or ASA certification and demonstrate at least 500 hours of shotcrete experience before offering performance warranties.

The critical importance of at-grade transitions

Waterproofing system performance depends critically on two factors: appropriate detail design and proper installation that follows these details at transitions and terminations. Analysis of waterproofing failures indicates that many occur at system edges where installations begin, terminate, or transition between different materials or substrates. These areas present nuanced design challenges and may require specialized details depending on the connecting systems at grade or special conditions such as back-lagged shoring or shotcrete shoring SOE. Transition strategies for blindside waterproofing must also be adapted to different shoring methods. This section outlines concerns at these critical areas and presents solutions and best practices.

Wood lagging transitions

For sites where the top of the lagging is accessible, most pre-applied vertical foundation wall waterproofing membranes terminate below the at-grade slab construction joint. The uppermost lagging boards are removed, and piles are cut off to expose the top edge of the pre-applied membrane and the positive side of the concrete foundation wall.

Protecting the membrane from burns and damage caused by soldier pile and wood lagging removal is critical. Cement board backing typically provides effective protection. If the pre-applied below-grade membrane is damaged, the damaged area must be repaired prior to detailing the at-grade transition. The key to success for at-grade transitions is achieving a well-adhered, continuous positive lap over the in-place blindside foundation wall waterproofing system. For this to be accomplished successfully, a clean, fully adhered, non-damaged membrane must be available to perform an adequately detailed transition.

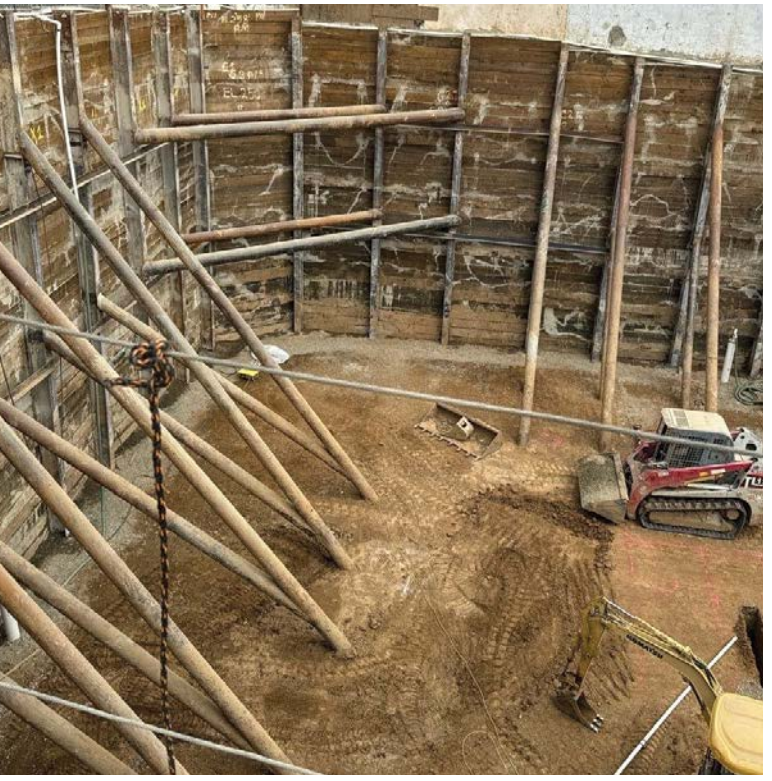
Limited access conditions

For project sites where access is limited and soldier pile lagging cannot be removed, extending a "tail" or transition strip of the below-grade shoring waterproofing membrane above the construction joint and at the top of wall maintains system continuity in shoring wall to suspended slab applications.

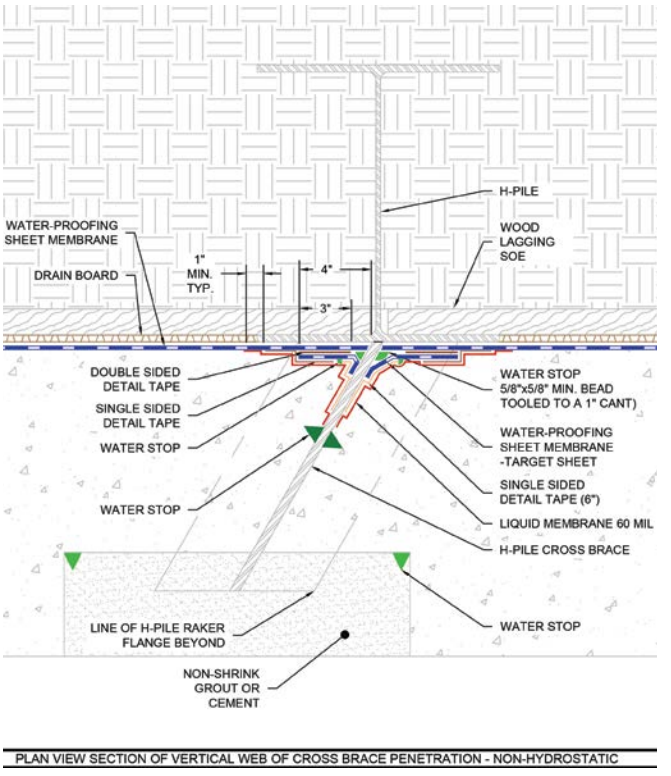
Two approaches are available:

- Folded transition—Fold this transition strip over and sandwich the extended membrane tail into the deck waterproofing to provide a seamless transition.
- Vertical termination—Terminate on the vertical shoring and transition the horizontal deck waterproofing up the vertical face.

Care must be taken to ensure the membrane "tail" remains undamaged and clean for a successful transition to the above-grade waterproofing system. It will be exposed until



Back-lagged soldier pile lagging support of excavation with multiple bracing elements.



An example of a waterproofing detail at strut intersect to blindside waterproofing.

the grade-level slab is poured and the above-grade waterproofing system is applied. Inspection and quality control are critical, requiring commitment from the general contractor and follow-on trades.

Material compatibility considerations

Depending on project design, above-grade waterproofing systems, such as hot-applied rubberized asphalt, may transition to below-grade blindside waterproofing systems. In this case, confirming material compatibility between different membrane systems is essential. Hot rubberized asphalt, commonly used as a deck waterproofing membrane, can damage below-grade waterproofing systems at transitions due to high installation temperatures. A transition membrane, such as a modified-bitumen self-adhesive sheet, may need to be applied to the blindside waterproofing to accomplish an effective tie-in.

Detailing sealants, fluids, or adhesive backing for tie-ins with above-grade air barrier systems may not have effective adhesion or be compatible long term with the below-grade waterproofing system. Consulting with the air barrier manufacturer and written documentation to determine compatibility is recommended.

Shotcrete shoring transitions

Shotcrete shoring often causes more complications than soldier pile shoring. Due to space constraints, repairing below-grade waterproofing membrane damage from the concrete shoring removal process can be exceptionally challenging for zero-lot-line projects. Coordinating the concrete removal and membrane repair process early in pre-construction meetings is essential.

Similar to soldier pile shoring construction, here, the vertical foundation wall waterproofing membrane is installed up to grade elevation. Cement board or plywood is placed between the vertical foundation wall waterproofing system and shotcrete shoring to protect the membrane during the concrete removal process. This provides membrane protection at grade level and ensures a planar substrate for membrane application, enhancing membrane adhesion to the foundation wall at such a high-risk area. Once the shotcrete shoring and protection board are removed, above-grade wall or deck waterproofing can transition into the below-grade waterproofing system.

Best practices and project management

It is not uncommon for one manufacturer's product to be used for below-grade shoring waterproofing and another manufacturer's system for above-grade waterproofing. Ensuring compatibility and proper transitioning is the responsibility of the designer, in consultation with system manufacturers. To help resolve this challenge, many waterproofing manufacturers provide systems for both below-grade shoring and above-grade waterproofing. Specifying manufacturers that have clear and concise details for these critical transitions is recommended.

Drain outlets placed in the foundation wall to the interior subgrade of the structure.

Blindside waterproofing presents notable challenges, but careful planning and early collaboration between stakeholders ensures successful outcomes. Waterproofing consultants, product manufacturers, and applicators can offer valuable expertise regarding complex tie-in details, system compatibility, and strategic sequencing, and can identify conflicts early in the design process. The complete set of SOE plans should be provided to the applicator prior to construction so suitable, site-specific shop drawings can be developed for the project. Engaging directly with waterproofing membrane manufacturers to review specific project conditions often yields valuable recommendations for project-specific details and proper application procedures. Preconstruction meetings that address waterproofing inspection requirements, including substrate requirements, installed waterproofing exposure limitations, and repair procedures, are an essential component of the construction process.

The unfortunate price of failed blindside waterproofing

Conventional waterproofing failures typically manifest as basement seepage that can be addressed through exterior excavation and repair. However, foundation wall excavation is not feasible for projects that use blindside waterproofing. Failures often require extensive remedial measures such as costly chemical injection from inside the structure. Potential expenses include structural damage, business interruption, legal liability, and reputation damage. Therefore, careful design, proper application, and enhanced quality control measures are essential. Attempting to remediate a failed blindside waterproofing system can cost anywhere from 10 to 20 times the original installation while never achieving the long-term reliability of a properly executed initial system. Ultimately, it can prove a costly mistake to turn a blind eye to blindside waterproofing.

NOTES

[1] Refer to eproinc.com/products/waterproofing/sheet-membranes/pretak/pre-applied-vertical#system-breadcrumbs

[2] See "Mastering blindside waterproofing: A proactive, integrated approach" on constructionspecifier.com/mastering-blindside-waterproofing-a-proactive-integrated-approach

[3] Read "Material Velocity at the Nozzle" Shotcrete (Fall 2013), page 22.

additional information

AUTHOR

As director of product development for EPRO, **Scott Schendel** manages an innovative portfolio of products that help protect structures in any site conditions, at any location. He has more than 15 years of relevant building envelope experience with specific expertise in below-grade waterproofing for new construction and restoration applications. From large-scale civil infrastructure to elevator pits and planters, Schendel has a wide range of project experience. He is a member of the SWR Institute and regularly collaborates on waterproofing projects across North America.

