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# CONSTRUCTION CANADA

OCTOBER 2025 VOL. 67 NO. 7
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**Sprayfoam for Smarter Envelopes**

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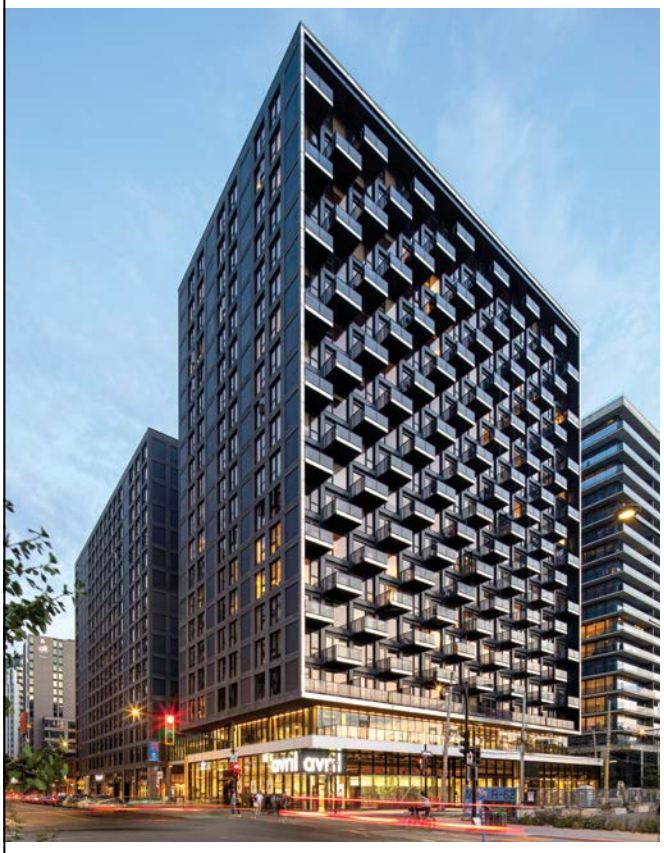

Montreal's Griffin Square, by ACDF Architecture, reshapes Griffintown with a striking facade. Staggered balconies, stainless steel accents, and reflective framing create shifting perspectives and dynamic light play, establishing a "fifth elevation" that enlivens the streetscape and defines the project as a contemporary urban landmark.

PHOTO BY ADRIEN WILLIAMS/COURTESY V2COM

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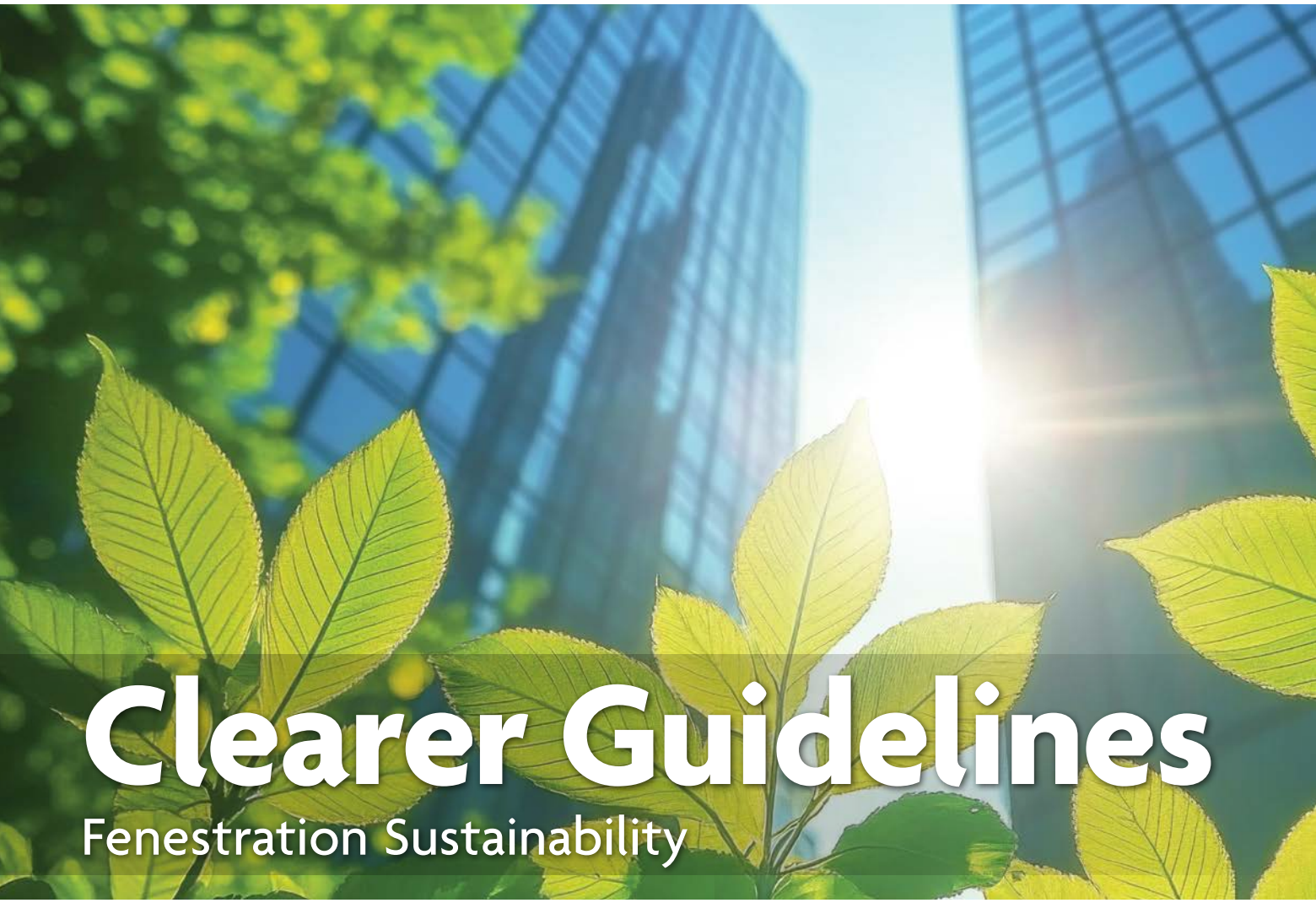