KEY TAKEAWAYS

Blindside waterproofing in zero lot line construction demands careful system selection, precise detailing, and expert installation. Success hinges on managing substrate variability, transition complexity, and coordination among trades. Poor execution can lead to costly, irreversible failures, making early planning, material compatibility, and rigorous quality control essential to long-term waterproofing performance.

MASTERFORMAT NO.

03 37 13—Shotcrete
07 10 00—Dampproofing and Waterproofing
31 41 00—Shoring

UNIFORMAT NO.

B2010—Exterior Walls
C1010—Foundation Construction

KEYWORDS

Division 03, 07, 31
Blindside waterproofing

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System Intelligence

The Rise of Rainscreen Technology in Building Longevity

By David Hohenstern

PHOTOS COURTESY STO CORP

Rainscreen technology is revolutionizing building envelope performance, significantly contributing to the longevity and resilience of modern structures. However, neither this technology nor the idea appeared overnight. It is the result of knowledge accumulated over centuries and evolving technology. In this article, explore where the concept of a building envelope began and how it evolved into today's advanced components. Before travelling back in time to the roots of this building concept, let's define what a rainscreen is designed to do.

The rainscreen system defined

Since "rain" is in the name, many laymen believe the primary function of a rainscreen is to act as a barrier against water penetration. However, that role belongs to the air- and water-resistive barrier (AWRB). A rainscreen is designed to limit the amount of water that could potentially come into contact with the primary building envelope's WRB, reducing the risk of moisture intrusion by resisting five key forces: kinetic energy, gravity, capillary action, surface tension, and pressure gradients.[1]

The origins of the rainscreen concept

The term "rainscreen" has been around since the 1960s, although it usually referenced cladding material. The idea of creating a weather-tight seal around a structure has been traced all the way back to 12th-century Norway.

The "open-jointed barn technique" earned its name because it was a design used primarily in the construction of barns. This method consisted of timber claddings adjoined to traditional stone walls, using closed joints down the sides and open ones at the top and bottom to allow rainwater to drain away or evaporate.[2]

From this early milestone, rainscreens would continue to evolve and the idea really took hold in the 20th century. The Alcoa building in Pittsburgh, originally designed by the architect Harrison + Abramovitz was one of the first large buildings to use modern rainscreen cladding. According to building science professor John Straube (RDH Building Science Laboratories), the 30-story Alcoa building, built in 1952, was an early example of a structure with a "pressure-moderated" ventilated outer wall. It was clad with large,

baffled aluminum panels, which provided resistance to water penetration. Ventilation was provided in the airspace between the cladding and the main wall to dry any moisture.

Building researchers and scientists began testing and validating open rainscreen systems, as well as simple vented and drained systems, in the 1960s. This foundational work led to continued research and refinements in Canada and Europe throughout the late 1960s and 1970s. In 1971, the American Architectural Manufacturer's Association (AAMA) published the first formal guide for pressure-equalizing designs, building on these earlier developments.[3]

By the 1980s, the principles of rainscreen cladding were well understood and widely used throughout Europe. As the science behind these systems improved and there was clear data to support the performance claims, rainscreens became the norm in the U.S. as well.

The difference between then and now

While contractors and craftsmen have been doing their very best to construct energy-efficient buildings that stand up to the elements through the centuries, the most significant flaw in their approach was the lack of a single unified and comprehensive solution. Instead, multiple craftspeople and contractors executed a piecemeal solution. Current best practices clearly identify that properly sealing a building and creating a truly functional, comprehensive envelope requires a single, cohesive system.

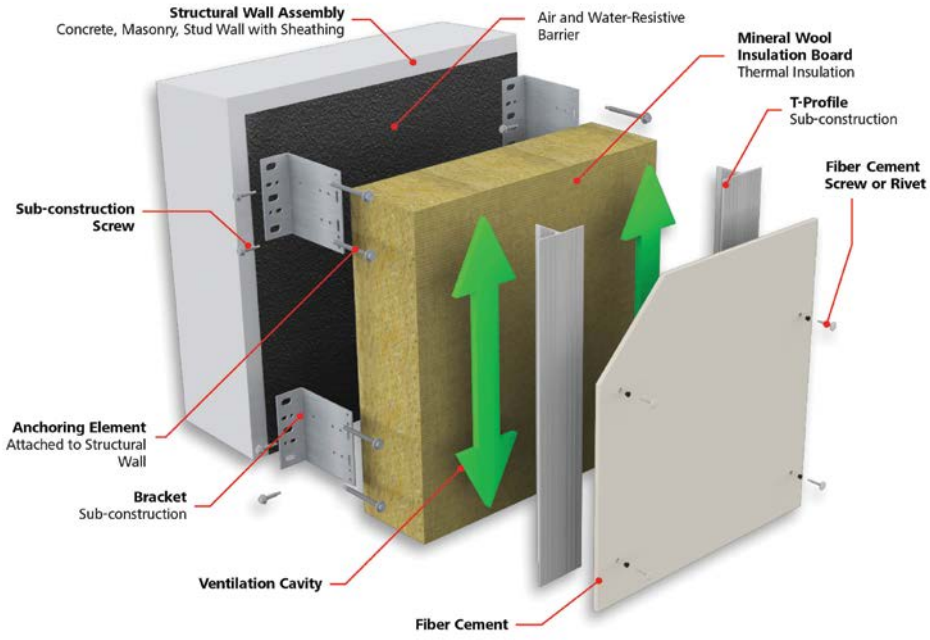
Modern rainscreens use this comprehensive and cohesive system approach with the best, most functional systems employing a common baseline structural substratum. Building on a common substrate with a uniform foundation streamlines the installation process and offers unmatched versatility that then allows nearly every cladding finish or type to be installed over it. As a result, architects and specifiers can achieve seamless transitions between significantly different cladding materials to achieve looks and textures within the same project, marrying aesthetic flexibility with robust, high-performance functionality.

Advanced components of a modern rainscreen system

Today's rainscreens are made up of several key structural components, each serving a critical role in moisture management, energy efficiency, and durability; these components typically include:

- Outer cladding material—Cladding serves as the primary barrier between a building and the elements. Material selection should be based on the building's climate zone and exposure to environmental hazards. Materials such as fiber cement, metal panels, high-pressure laminate (HPL), or specialized render systems can be customized with site-specific conditions in mind to meet the required level of protection. Specialized render systems refer to advanced, multi-layered exterior finish systems—typically including a base coat, mesh reinforcement, and finish layers—that are formulated to deliver specific performance benefits such as weather resistance, impact durability, vapor permeability, or fire performance. Many of these systems are available as pre-engineered assemblies, tested to meet established standards for factors like wind loads, thermal values, or fire resistance, helping to streamline specification, ensure code compliance, and reduce field coordination challenges during construction.
- Air gap or cavity—A ventilated space behind the cladding that helps manage moisture. A modern rainscreen system incorporates a larger air gap to promote drainage and drying of wall assemblies.
- AWRB—This is attached directly to the building's frame and is the last line of defense against air leakage and moisture intrusion. Depending on the climate, the AWRB may be permeable or impermeable to water vapor.
- Exterior insulation (a building's thermal overcoat)—This outer layer of insulation can

Engineered rainscreen systems are key to achieving climate-resilient, energy-efficient building envelopes that align with evolving codes and sustainability targets.



Above: Modern rainscreen systems rely on integrated air gaps, sub-construction, and insulation to meet energy, fire, and moisture performance standards

Right: This fiber-cement rainscreen system provides a fully tested, high-performance envelope solution with noncombustible components and thermal efficiency.

handle some moisture and drying without degrading or reducing its R-value. Depending on the building owner's thermal requirements and targets, this layer may be supplemented. Locally adopted energy codes require different degrees of exterior wall thermal performance.

- Venting profiles—Modern construction detailing offers a wide variety of ventilation options to help direct moisture away from the wall surfaces while remaining successful at keeping out pests.

System intelligence examples

The performance of a rainscreen is only as reliable as its individual components. The individual components must work in concert to manage moisture, withstand site-specific and sometimes extreme wind loads, and still enhance fire resistance. If one component underperforms or fails, the entire system fails.

Engineered for modern construction, a robust system can offer advanced thermal performance, fire protection, and weather resistance, with features that can include non-combustible continuous insulation (c.i.), a weather-tight AWRB, thermally broken adjustable sub-construction, and high-density, non-combustible fiber cement panels.

Fiber cement offers flexibility in design through shapes, color, texture, perforations, and visible or concealed fastening. It uses the same sub-construction as other cladding options. These design choices are easily integrated to complement or contrast with the fiber cement. Combined with recognized compliance under AAMA and NFPA standards, a well-designed rainscreen system delivers the versatility and compliance architects trust. Mix and match any cladding texture, material, shape, or color to create a true original.

Benefits of well-designed, properly installed rainscreen

A rainscreen system is designed to protect inner walls from weather exposure and prevent water and moisture from penetrating the building envelope. With today's systems, that is only where the benefits begin.

- Energy efficiency—Rainscreen cladding improves thermal performance, reducing heating and air conditioning costs by up to 40 percent annually.
- Insulation—An added insulation layer enhances thermal efficiency and limits condensation.
- Protection—The cladding protects the building's exterior from wind, rain, and snow, extending its lifespan and reducing maintenance costs.
- Structural stability—The air cavity in the rainscreen mitigates temperature variations, reducing structural movements and the risk of cracks.
- Acoustic insulation—An additional layer of insulation helps block outside noise, which is beneficial in urban environments and especially important in healthcare or wellness facilities.

- Design freedom—A rainscreen system provides an exoskeletal structure that supports a variety of architectural finishes.

How to choose the best rainscreen for a project

As demand for high-performance building envelopes has increased, so too has the number of manufacturers offering rainscreen solutions. Today, there are several excellent solutions on the market. When considering which product to invest in, ask these questions:

- Does the manufacturer offer a complete system? The fewer manufacturers to deal with, the easier the project will be. One manufacturer that provides everything from the sheathing out is ideal because one warranty will cover the entire system. The last thing one wants to do is stitch together a piecemeal system and hope that the subcontractors have successfully installed it to create a properly sealed envelope.
- Has the system undergone extensive testing? One of the most recognized tests for rainscreen systems is AAMA 509. It was the first North American testing standard for drained and back-ventilated (DBV) rainscreen cladding. This standard was developed to create a benchmark in DBV rainscreen performance and provides specific criteria for ventilation and moisture control. Make sure the selected rainscreen meets this standard. If unsure, just ask.
- Does the manufacturer offer on-site support? The right company will have project service managers who have a deep understanding of building science and can help with the needed systems. They will provide thermal modeling to help balance the thermal target with the structural loading and work with the general contractor to ensure the project progresses smoothly.
- Is a manufacturer with expertise in a particular area needed? This depends on the specifics of a project. For example, if there is significant water intrusion into the interior of the building, project teams may want to find a company with expertise in AWRBs. If extreme weather conditions are taking a toll on the cladding, consider retaining professional consulting services from a company with significant cladding expertise. The vast majority of larger manufacturers retain the knowledge and experience to solve virtually any problem with their in-house experts. Their experience is vast and will likely offer appropriate solutions to remedy the situation.
- Does the manufacturer offer a wide variety of design options? This is very important. If the rainscreen system has limited design options, the architect will be restricted in meeting the aesthetic goals of the project. By default, the system's functionality is prioritized over the appearance of the building. Also, buildings need to be refreshed over time. By installing a system with endless design possibilities today, the option of updating only the cladding later expands greatly, as opposed to replacing the entire rainscreen to achieve the desired new look. The right product and manufacturer will offer a variety of design options so the client

Ventilated cavity designs, paired with properly installed air- and water-resistive barriers (AWRBs), mitigate moisture intrusion and contribute to long-term façade durability.

can achieve the desired look and feel now and in the future.

- Is the system eco-friendly? This is becoming increasingly important with every passing year. The system should be built for the future, offer lightweight solutions, use recycled materials, and incorporate sustainable components. Building codes are becoming stricter, and environmental considerations are becoming codified. The expectation is that building owners will do their part to be mindful of the environment in new construction and retrofits.

The future of rainscreens

While research and testing on rainscreens continues, there are initiatives to grow towards a standardized rainscreen specification and criteria that continue to gain traction. In 2020, a highly diverse community of industry professionals passionate about supporting performance-driven rainscreen assemblies joined forces to create an international not-for-profit industry association, called the Rainscreen Association in North America (RAiNA), dedicated to serving the rainscreen market in North America.

With the guidance of these industry groups, rest assured that these systems are only going to become easier to install, more reliable, and more versatile.

The rise of system intelligence

As discussed in earlier sections, such as "The difference between then and now," which highlights the shift from piecemeal construction to unified systems, and "System intelligence examples," which illustrates how components now work together for energy efficiency, fire protection, and design flexibility, the concept of the rainscreen has evolved through centuries of refinement. This progression has resulted in intelligent, high-performance systems that define contemporary cladding assemblies. As climate resilience, energy efficiency, and material performance become ever more critical, the integration and adaptability of rainscreen systems will continue to shape the future of sustainable architecture.

Notes

See references online at constructionspecifier.com/rainscreen-systems

additional information

AUTHOR

David Hohenstern is StoVentec R&D manager at Sto Corp. He joined Sto in May 2022. He is a voting member of the C17 committee at ASTM, which owns and manages the fiber cement standards used in the Americas, as well as E05, the committee on Fire Standards, and E06 on Performance of Buildings. Hohenstern is a lifelong Georgia resident and a two-time graduate of the Georgia Institute of Technology.

KEY TAKEAWAYS

Rainscreen technology has evolved over centuries into a key system for protecting buildings from moisture and environmental damage. Modern rainscreens include cladding, air gaps, air- and water-resistive barriers (AWRBs), insulation, and venting to improve energy efficiency, durability, and design flexibility. A well-designed system reduces maintenance and energy costs while enhancing performance. Choosing the right rainscreen involves evaluating full-system offerings, performance testing, on-site support, and sustainable materials. As the industry advances, rainscreens will continue to play a vital role in creating resilient, high-performance buildings.

MASTERFORMAT NO.

07 27 00—Air Barriers
07 42 00—Wall Panels
07 44 00—Faced Panels
07 46 00—Siding

UNIFORMAT NO.

B2010—Exterior Walls

KEYWORDS

Division 07
Rainscreen systems

Door Specifications

Achieving Code-compliant Design Flexibility

By Tysen Gannon

PHOTOS COURTESY AD SYSTEMS

Flexible design allows a facility to offer occupants more functional interiors in the present while supporting the ability to shift and adapt to future needs. This approach to design can benefit almost any project, but healthcare facilities, in particular, often see several far-reaching benefits from optimizing flexibility.

For example, a flexibly designed medical center can help medical professionals more easily move patients with mobility challenges to specialized care. It can also help providers use spaces in multiple configurations in response to patient needs on any given day. Both aspects improve outcomes and patient experience. Flexible design can also allow these spaces to more readily incorporate new technologies, which may further improve the level of care possible within these facilities.

When a building is planned to be flexible, it often enjoys a longer lifespan than more stagnant architecture. On one hand, this reduces the need to plan for costly renovations and other construction, which may help healthcare organizations develop and improve general and specialized care. On the other, flexible design also reduces construction's environmental impact, allowing a building, or a part of a building, to be easily modified to fit a new purpose. These goals are important since the cost of new healthcare construction has seen year-over-year increases over the past five years. Likewise, the emphasis on sustainable construction has been underscored as the building industry inches closer to 2030 net-zero goals.

While many parts of the built environment have the potential to contribute to a flexibly designed space, doors represent a cost-effective and highly impactful means to improve a building's ability to adapt to changes in use and occupant need. This is particularly true of sliding doors and other systems that allow for more flexible openings. That said, when planning more flexible spaces, specifiers will still need to meet building codes and accessibility requirements, both of which can seem to work against this design approach. This article will define design

Above: Bi-parting sliding doors support accessibility requirements while preserving usable square footage.

Right: Minimizing approach and maneuvering requirements, commercial sliding doors contribute to more accessible designs for tight spaces.

flexibility, review relevant code requirements, and offer solutions to resolve challenges of incorporating design flexibility into a project.

What is design flexibility?

While intended building use can change what design flexibility means, generally, the term refers to considerations that allow a building to evolve, within reason, over time in response to changes in end-user needs. Since shifts in operational requirements would not necessarily render a flexibly designed building obsolete, this approach to design helps secure longer lifespans for facilities.

Design flexibility can hinge on active considerations, such as movable partitions, multi-use spaces, open floor plans, wide corridors and high-capacity service areas. It can also consist of passive elements, including the ability to incorporate modular structures to expand floorplans efficiently. Further, there are three types of design flexibility, depending on which changes a floor plan or building element allows for. First, adaptability refers to the capacity of the built environment to accommodate multiple functions. Next, transformability indicates the degree to which a building can be changed in response to certain conditions. Finally, convertibility describes how readily modifiable a building is.

All of these considerations can come together when a designer is seeking to optimize the overall flexibility of a healthcare space. As an example, a medical center can be made more flexible by planning wider openings that support the movement of large equipment or by specifying oversized sliding doors that allow two adjacent spaces to transform into one large space when needed. Finally, space-efficient and flexible width doors can preserve useable square footage to free up space for overflow areas when a facility needs to manage surges of incoming patients.

In these examples, the strategies used to achieve more flexibility support the general useability of a space while leaving options open for future developments in occupant needs. These considerations continue to be a crucial aspect of healthcare design as more medical centers have consolidated multiple types of care within the same facility.

How do building code requirements impact flexible interiors?

While not every strategy for incorporating elements of design flexibility will be significantly impacted by accessibility and building code requirements, many are—including the use of space-efficient and flexible opening door systems. These requirements can dictate opening width minimums, approach and maneuvering clearances, opening force maximums, and much more. In addition, the use of a room can be limited due to a door's dimensions and operation, based on code requirements. As such, code-compliant door specifications can sometimes feel at odds with planning more flexible built environments.

However, knowing these requirements can help guide specifiers in choosing door systems that meet codes and maximize flexibility. To simplify the discussion, this article will focus on model code requirements within the National Fire Protection Association (NFPA) codes and the *International Building Code* (*IBC*). It is recommended, however, that building professionals consult with local codes and clarify with an authority having jurisdiction (AHJ) to ensure their plans meet all requirements relevant to a project's specific location, use, and context.

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Above: Sliding and flexible swing doors can be used in tandem to maximize accessibility, optimize space use, and meet code requirements for inpatient rooms.

Middle: Sliding doors with premium acoustic performance support provider workspaces by mitigating sound transfer.

Right: Flexible opening swing doors provide wide openings when needed and minimal swing arcs for day-to-day use.

According to the NFPA and *IBC*, most doors in healthcare settings need to have a clear opening width of at least 813 mm (32 in.). This includes exam rooms, patient rooms, restrooms, doors within healthcare suites, respite rooms, and more. There are two general exceptions.

The NFPA allows doors to have a minimum opening clearance of 711 mm (28 in.) if a room is under 6.5 m^2 (70 sf) and is not required to be wheelchair accessible. The *IBC* echoes this exception for resident sleeping units that are not required to be wheelchair accessible. Alternatively, in Group I-2 occupancies, which include hospitals and nursing homes, doors along the means of egress that need to accommodate the movement of beds must provide opening widths of at least 1,054 mm (41.5 in.).

In addition, for rooms with an occupancy load of 10 or more people, at least one egress door needs to swing out in the direction of egress. This requirement, along with the varying widths in door size, can inhibit flexibility by limiting what a space can be used for based solely on the door system that leads into it. Further, these requirements may make it more difficult to optimize interior space, which can indirectly complicate more flexibly designed health care facilities.