# Clearer Guidelines

## Fenestration Sustainability

**By Amy Roberts**

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Property owners, specifiers, architects, and organizations are increasingly seeking sustainable products and building practices. To better educate industry stakeholders and customers about how fenestration and glazing systems can help construct environmentally friendly and energy-efficient buildings, the Fenestration and Glazing Industry Alliance (FGIA) has developed NSF International (NSF) 1102-23, the Product Category Rule (PCR) for Fenestration Assemblies, in collaboration with the National Glass Association (NGA) and the Window and Door Manufacturers Association (WDMA).

NSF 1102-23 provides manufacturers with the base document required to create an Environmental Product Declaration (EPD) for a building material or product. Formerly known as the Windows PCR, this updated and expanded version provides EPDs for exterior-grade, finished fenestration assemblies, including skylights, tubular daylighting devices (TDDs), and door systems, as well as curtain wall, window wall, and storefront systems.

Informed by third-party verified life-cycle assessments (LCAs) within the framework of a PCR, EPDs help building owners, product specifiers, design professionals, and others make accurate product comparisons required by some green building certification programs and a growing number of jurisdictions. An eco-label of the material/product, EPDs enable building teams to assess and compare the environmental impacts produced through the manufacturing of that material or product. EPDs also demonstrate a manufacturer's commitment to sustainability and willingness to provide non-proprietary, environmental data with transparency and clarity. Additionally, they help companies understand how their product

Mandatory impacts include Global Warming Potential (GWP), ozone depletion potential (ODP), Eutrophication Potential (EP), Acidification Potential (AP), and Photochemical Oxidant Creation Potential (POCP). Life-cycle assessments (LCA) category indicator results must be reported separately as cradle-to-gate scope, total life cycle, and separately for the framing and glazing.

PHOTO COURTESY GRAHAM COMMERCIAL

performs, from a sustainability perspective, in comparison to its competitors.

An LCA evaluates the environmental impacts of a material or product from extraction to when the product leaves the factory (cradle-to-gate). Other LCAs include the entire life cycle, including the end of the in-use phase (cradle-to-grave), and others are focused on a specific stage of the product's life cycle (gate-to-gate). Manufacturers use the PCR and LCA data to help create a third-party verified EPD. Without a well-defined industry PCR, it is difficult for specifiers, architects, builders, and other EPD users to make accurate comparisons in today's sustainability-conscious world.

NSF 1102-23 is important for reporting and standardizing EPD information for fenestration systems. It documents the goal and scope of LCAs for this category so that EPDs can be generated in accordance with ISO 14025:2006, Environmental Labels and Declarations—Type III Environmental Declarations—Principles and Procedures, and ISO 21930:2017, Sustainability in Building Construction—Environmental Declaration of Building Products.

## Fenestration assembly defined

The PCR defines fenestration assemblies as "exterior-grade, finished, assembled fenestration assemblies that selectively permit the passing of air, daylight, or people."