How do accessibility standards impact door specification?

In addition to opening width clearances and other model building code standards, accessibility standards listed in the *Americans with Disabilities Act* (*ADA*) also detail requirements for hardware, opening force maximums, and approach and maneuvering clearances. While door hardware and opening force requirements can impact door specification, maneuvering clearances more readily impact flexible design goals.

Maneuvering clearances vary based on opening direction, direction of approach, door hardware, and door width. These measurements include the spaces parallel and perpendicular to the opening. For example, front approaches for swing doors require 1,524 mm (60 in.) perpendicular to the pull side of the door and the opening width plus 457 to 610 mm (18 to 24 in.) of additional space on the latch side parallel to the door. For the push side, they require 1,219 mm (48 in.) perpendicular to the door and the opening width size for the space parallel to the door. If the door includes a latch and closer, it will require an additional 305 mm (12 in.) of parallel space.

Sliding doors only require the perpendicular space to measure 1,219 mm (48 in.) and the parallel space to be the door width for front approaches. As such, they can help designers meet these standards in a space-efficient way while also preserving square footage by eliminating swing arc trajectories.

It is important to note that maneuvering clearances can be more for doors in a series or within vestibules. Allowances for maneuvering clearances also depend on where the doors are located. For instance, in multi-stall restrooms, no elements can overlap door maneuvering clearances. However, in family, assisted-use, or single-user toilet rooms where there is unobstructed wheelchair space beyond the door swing, doors can swing into fixture clearance areas and still comply with these standards. Specifiers can refer to section 4.13.6 in the *ADA* standards for a complete overview of approach clearance requirements.

Meeting code requirements and contributing to flexibility

Most commercial door systems can meet a wide range of building and accessibility code requirements. However, not all of these systems can significantly contribute to design flexibility. For instance, swing doors, especially when they exceed minimum widths, can require more space to account for their swing arc trajectories as well as their approach and maneuvering clearances. As such, designers may not be able to specify oversized doors, which inhibits the ability for a space to accommodate the movement of equipment or to be used in different configurations. They may also not be able to plan for overflow spaces, as square footage will be relegated to accounting for accessible door operation.

Offering an alternative, commercial sliding doors and flexible swing doors can preserve useable square footage while meeting building and accessibility requirements. For example, because sliding doors do not require additional space for maneuvering clearances or swing arc trajectories, they can save up to 2.8 m^2 (30 sf) per door. These savings accumulate across an entire floor, so designers can use this to plan more exam rooms or flexible overflow spaces to handle patient surges. Likewise, these doors can be specified in larger-than-average opening widths to help medical professionals maximize the usage potential for provider-only spaces.

It is important to note that accessibility standards only require one door leaf to meet the clearances listed in the *ADA*. With this in mind, specifiers can choose swing doors with auxiliary leaves to meet minimum requirements for daily use. Occupants can then engage the auxiliary leaf for a wider opening when needed. As a result, these doors can help spaces adapt to changing needs without requiring large clearances for day-to-day use.

Flexible openings can contribute to future-proofing strategies while supporting more functional ICU design.

How can multiple door systems work toward consistency?

When one type of door system cannot meet all code requirements for every application, specifiers can use several door types to ensure code compliance and design flexibility are not mutually exclusive. However, using multiple door systems can create complications at several junctures in the construction process.

At the specification and purchasing stage, selecting multiple door types within a building can make planning for lead times more difficult, especially when these systems come from multiple suppliers or manufacturers. Further, unforeseen delays in fabrication and shipping can also throw wrinkles into a construction timeline. Specifiers can sideline these potential issues by choosing door manufacturers that can provide multiple types of door systems. Not only does this help

Sliding doors optimize space use for flexibility and patient care.

PHOTO ©ALAN BLAKELY PHOTOGRAPHY

project stakeholders reduce the chance of complications, but it also allows more control over shipment schedules. This control can work well in projects that use modular and prefabricated construction by streamlining delivery timelines to ensure an uncluttered jobsite.

A highly controlled shipment schedule is not the only benefit to a single-source approach to door specification. When door systems come from the same manufacturer, it can simplify and standardize installation and maintenance to minimize complications during the construction and use phases of a project. In addition, a single-source door manufacturer can also standardize hardware. This helps create both a unified look and universal operation, both of which are key drivers in healthcare settings where patient experience and comfort are uniquely important.

Plan for doors that contribute multiple value points

Door specification can contribute more to a building than code compliance. Doors that provide flexible opening widths, preserve useable square footage, and offer consistency across the built environment can support several aspects of design flexibility. Likewise, when these doors come from a single source with a proven track record, they can streamline construction to minimize delays at multiple points in the building process.

While commercial sliding doors and flexible-opening swing doors can contribute a large amount of value to a project's interior on their own, this value can be increased when building professionals collaborate with door manufacturers throughout the construction process. This can help ensure the systems specified meet local code requirements and help project teams build custom solutions for challenging healthcare projects.

Finally, it is important to note that doors remain one of the most touched parts of any building. As such, they can significantly impact space's functionality. This goes beyond design flexibility. When doors facilitate more accessible designs and intuitive use, they can improve occupant experience, comfort, and wellbeing. This can be especially imperative in healthcare settings, which makes planning for door standardization incredibly valuable for these occupancy types.

additional information

AUTHOR

Tysen Gannon, LEED AP, from AD Systems has more than 15 years of experience in the architectural products industry, including roles in sales, product management, research and marketing, with a focus on glass and glazing, fenestration and facade systems.

KEY TAKEAWAYS

Flexible design is essential in healthcare facilities, enabling spaces to adapt to shifting patient needs, technologies, and care models. Features such as oversized sliding doors and flexible-opening systems can improve accessibility, optimize square footage, and future-proof interiors. However, specifiers must still navigate the *International Building Code* (*IBC*), National Fire Protection Association (NFPA) standards, and *Americans with Disabilities Act* (*ADA*) requirements to ensure code compliance. By selecting door systems that meet both flexibility and code demands—and sourcing from a single manufacturer—teams can streamline construction, enhance patient experience, and extend a facility's usable lifespan. Flexible doors offer performance, adaptability, and consistency.

MASTERFORMAT NO.

08 71 00—Door Hardware
08 10 00—Doors and Frames
08 30 00—Specialty Doors and Frames

UNIFORMAT NO.

D1010—Entrances
C1030—Special Interior Doors
C1020—Interior Doors

KEYWORDS

Division 08
Accessibility
Door systems
Healthcare design

Light Meets Structure

A Clear Upgrade for Parking Garages

Over the past few years, architects and engineers designing parking structures have discovered the benefits of ventilated glass rainscreen systems. Improved aesthetics, lower material costs, and faster installation are a few of the major benefits. In a well-engineered ventilated facade system, the open, translucent cladding stops more than 90 percent of wind-driven moisture and delivers abundant natural ventilation and daylight.

Recent engineering improvements, however, have made glass rainscreen systems even easier to install through innovative clip systems that further reduce installation times and costs.

Glass rainscreens

Glass rainscreens provide substantially more natural light to structures than perforated metals, which have been a favorite of the design community for parking facades. Glass's inherent strength and non-porous surface provide durable protection and a low-maintenance exterior. Jewel-like, imbricated facades provide superior airflow, reducing the need for mechanical equipment to support ventilation.

Rainscreens also enhance sustainability objectives and can be used in multiple applications.

The versatility of rainscreen systems allows them to be used for commercial or residential buildings. A fully mechanical system eliminates the need for silicones, mastics, or tapes to install. These systems can be used on train stations, stadiums, timber-framed structures, and almost any second-skin facade.

Retrofitting an existing structure can many times be achieved without costly and wasteful demolition.

More architects are beginning to discover the benefits of the glass rainscreens for parking facades.

By Thomas Renner
PHOTOS BY TASHIO MARTINEZ

The project at 727 West Madison in Chicago features a rainscreen system to enhance the appearance of a mixed-use development and residential tower.

A new direction

For centuries, projects were constructed with natural materials such as stone, wood, and concrete. Architects began the use of steel to form the structural frames of high-rise commercial buildings during the late 1800s, ushering in a new era in building design.

Building materials and systems continued to evolve. The new solutions for building design are designed for strength and the ability to withstand weather conditions. Different materials also allow for improved and varied aesthetics.

Parking structures have traditionally been covered mainly with various designs of perforated metal. However, the design community has been seeking alternatives that incorporate glass. Ventilation and light are essential considerations for parking structures. Therefore, new systems must address these concerns while also ensuring ease and speed of installation.

Due to the high number of buildings in need of facade restoration, new systems are being developed to protect the exterior effectively and affordably while transforming its appearance. These methods aim to minimize disruption to both the building and its occupants.

Why glass?

One of the primary advantages of glass as a material for parking facades is its tremendous design potential. Further, transparent and translucent glass types offer daylighting advantages not found in the wood, metal, stone, and terracotta frequently used in these structures.

Bringing light into the parking structure is a critical safety and energy-saving function of the system. Safety and security are among the most important considerations in the design of any parking structure. The biggest safety issue in any garage is the risk of pedestrians being struck by cars after they park. A glass facade, combined with proper lighting, helps minimize these safety risks by increasing visibility. Installing the glass with varying gaps allows for ventilation while also offering protection from the elements. The reduced need for secondary ventilation and lighting lowers the structure's operation cost and carbon footprint.

Glass rainscreen systems repel 90 to 100 percent of wind-driven rain and moisture. They are maintenance-friendly and resist permanent staining and graffiti. Even if a building's facade is made of wood, a well-designed glass rainscreen can protect it and ensure its performance for decades.

Glass also evokes a range of positive associations, such as sophistication, openness, modernity, brightness, and cleanliness. The nature of glass also allows design professionals to transform unexciting structures into striking, prominent buildings, changing their appearance from day to night.