Fenestration assemblies can be provided by a single source, manufactured at multiple locations, or travel to different distribution or retail centre suppliers using industrywide components. Per ISO 21930:2017, products must be functionally equivalent, and the environmental indicators of the average composition shall not differ by more than ± 10 per cent of the individual.

The PCR defines the normalized "declared unit" as 1 $m^2$ (11 sf) of fenestration assemblies for both framing and glass. Glazing beads and stops, sealants, gaskets, and other parts retaining or supporting the glazing are considered part of the framing assembly, and not the glazing system.

Fenestration assemblies may include insect screens, especially in the residential market, but

When materials are sent to landfills, one must assume emissions will accumulate over 100 years. Due to the limited availability of data relative to waste generation, recycling, and disposal of fenestration assemblies, a conservative default of 100 per cent to landfill shall be used.

PHOTO ©COLLEEN MICHAELS/ COURTESY SHUTTERSTOCK.COM

they are not required for a fenestration assembly to function properly. Therefore, they are not included as part of the declared unit. However, where applicable, doors may be considered as part of fenestration assemblies (*e.g.* French doors, sliding doors).

Since manufacturers may make only the frame, and a building's glazing may be a function of regional and customer preferences, EPD results must disclose LCAs as a total for the system, and separately for both the frame and glazing. This allows for better transparency for both industry and EPD users.

It is important to note that all non-optional components in fenestration assemblies must be included in EPDs, using NSF 1102-23 as a reference PCR, and cannot be excluded under the cut-off criteria. Table 1 (Modifications of Table 4-3 from ANSI/NFRC 100-2020 to accommodate fenestration assembly types covered by this PCR) lists the fenestration assemblies covered under this PCR.

The relative ratio of framing and glass for EPDs based on this PCR is derived from National Fenestration Rating Council (NFRC) standard sizes and configurations prior to normalization. This may or may not be representative of project-specific sizes and configurations on an individual building or a group of buildings. The product must also meet the relevant performance standards in American National Standards Institute (ANSI)/NFRC 100-2020, Procedure for Determining Fenestration Product U-Factors.

**TABLE 1**

| Product type | Opening (X) Non-operating (O) | Model size (width × height) SI (IP) |
|---|---|---|
| casement – single | X | 600 x 1,500 mm (24 × 59 in.) |
| dual action | X | 1,200 × 1,500 mm (47 × 59 in.) |
| fixed | O | 1,200 x 1,500 mm (47 × 59 in.) |
| hinged escape | X | 1,500 × 1,200 mm (59 × 47 in.) |
| horizontal slider | XO or XX | 1,500 x 1,200 mm (59 × 47 in.) |
| JAL/jai awning | X | 1,200 x 1,500 mm (47 × 59 in.) |
| pivoted | X | 1,200 × 1,500 mm (47 × 59 in.) |
| projecting (awning – dual) | XX | 1,500 x 1,200 mm (59 × 47 in.) |
| projecting (awning – single) | X | 1,500 × 600 mm (59 × 24 in.) |
| door – sidelite | X or O | 680 × 2,090 mm (24 × 82.375 in.) |
| skylight/roof window | X | 1,200 x 1,200 mm (47 × 47 in.) |
| sliding patio door with frame | XO or XX | 2,000 x 2,000 mm (79 × 79 in.) |

## Life-cycle stages

The PCR has been developed to conform with ISO 21930:2017 and only uses the mandatory modules and life-cycle stages described in that standard.

The stages, called the construction works life cycle information within the system boundary, are separated into four phases: production, construction, use, and end-of-life stages.

*Production stage*

The mandatory production stage includes extraction and upstream production, transport to factory, and manufacturing.

*Construction stage*

The construction stage includes transport to the jobsite and installation.

*Use stage*

The use stage comprises use, maintenance, repair, replacement, refurbishment, operational energy use, and operational water use. The maintenance, repair, and replacement stages

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**Left:** Informed by third-party verified life-cycle assessments (LCAs) within the framework of a Product Category Rule (PCR), Environmental Product Declarations (EPDs) help building owners, product specifiers, design professionals, and others make accurate product comparisons required by some green building certification programs and a growing number of jurisdictions.

PHOTO COURTESY SHUTTERSTOCK.COM

**Right:** It is recommended to include greenhouse gas (GHG) emissions from land-use changes, when significant, when determining the product's Global Warming Potential (GWP).

PHOTO ©S. BORISOV/COURTESY SHUTTERSTOCK.COM

also include production, transport, and disposal of necessary materials.

*End-of-life stage*

The end-of-life stage includes deconstruction/demolition, transport to waste processing or disposal, waste processing, and waste disposal.