Holding pattern

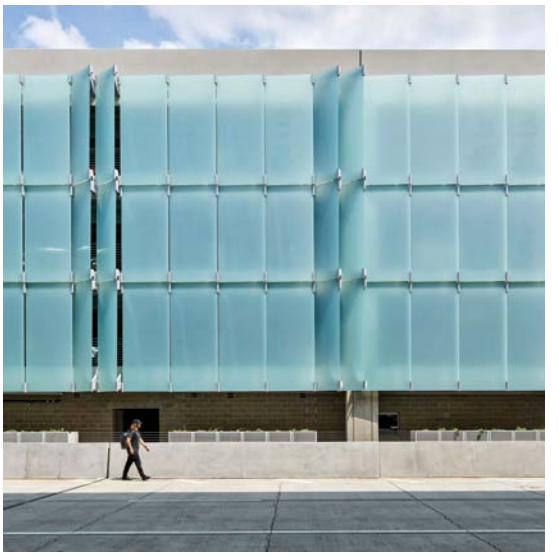
Recent innovations include reengineered aluminum fittings, making it faster and easier to install glass rainscreens to a range of surfaces. These fittings streamline installation and can be used in multiple applications.

Fittings vary in size based on the design requirements of the structure, glass, and calculated wind loads. The systems are engineered, allowing the glass panels to be attached directly to the concrete structure, thereby supporting the weight of the glass panels while accommodating construction tolerances, live load movement, wind loads, and expansion joints. These systems not only streamline construction but also eliminate the need for an expensive steel support framework, dramatically reducing material and labor costs while maintaining the integrity and durability of the facade. Patented compression fittings do not require glass drilling or notching, affording greater wall strength, quick assembly, and significant savings in labor costs.

The Kansas City International Airport required custom-engineered clips and mounting attachments. The 356-mm (14-in.) fastenings were set into the precast concrete structure with embeds and were designed to allow 78 mm (3 in.) of tolerance in all directions. The design also allowed for building movement. The project features more than 4,645 m^2 (50,000 sf) of tempered and laminated glass. The parking garage has over 6,000 spaces and covers more than 185,806 m^2 (2 million sf).

Advance consultation between the architectural glass provider and its partners also helped optimize the outcome. This allowed the team to contribute to the attachment system design ahead of time.

Rainscreens can be used on many buildings as second-skin facades. Train stations, stadiums, timber-framed structures, offices, and hospitals are among the applications in which the system with compression fittings can be installed. As an example, workers installed 1,301 m^2 (14,000 sf) in a vertically-and-horizontally-shingled cladding system at the University of Iowa's Kinnick Stadium. The project spans more than 200 m (655 ft), with glass panels exceeding 1.5 x 4 m (5 x 12 ft). Employing a rainscreen system, workers covered an additional 557 m^2 (6,000 sf) with fiber-cement panels that were seamlessly integrated into the facade.



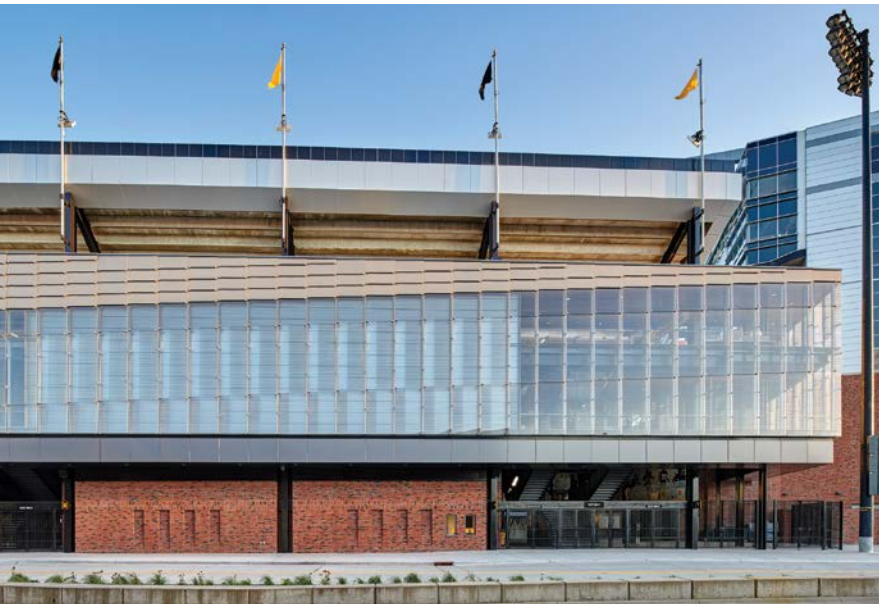
The Kansas City International Airport required custom-engineered clips and mounting attachments. The fastenings were set into the precast concrete structure with embeds and were designed to allow 78 mm (3 in.) of tolerance in all directions. The design also allowed for building movement.

PHOTOS BY MICHAEL ROBINSON

Calculating details

The quantity and type of compression fitting used to hold one piece of glass depend on the structure's design. Typically, there are four points of contact, and the amount of weight the fittings can hold is dependent on the system.

The weight of the glass is the last component to review. First, make sure the glass meets the



A vertically-and-horizontally-shingled cladding system at the University of Iowa's Kinnick Stadium.

PHOTOS BY CAMERON CAMPBELL

project's design criteria in terms of stress and deflection. To minimize deflection and/or stress, consider using thicker glass or selecting a different lamination interlayer. If the glass continues to exhibit excessive deflection or stress, increase the size of the edge support to reduce the unsupported span of the glass. The compression clips are secured to the building, but the type of building construction determines how they are installed.

Installers typically use embeds to attach to a concrete slab, beam, or wall for new construction. Different fasteners engineered specifically for the project's condition can also be used for existing construction. For walls of cold-formed metal framing, different attachment systems are designed and engineered based on the gauge of the metal.

The systems are designed to work with different materials. For example, if fiber cement panels and glass are used with the same system (*e.g.* Kinnick Stadium), the fiber cement panel's midpoint deflection is not the same as that of glass. In this instance, the fiber cement panels had to be reinforced with continuous support.

West Madison project

The project at 727 West Madison in Chicago offers a glimpse into the creation of a jewel-like structure that maximizes cost-saving natural ventilation and daylight.

As a collaborative effort, FitzGerald Associates Architects specified a rainscreen system to enhance the appearance of a prominent mixed-use development and residential tower in the heart of the Windy City's bustling north-south transportation corridor.

The parking facade project at the Mueller Parking Garage in Austin, uses more than 502 m^2 (5,400 sf) of laminated glass and louver panels.

If the louvers were over-deflecting, thicker aluminum would have been used, or the metal alloy would have been changed. The fittings provided the strength and support needed to seamlessly integrate the glass and louver panels. Always start with the glass to ensure the glass can span from slab to slab and thus avoid using continuous metal support.

The new building's location and high public profile required thoughtful design for its street-facing resident parking structure. The ventilated glass facade encloses the multi-level parking on three sides and features two distinct wall designs. The project consists of 1,000 glass panels, ranging in size up to 0.9 x 3 m (3 x 10 ft) and totaling more than 2,230 m^2 (24,000 sf).

The glass on the north and south faces is arranged in a staggered in-and-out fashion, creating 203-mm (8-in.) spacing between adjacent panels to provide natural ventilation. The same system in a flat wall configuration shapes the west facade.

The north-south walls feature translucent white laminated glass in two levels of opacity.

Forward glass panels offer a more transparent shade, while background panels are denser white to enhance the visual sense of depth. The west facade features white fritted glass with a custom linear pattern.

In addition to providing enhanced aesthetics, the facade contributed cost savings that amounted to more than $1 million. The glass cladding system attaches directly to the concrete walls and slabs, eliminating the need for costly structural steel supports. The natural ventilation through custom panel spacing reduced the requirements for mechanical ventilation. The reduced need for air handling equipment saves money initially, but in perpetuity, as less energy is needed to operate the building.

By leveraging passive airflow, the garage benefits from improved air quality, reduced energy consumption, and lower maintenance costs throughout the building's lifespan.

Convincing architects

The ultimate judges of any building material are the architects and specifiers designing buildings. Parking facades with innovative compression fittings are catching the attention of the design community.

The most notable aesthetic accomplishment is its nearly weightless appearance. The glass seems to float over the concrete parking structure. It is luminous and free of visible vertical supports and shadow lines.

The system benefits from daylight, solar shading, protection from wind-driven rain and snow, access to fresh air, and natural translucency.

The parking facade project at the Mueller Parking Garage in Austin, uses more than 502 m² (5,400 sf) of laminated glass and louver panels.

PHOTOS COURTESY BENDHEIM

additional information

AUTHOR

Thomas Renner writes on building, construction, engineering, and other trade industry topics for publications throughout the United States.

KEY TAKEAWAYS

Glass rainscreens offer architects a powerful tool to elevate facade design without compromising function. These systems provide natural light, improved airflow, and striking visual impact, while new mechanical fittings streamline installation and reduce material waste. Ideal for high-profile or utilitarian structures, rainscreens transform parking garages, stadiums, and transit hubs into luminous, modern landmarks.

MASTERFORMAT NO.

07 42 00—Wall Panels
07 42 43—Rainscreen Wall Cladding

UNIFORMAT NO.

B2010—Exterior Walls

KEYWORDS

Division 07
Rainscreens
Architectural glass

Access Granted

Building Smarter Data Centers

By Heather Bender

PHOTOS AND ILLUSTRATION COURTESY CLOPAY CORPORATION

Surging demand for artificial intelligence (AI), cloud computing, and other digital endeavors has made data centers one of the fastest-growing sectors in commercial construction. Data centers are the backbone of modern digital life, housing the servers and storage systems that run applications, manage data, and support online services. As such, facility construction demands unique safety and security measures as well as climate control and energy-efficient building design, which relies on high-performance materials, insulation, and technology for reducing energy consumption.

Two building components equipped to meet these diverse needs are the sectional door and the rolling door. Commonly used in warehouses, loading docks, and industrial facilities, these doors come in various designs that prioritize everything from passive fire protection to advanced insulation. Offering a wide variety of features, application flexibility, and ease of use, commercial doors check many boxes for data center designers and specifiers.

Doors at work: A data center example

To see where doors fit into data center design and what type works best for each application, consider a basic three-story layout that houses multiple secured pods for different tenants.

[Basic three-story data center design drawing with A, B, C, and D areas labeled.]

A—Ground floor loading bays

B—Upper floor loading bays

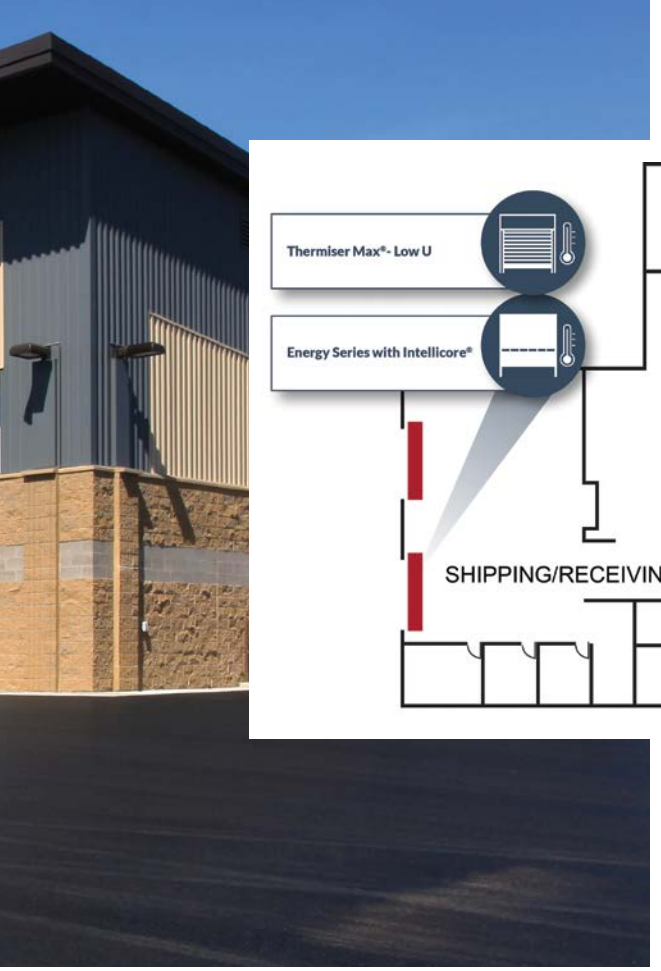
C—Data pods

D—Secondary spaces

Area A: Ground floor loading bays

Door: Energy-efficient sectional door

For a data center's ground floor loading bays, which are standard areas for moving equipment, sectional doors featuring foamed-in-place polyurethane provide security and energy efficiency. During the manufacturing process, the foam is injected between the steel layers of the door, expanding to fill the door's structure and frame and creating a more complete seal. Doors with three-layer construction have an exterior skin, an insulated core, and a steel backing, and the insulation bonds directly to the interior and exterior steel skins. Section joints are also thermally-broken. Doors designed with a polyurethane core can deliver R-values ranging from 12 to 27 and U-factors from 0.16 to 0.21. Specifiers can select insulated sectional doors



These insulated and fire-rated doors are strategically placed throughout data centers to maintain critical climate control, security, and fire protection.

with stucco or woodgrain embossed steel exteriors in flush, ribbed, or raised panel section designs. Additional options include the number and size of windows, as well as glazing options that range from clear and tinted glass to acrylic and polycarbonate. Maintenance-free steel finishes include standard white, black, tan, brown, and gray. Some manufacturers also offer thousands of custom paint options from well-known paint brands, as well as anodized finishes in bronze, dark bronze, black, and custom colors for full-view sections. Color-matched aluminum panels, wood-look finishes, and panel textures are also options.

Area B: Upper floor loading bays

Door: Low U-factor insulated rolling door

On the second and third floors, designers and specifiers can opt for low U-factor insulated rolling doors. U-factor measures the insulating ability of the entire assembly and includes all the materials in the assembly, whereas R-value only captures one part of a door's construction. While upper-floor loading bay doors are accessed less frequently, their compact footprint, insulating properties, wind resistance, and sound transmission remain important specifications for ensuring consistent indoor temperatures and comfortable working conditions. Using an insulated curtain plus perimeter seals and strategic thermal breaks, low U-factor rolling doors minimize heat transfer through the door assembly when in the closed position. Specifiers can select insulated rolling door models with U-factor ratings as low as 0.532, the lowest available in the rolling door market. Low U doors are also sound transmission rated, providing control over interior noise levels.

A unique consideration for rolling doors used with upper floor loading bays is that they are accessed by cranes. To promote safety at these heights, specifiers should opt for motorized door operation instead of manual chain hoists to ensure safer, more stable door control. Models can be labeled for ASHRAE 90.1, *IECC* 2021, and California's *Title 24*, and they can be configured to meet specific wind load requirements.

Area C: Data pods

Door: Rolling fire door

Inside a data center, rolling fire doors are a go-to for securing and compartmentalizing the data pods where servers and data storage equipment are housed. Rolling fire doors are engineered to slow the advance of smoke and flames between pods during a fire event. When integrated with a data center's primary alarm system, rolling fire doors can automatically close when the building's alarm is triggered or when power is lost. This is an important distinction from older-style thermally triggered rolling fire doors that require high heat

Low-U insulated rolling doors and energy-efficient sectional doors help maintain the precise environmental conditions data centers demand to keep cooling costs down.

to close the door and seal off an area. A thermal trigger is typically a fusible link that melts and releases the door's holding mechanism, causing it to close; however, when temperatures become hot enough to melt the link, it is often too late to save the equipment inside from smoke damage. Thus, specifying a rolling fire door that can be integrated into a data center's alarm system is recommended. Fire shutters with the same alarm-activated closure features are available for smaller spaces or counter applications.

Specifiers can also choose smoke and draft control features tested to the UL 1784 standard to ensure smoke is compartmentalized and does not spread throughout the facility and damage equipment in other areas. Fire protection rating options for rolling fire doors include 45 minutes, 90 minutes, three hours, and four hours.

Area D: Secondary spaces

Door: Elevator smoke curtain

For multifloor facilities with hoistways, integrated smoke curtains quickly and efficiently seal elevator door openings to reduce the advancement of smoke and hot gases up the elevator shaft during a fire. Available designs include magnetic-type curtains, which are held in place by magnets, as well as gravity-drop and motorized systems, which lower the curtain via gravity or motor mechanism. Curtains may also be transparent, providing first responders and evacuating occupants better visibility when the curtain is deployed. Other style options include vertical, horizontal, perimeter, and draft curtains. Depending on the curtain design, deployment may be triggered by a fire alarm system (the most common), smoke detectors, power loss, or manual activation. Some motorized models include a battery backup to ensure deployment during a power outage. The most compact offering available occupies less than 254 mm (10 in.) of headroom, and it complies with *IBC* 2003–2024 and other standards, including the AC-77, *Acceptance Criteria for Hoistway Openings*, as well as UL1784 and 864, ASTM E84, and California State Fire Marshal. Some models also meet UL 325 requirements.

Keeping cool is key

According to the National Renewable Energy Laboratory (NREL), the cooling necessary to protect sensitive data center equipment can represent as much as 40 percent of its total utility costs.[1] While researchers are pursuing more

Elevator smoke curtains seal openings to block smoke spread in multifloor data centers, maintaining clear paths for occupants and first responders.

efficient cooling solutions to reduce data center energy use, building components with high thermal resistance, air seals, and durability continue to be in demand.

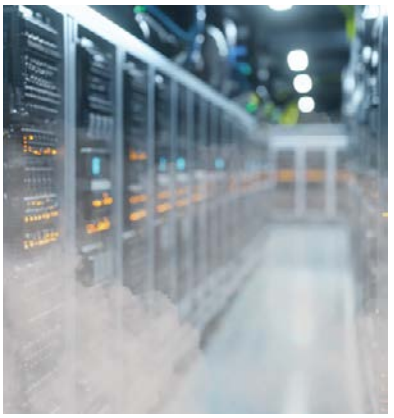
Sectional doors are the standard for energy efficiency, but when these products do not meet building code requirements, such as the *International Energy Conservation Code* (*IECC*), low U-factor rolling doors are the optimal alternative. The low U-factor insulated rolling door is a prime example of a building envelope component that can help keep cooling costs in check. These doors typically feature double-wall slat construction, where the curtain is formed from two layers enclosing an insulated core. This assembly enhances both structural integrity and thermal performance. The core material is commonly polyurethane, polystyrene, or mineral wool.

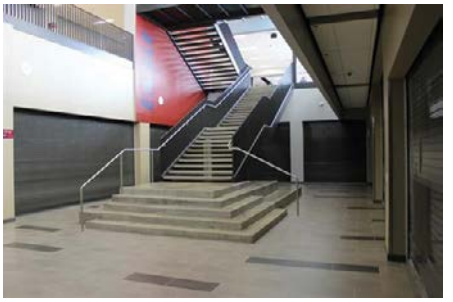
In many standard rolling door designs, direct steel-to-steel contact between the inner and outer layers can create thermal bridges. To eliminate this, some manufacturers incorporate a thermal break to improve thermal isolation. Another potential source of thermal energy loss is the door guide system, *i.e.* the vertical steel tracks that guide and support the curtain during operation. While weather seals are typically specified to reduce air infiltration, they do not address thermal bridging at the steel-to-steel interfaces within the guide assembly. To resolve this, one manufacturer has developed a proprietary thermally broken guide design, integrating low-conductivity materials within the guide channels. These strategically placed breaks interrupt direct conductive paths and help maintain building envelope integrity—performance benefits that are especially important in heavily cooled data centers where every effort to control energy use counts.