## LCA modelling framework

The LCA approach must follow both the modularity and polluter pays principles, as described in ISO 21930:2017. The EPD must include warranty periods either in the product description or in the additional environmental information section.

## System boundaries

The material acquisition, preprocessing, intermediate processing, and processing stage starts when raw materials are extracted from nature (*e.g.* bauxite ore). This stage ends when intermediate materials (*e.g.* aluminum, glass, etc.) reach the gate of the production facility and are processed into the final product and packaged for shipping.

Materials can be considered "primary" or "secondary." Inbound transportation will be included in life-cycle inventory (LCI) for the production stage. All transportation, including interfacility transport, before the material is shipped to the application site, must be included. If more than one primary data point is available for inbound transportation distances of a raw material, an average distance weighted by the transported mass may be calculated, and the methodology must be included in the EPD. All transportation by truck must be reported as round-trip. If a different vehicle class or more than one transportation mode is required, then the LCA model should use multiple transportation datasets to represent these, provided separate LCI datasets are available for the vehicles, modes, or both.

The waste and scrap created during raw material manufacturing, as well as the emissions associated with transporting them to the point of disposal, should also be accounted for in this stage. Additionally, waste and scrap created during the manufacture of the product should be included in the LCA model. When materials are sent to landfills, one must assume emissions will accumulate over 100 years. Due to the limited availability of data relative to waste generation, recycling, and disposal of fenestration assemblies, a conservative default of 100 per cent to landfill shall be used.

## Criteria for the inclusion of inputs and outputs

In cases of insufficient input data or data gaps for a unit process, the cut-off criteria shall be one per cent of renewable primary resource (energy), one per cent of non-renewable primary resource (energy) use, one per cent of the total mass input of that unit process, and one per cent of environmental impacts. The total of neglected

input flows per module shall be a maximum of five per cent of energy use, mass, and environmental impacts.

## Data collection

Primary data is highly encouraged for products manufactured wholly or largely outside of the reporting company's control (*e.g.* contracted products or assemblies). However, when primary data is unavailable, companies can use representative secondary data that is less than five years old. The data should represent the technology(ies) and process(es) currently in use.

Any delayed emissions from temporary carbon sequestration (*e.g.* through wood content or paper-based packaging material that eventually degrades) must be reported in the additional environmental information section.

## Allocation for co-products

A fenestration assembly containing wood from an unmanaged forest may have negative CO2e associated with carbon flows in the production stage. However, if the product is assumed to break down and release carbon at end of life, then that release should be modelled according to ISO 21930:2017 Clause 7.2.7 even though it would occur outside the cradle-gate scope of this PCR. It must also be reported in the EPD's additional environmental information section. This would also apply to biomaterial-based packaging materials.

All EPDs developed using this PCR are only expected to include information regarding the production stage or cradle-to-gate phase. Information pertaining to the product's construction stage is optional because there is no single baseline regarding the uses of fenestration assemblies due to wide variations in use-case scenarios between various systems.

All relevant inputs must be included in LCA models except:

- Personnel impacts
- Research and development activities
- Business travel
- Any secondary packaging (*e.g.* pallets)

These have been excluded as they have a negligible environmental impact in the overall life-cycle performance of a fenestration assembly.

## Average EPDs for similar products

Given the specifications of fenestration assemblies, average EPDs for groups of similar products may be necessary. For example, if Site A manufactures 80 per cent of the product

Environmental Product Declarations (EPDs) may also include the potential effects of emissions on human health and toxicity.

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system covered by the EPD and each kilogram of product manufactured requires 5 MJ of energy, whereas as Site B makes 20 per cent of the product and each kilogram of product manufactured requires 10 MJ of energy, the average energy used per kilogram would be 6 MJ [(80 per cent * 5)+ (20 per cent * 10)].

The same logic applies if multiple products are made at one site. For example, if a site manufactures five different products and the specific product being assessed only represents 10 per cent of the site's output, then 10 per cent of the impacts occurring at that manufacturing site will be applied to that product's LCA.

## Impact assessment indicators

Mandatory impacts include Global Warming Potential (GWP), ozone depletion potential (ODP), Eutrophication Potential (EP), Acidification Potential (AP), and Photochemical Oxidant Creation Potential (POCP). LCIA category indicator results must be reported separately as cradle-to-gate scope, total life cycle, and separately for the framing and glazing.

## Additional environmental information

EPDs developed using this PCR should include, where relevant, additional information related to environmental issues, apart from the environmental information derived from LCA, LCI, and information modules. Identification of the significant environmental aspects must conform to ISO 21930:2017 Clause 8.4 and ISO 14025:2006 Clause 7.2.4.