Other door features to consider

When specifying doors for data centers, it is important to evaluate more than just passive fire protection or insulating capabilities. Doors offer a wide range of other functional, safety, aesthetic, and performance options that make them ideally suited for the data center environment. Additional features to consider include:

- Flexible installation—Sectional doors offer numerous track options to accommodate different installation scenarios, including front- or rear-mount tracks, vertical tracks, and high-lift designs. Likewise, steel rolling doors can be





Above: Without fire-rated doors and smoke curtains, smoke can rapidly spread through a data center, damaging sensitive equipment before fire suppression even activates.

Right: These rolling fire doors are engineered for automatic deployment during an alarm event, helping protect data pods and limit the spread of smoke and fire inside data centers.

installed on the face of a wall or between jambs, making them suitable for interior and exterior walls. They are also compatible with common construction types, including masonry, structural steel, and drywall assemblies using wood or steel studs.

- High-cycle durability—Sectional doors are up to the task with springs offering up to 100,000 cycles for long performance life. In high-use areas, rolling doors can be equipped with a springless design rated for up to one million cycles for high performance, extending operational life and minimizing downtime for service or replacement.
- Seismic compliance—For data centers in earthquake-prone regions, doors can be evaluated for compliance with the ASCE 7-05 seismic requirements.
- Dependable seals—Sectional and rolling doors feature a bottom astragal that conforms to floor irregularities on both the interior and exterior sides of the door, limiting water and air infiltration, and ensuring a reliable fit without requiring excessive bottom limit adjustments.
- Wind load—Sectional and rolling doors can meet various wind load requirements, up to and including *IECC*-500 tornado shelter ratings for some rolling doors.
- Aesthetics and customization—Sectional door designs can be configured with two or four glass panels in sizes from 610 x 203 mm (24 x 8 in.) to full-view panels that maximize natural light. For rolling doors, some manufacturers offer powder coating in more than 180 colors, plus extra-durable finishes for doors exposed to harsher outdoor conditions.

As data centers grow in number, scale, and complexity, doors will continue to innovate too, playing an important part in securing, protecting, and insulating the technological future stored inside. In the next few years, commercial door manufacturers will likely introduce more secure access control systems embedded in door assemblies, such as biometric authentication, real-time monitoring, and integration with facility-wide security platforms. Construction and insulation materials, thermal break engineering, and perimeter seals will also continue to improve to meet increasingly strict energy efficiency targets. In a time powered by data, every door will be a critical component of the infrastructure that keeps modern life connected.

Notes

[1] Refer to nrel.gov/news/program/2023/nrel-joins-effort-to-advance-data-center-cooling-efficiency.html

additional information

AUTHOR

Heather Bender, director of commercial product marketing at Clopay Corporation, leverages 17 years of experience in manufacturing and building materials. Excelling in product management, she adeptly handles product inception to commercialization. Her role involves finding unique solutions for building owners and designers, highlighting her strategic and innovative approach to complex industry challenges. Bender can be contacted at hbender@clopay.com.

KEY TAKEAWAYS

Surging demand for artificial intelligence (AI) and cloud computing is driving data center construction, where doors play a critical role in energy efficiency, fire protection, and security. Sectional and rolling doors, each with specific thermal, acoustic, and safety features, support various areas from loading bays to server pods. With rising cooling costs and performance needs, door design is key to protecting infrastructure and optimizing operational efficiency in modern data centers.

MASTERFORMAT NO.

08 34 16—Sectional Doors
08 30 00—Specialty Doors and Frames

UNIFORMAT NO.

B2030—Exterior Doors
C1030—Interior Doors

KEYWORDS

Division 08
Firestopping
Rolling doors
Sectional doors

Lighting the Way to Safer Correctional Spaces

By Matt Szymanski
PHOTOS COURTESY KENALL MANUFACTURING

Correctional facilities can have a significant impact on the wellbeing of staff and inmates. Poor lighting, inadequate ventilation, and overcrowding can exacerbate the negative aspects of the environment, leading to increased stress, tension, and conflict. There are a variety of features and some long-standing best practices that can be incorporated to improve the environment and safety to improve this difficult setting.

Utah State Correctional Facility

The $1.5-billion Utah State Correctional Facility (USCF) in Salt Lake City, which replaces the long-outdated Utah State Prison that opened in 1951, was designed by Salt Lake-based GSBS Architects, who worked with national architecture firm HOK Group, Inc., and Miami-based CGL. It was constructed via a joint venture (JV) of Layton Construction and Oakland Construction (LOJV). The facility looks to turn the corner on recidivism rates and provide a better atmosphere for offenders and officers alike. To that end, the design incorporates a direct-supervision model that was approved by the Department of Correction and the State of Utah Division of Facilities Construction and Management.

Unique design

Research shows that a prison population's surroundings play a crucial role in their psychological rehabilitation. The intentional design of the new facility incorporates natural daylighting as a major design driver, along with creating spaces that offer less of a prison feel while still adhering to safety and security measures. One of the real breakthroughs in the design was shifting to the linear model of housing. The cells are arranged on either side of a rectangle around a dayroom, and at one end are floor-to-ceiling windows that let in natural light and views of the surrounding mountains. This design is incorporated in the housing sections, from the highest security to the lowest. In addition, each building unit features different housing styles: eight-person cells, two-person cells, and dormitory-style cells, to offer an increased measure of privacy as is deemed appropriate.

Inmates with greater exposure to daylight experience 22 percent lower rates of depression and anxiety compared to those in a dimly lit cell.[1] Additionally, facilities that prioritize daylight report 24 percent fewer violent incidents. These findings highlight a compelling truth: the right design choices can fundamentally improve correctional environments.[2]

The 120,774-m^2 (1.3-million-sf) complex spans 77 ha (191 acres), is comprised of 33 buildings, and accommodates 3,600 inmates of all classifications. With dedicated units for both genders, the facility also includes mental health housing that provides acute mental health and substance abuse treatment; medical facilities, including space for clinical examination, optometry, dentistry, dialysis, phlebotomy, and physical therapy; classrooms; kitchen; laundry; religious spaces; and room for future expansion. Bringing more design-savvy features to the inmate experience

aids in facilitating rehabilitation, as well as helping the staff feel better about working there.

Construction challenges

Spanning nearly 81 ha (200 acres), the greenfield site required extensive development. Along with constructing deep utilities and infrastructure, the construction team imported nearly 2 million tons (1.8 million tonnes) of engineered fill to raise the site 0.61 to 1.22 m (2 to 4 ft) above the existing grade. Above ground, site activity was constant. All tilt panels for the buildings were formed on site, which at the project's peak, hosted more than 1,500 workers. LOJV employed sophisticated site management and elevated communication throughout the project's completion.

The project was in full swing when the COVID-19 pandemic hit. The team quickly strategized and implemented strict protocols on how the trade partners could remain onsite safely to keep the project moving forward. The team also had the foresight to procure 95 percent of supplies prior to the pandemic, so they avoided supply chain issues.

Correctional lighting

Lighting plays an important role in supporting staff and inmate safety. Luminaires that have doorless-style housings firmly secured to the ceiling ensure there are no crevices or gaps to allow vandalism, making the fixture virtually impenetrable. Whether they are installed in a minimum, medium-maximum, or super-max setting, luminaires specifically engineered for correctional best practices resist everything from substantial abuse to the cleverest attempts at tampering and concealment.

Correctional cells represent one of the toughest environments for lighting fixtures because inmates are unsupervised for most of their in-cell time. As a result, cell lighting must be able to withstand extreme physical abuse, clever entry and concealment attempts, and repeated tampering.

A Wisconsin-based lighting manufacturer with a long-standing reputation in the correctional industry supplied high-abuse luminaires ideal for the new facility.

"They were incredibly flexible and willing to customize the luminaires," says Dave Wesemann, president and CEO, Spectrum Engineers. "USCF had a specific light level output for the cells' night lights. We worked with the lighting manufacturer through a mock-up process, which adjusted the levels in order to obtain the right footcandles," Wesemann added.

USCF installed these luminaires throughout the facility, with and without the optional night light. They are also installed in the day rooms, sally ports, cells, hallways, medical areas, showers, toilets, classrooms, and many other areas.

"USCF has many unique design features to ensure offenders' safety and security, including the selected lighting systems," said Jerry Jensen, deputy director of facilities management at Utah Department of Corrections. "We are confident the luminaires are able to withstand any violent abuse by offenders while also providing the necessary light levels."

additional information

AUTHOR

Matt Szymanski is the Western regional sales manager for Kenall, a company founded in Chicago in 1963 that specializes in the design and manufacture of durable lighting products. Kenall luminaires are produced in Kenosha, Wis., and meet Buy American Act requirements, with more than 65 percent of component costs originating in the United States. He can be reached at matthew.szymanski@kenall.com. For more information, visit kenall.com.

KEY TAKEAWAYS

The Utah State Correctional Facility uses high-abuse, tamper-resistant luminaires throughout its complex to enhance safety and support rehabilitation. Customized for precise light levels, including night lighting, the fixtures are designed to withstand vandalism and concealment attempts. Combined with natural daylighting, the lighting strategy improves visibility, reduces incidents, and promotes wellbeing for inmates and staff.

MASTERFORMAT NO.

26 51 00—Interior Lighting
26 55 00—Special Purpose Lighting

UNIFORMAT NO.

D5020—Lighting and Branch Wiring

KEYWORDS

Division 26
Luminaires

A New Era in HVAC

The Benefits of Non-metal Diffusers

By Marc Mascarello

PHOTOS COURTESY INVI AIR

On average, Americans spend approximately 90 percent of their time indoors. This makes maintaining a healthy indoor environmental quality (IEQ), especially for those who are susceptible to the impacts of pollution, even more important. Key aspects to consider for optimal IEQ include ventilation, filtration, and dehumidification of the HVAC system. This will ensure clean air and comfortable humidity levels, preventing issues such as mold and bacteria growth.

One small but essential part of any HVAC system is the diffuser, which distributes the cold or warm air into a room. Since their invention 75 years ago, HVAC diffusers have seen minimal innovation. Traditionally, their design has prioritized manufacturing simplicity and profitability over functionality and aesthetics. While metal diffusers are cost-effective and simple to stamp, extrude, and produce in large quantities, their appearance is often unappealing, and they frequently present performance issues. They are prone to condensation, rust, and dust accumulation, leading to water damage, mold growth, noise issues, reduced air quality, and system inefficiency.

While traditional metal diffusers have long been a staple in HVAC systems, their limitations have become increasingly apparent. Newly developed composite material diffusers offer advanced performance characteristics that make them more suitable for modern HVAC systems. This innovative material is reshaping industry standards, providing numerous technical benefits that address the core challenges architects and designers face. This is notably the first major development in HVAC diffusers since the advent of centralized air conditioning. The innovative composite material presents significant benefits compared to traditional metal diffusers, and its patented installation method capitalizes on these benefits.

Minimizing condensation

One of the primary issues with traditional metal diffusers is their tendency to accumulate diffuser condensation. Metals such as steel or aluminum have a high coefficient of heat transfer. This means quickly releasing any heat they contain to the conditioned air, lowering their temperature rapidly. Then, they readily absorb heat from the ambient air, quickly reducing the temperature of the surrounding air. The result often pushes air near the diffuser below the dewpoint, causing condensation.

Composite diffusers are engineered to significantly reduce diffuser condensation by up to 95 percent compared to aluminum.

This is especially true in hot, humid climates, and until recently, this problem has not been addressed. This moisture can lead to water damage, rust, and mold growth, compromising both the structural integrity of a building and the health of its occupants.

As maintaining indoor humidity between 40 and 60 percent has been widely recognized as optimal for human health—especially for optimal respiratory and immune system function—achieving this balance has introduced new challenges for HVAC systems. As buildings increasingly aim to operate within this humidity range, they extract less moisture from the air than previous over-dried systems. This creates a smaller margin for error when it comes to condensation management, particularly around components such as diffusers that are prone to cold surface temperatures. Composite diffusers present a crucial advancement. Unlike traditional metal diffusers, composite materials have a lower thermal conductivity, reducing the likelihood of surfaces reaching the dew point and forming condensation. Helping prevent mold growth, buildings maintain healthier humidity levels for occupants. Composite diffusers address both sides of the equation, supporting occupant wellness through improved IEQ while protecting building systems from the hidden consequences of condensation.

Composite diffusers are engineered to significantly reduce diffuser condensation by up to 95 percent compared to aluminum.[1] This drastic reduction in moisture ensures optimal performance and durability while significantly eliminating the risk of mold. Additionally, composite materials do not rust, further enhancing the longevity and reliability of the diffusers. These benefits make composite diffusers an attractive option for architects and designers looking to create healthier, more sustainable indoor environments.

Reducing noise pollution for enhanced comfort

Noise pollution is a significant concern in building design, particularly in environments such as offices, schools, and hospitals, where a quiet and peaceful atmosphere is essential. Metal diffusers can amplify noise from the HVAC system, leading to a less comfortable indoor experience. However, smart composite HVAC diffusers offer a quieter alternative, free from the clattering and whistling often associated with metal diffusers, especially those with operable baffles and fins. The fins and baffles expand with heat and shrink in contact with cool air, which causes popping noises when they shift in the hardware that holds or adjusts them. Composite diffusers address this issue by cutting noise levels by up to 50 percent compared to metal alternatives. Diffusers made from composite material are less likely to vibrate in the same way that extruded or stamped metal can, and they also do not have any moving parts or directional fins that may cause velocity differentials, eddies, and resonance, which can all contribute to noise. This substantial noise reduction ensures a more peaceful and comfortable indoor environment, enhancing the overall experience for building occupants.

Incorporating composite diffusers into building design addresses the challenge of noise pollution and aligns with broader goals of enhancing indoor environmental quality and occupant wellbeing. With their streamlined design and advanced acoustical properties, smart composite diffusers create a serene indoor environment conducive to productivity and relaxation. Architects and designers can create spaces that support health, comfort, and productivity by choosing materials that reduce noise and improve acoustics.

Durability and sustainability

In addition to improving air quality and acoustic comfort, composite diffusers are designed to be highly durable and sustainable. Traditional metal diffusers are prone to rust and degradation over time, requiring frequent maintenance and replacement. Composite diffusers are both

moisture-resistant and fire-retardant, ensuring long-lasting performance with minimal maintenance. This durability translates into lower maintenance needs and reduced waste, making these diffusers a more sustainable choice.

Proprietary composite material diffuser offerings use additives that reduce water penetration and flammability. The flame and smoke spread rating, as determined by ASTM E84 testing, is class A, which meets even the most stringent building code requirements for air distribution components. Composite diffusers do not have any fire rating on their own. In order to use composite diffusers in a fire-rated wall or ceiling, the plenum box behind them must meet the fire-rating requirements.

The building sector contributes a staggering 40 percent of worldwide carbon emissions. Therefore, every step towards sustainability in this industry can have a significant impact. Composite diffuser material is sustainably sourced, and the production process leaves no carbon emission footprint, making it an eco-conscious choice. This shift in material choice represents a significant advancement in HVAC technology.

Enhancing indoor environmental quality

Choosing the right materials and products is crucial for creating long-lasting and healthy buildings. In new construction and renovations, selecting the appropriate air diffusers for HVAC systems can significantly impact building maintenance, human health, and sustainability. Composite diffusers offer a range of benefits that make them an ideal choice for modern building design.

In addition to improving air quality and acoustic comfort, composite diffusers are designed to be highly durable and sustainable.

As the building industry continues to evolve, composite diffusers will play a crucial role in shaping a healthier, more sustainable future. With people spending more time indoors now than ever, the demand for maintaining excellent IEQ is paramount. Advanced materials and thoughtful design choices, such as composite diffusers, are essential for achieving optimal IEQ, ensuring a beneficial environment for health and productivity.

NOTES

[1] Refer to inviair.com/wp-content/uploads/2023/08/INVI-AIR-Condansation-Test-Report-compressed.pdf

additional information

AUTHOR

Marc Mascarello is the head of design at Invi Air, where he has been working since 2018. After graduating with a master of architecture from Columbia University, he has more than 10 years of experience in the fields of fabrication and architecture. His broad base of knowledge and skills in these fields has allowed him to synthesize design and detail with highly engineered components, making Invi Air a leader in design-centric air diffusers, vents, and grilles.

KEY TAKEAWAYS

Composite HVAC diffusers offer a significant upgrade compared to traditional metal versions by minimizing condensation, reducing noise, and enhancing durability. Their moisture- and fire-resistant properties, sustainable materials, and sleek design improve indoor environmental quality, support occupant health, and align with modern architectural goals for energy efficiency, comfort, and sustainability.

MASTERFORMAT NO.

23 37 00—Air Outlets and Inlets
23 37 13—Diffusers (Composite HVAC diffusers)

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System Interruptus

In high-rise construction, vertical enclosures often utilize large expanses of prefabricated systems, such as unitized curtain walls. While prefabricated systems can provide improved quality control, consistency, and efficiency to the fabrication and erection process, the repetitive nature of generic systems can present some aesthetic limitations. To address this, horizontal or vertical interruptions of the unitized assembly—such as column and floor line accents, corner transitions, entrance surrounds, and other features—can be introduced to break the uniformity and enhance architectural articulation.

Accent elements that interrupt non-customized unitized assemblies are often components from a different manufacturer requiring unique detailing from that of the primary system and, in some cases, installation by separate trades. As the authors have discussed in previous "Failures" columns, coordinating the interface detailing between dissimilar systems can present significant challenges, particularly when multiple systems and subcontractors are involved in their fabrication and installation.

As is often the case, seemingly straightforward interface details can quickly become problematic if all parties do not fully understand each trade's detailing, sequencing of construction, and access needs. The integration of systems can become particularly critical when field-installed components are integrated with prefabricated assemblies. Installation under constrained conditions—such as from suspended scaffolding—can further complicate matters. In such scenarios, partially completed work may be prematurely concealed to maintain construction schedules or to temporarily make the building more weathertight and overlooked without adequate quality assurance oversight.

These challenges were recently encountered on a residential tower principally clad with a repetitive unitized curtain wall system interrupted at perimeter columns by aluminum plate accent panels supported by a conventional light-gauge framing, sheathing, and water-resistive air barrier (WRB) backup wall.

To ensure aesthetic consistency, the curtain wall contractor was responsible for the fabrication and erection of the metal panels, while a separate contractor installed the field-built backup wall assembly.

figure 1

figure 2

FIGURE 1: Close-up image illustrating poor quality of work and lack of proper integration between the unitized curtain wall and the field-installed accent panel assembly.

PHOTOS COURTESY WISS, JANNEY, ELSTNER ASSOCIATES (WJE)

FIGURE 2: Close-up image illustrating poor quality of work and lack of proper integration between unitized curtain wall and field-installed accent panel assembly.

As sequenced, the aluminum accent panel assembly was installed following that of the unitized curtain wall. However, it soon became evident that, as installed, the curtain wall did not allow sufficient access to properly integrate the WRB—a primary control layer of the underlying panel backup wall—to the curtain wall. This resulted in selective in-situ disassembly of the curtain wall edge trim in an attempt to address the lack of integration. This challenging effort adversely impacted the project schedule and budget.

However, despite efforts to properly integrate the WRB with the curtain wall, recurring water leakage was experienced at several column locations post-construction. Subsequent diagnostic testing and disassembly of the accent panel cladding revealed poor quality of work, resulting in discontinuities within and at the interface of the WRB and curtain wall, necessitating extensive removals to repair the enclosure at all columns with active leakage.

While unforeseen conditions are often inevitable during construction, the above illustration is an example of costly errors that could have been largely avoided by the collaborative development of integration detailing between varying assemblies, better coordination and sequencing of the work, and implementation of mock-ups prior to, or as part of, start of work.

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