EPDs may also include the potential effects of emissions on human health and toxicity, and may also include:

- Data on fenestration product performance (where environmentally significant)
- Instructions and limits for efficient use
- Organization's adherence to environmental management systems
- Environmental certification programs applied to the building product
- Other environmental activities of the organization, such as participation in recycling or recovery programs
- Preferred waste management option for unused or old/used fenestration assemblies

## Emissions reporting guidelines

It is recommended to include greenhouse gas (GHG) emissions from land-use changes, when significant, when determining the product's GWP. It is advisable to use internationally recognized methods, such as Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories. The use of wood from sustainably managed forests is preferred, as assessed and certified by CSA, Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI) Standards, etc.

## Validity period

An EPD is typically valid for five years and then must be reviewed and reissued. Further, an EPD must be updated if product formulation changes create shifts in any of the environmental impact categories by more than 10 per cent.

As a final note, waste metrics were calculated per ISO 21930:2017. However, these values represent rough estimates and should not be used as actual cradle-to-gate waste performance between products.

This PCR is valid until December 31, 2028. Companies can use this PCR to help them develop EPDs, thereby highlighting their sustainability credentials to potential customers.

**Amy Roberts** is the Canadian code and advocacy director for the Fenestration and Glazing Industry Alliance (FGIA). She leads FGIA's Canadian codes and regulatory initiatives with a focus on building and energy codes, standards development, and industry advocacy. In her role, she also supports the FGIA FENBC Region, working closely with stakeholders to represent industry interests at both regional and national levels. With more than 25 years of experience in glass and insulating glass (IG) manufacturing, as well as residential and commercial window production, Roberts brings deep technical expertise and strategic insight to advancing the Canadian fenestration and glazing industry. She can be reached at aroberts@fgiaonline.org.

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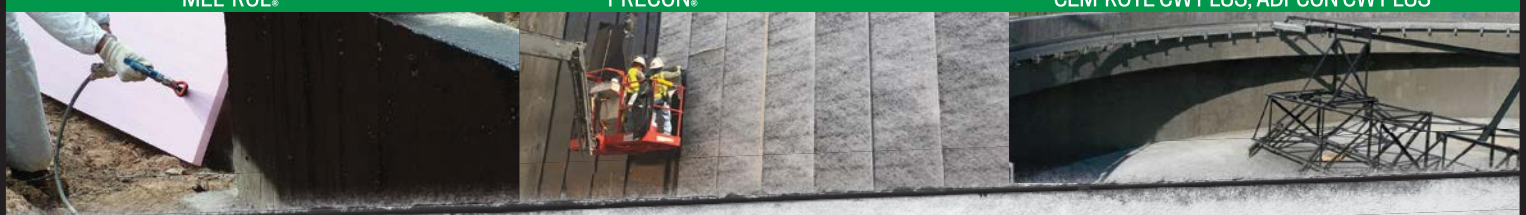


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# Whole-building Gains with Sprayfoam

**By Maxime Duzyk**

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For many, the appeal of sprayfoam insulation (SPF) lies in two key characteristics: its high R-value per inch and its ability to act as an air barrier. Among the two main types, open-cell and closed-cell, closed-cell SPF stands out for its combination of thermal performance, air sealing, and vapour control and radon protection. At R-6 per inch, it offers thermal resistance in a fraction of the space required by traditional insulation. This checks an important box for many builders who are working with space-constrained assemblies or retrofits that often have limited space in walls, floors, roofs, or attics. What is more, it can streamline construction and help meet aggressive energy targets as it insulates and air-seals in a single application.

However, these features are a mere springboard for SPF's real impact. SPF interacts with nearly every aspect of a building, from HVAC sizing to envelope durability and moisture control, becoming an instrumental contributor to whole-building performance. In both new builds and retrofits, its versatility helps close performance gaps that traditional insulation systems often struggle to address.


SPF affects multiple building systems, making it critical for stakeholders to adopt a holistic approach to its application. Doing so opens the door to better performance, smarter system integration, and longer-lasting assemblies. It can meet modern expectations on energy efficiency and code compliance, and just as importantly, ensure occupant comfort.

## Efficiency through integration

As a direct result of its dual ability to insulate and air-seal, SPF creates a seamless barrier that blocks heat transfer and air movement. From this foundation, a cascade effect follows: HVAC units work more efficiently, energy use drops, and building design becomes simpler and more performance-driven.

HVAC units benefit immensely from SPF. Simply put, SPF keeps the heat in during winter, and it keeps the heat out during summer. As a direct result of reduced air leakage, HVAC systems experience less strain and do not need to run as frequently or for extended periods.

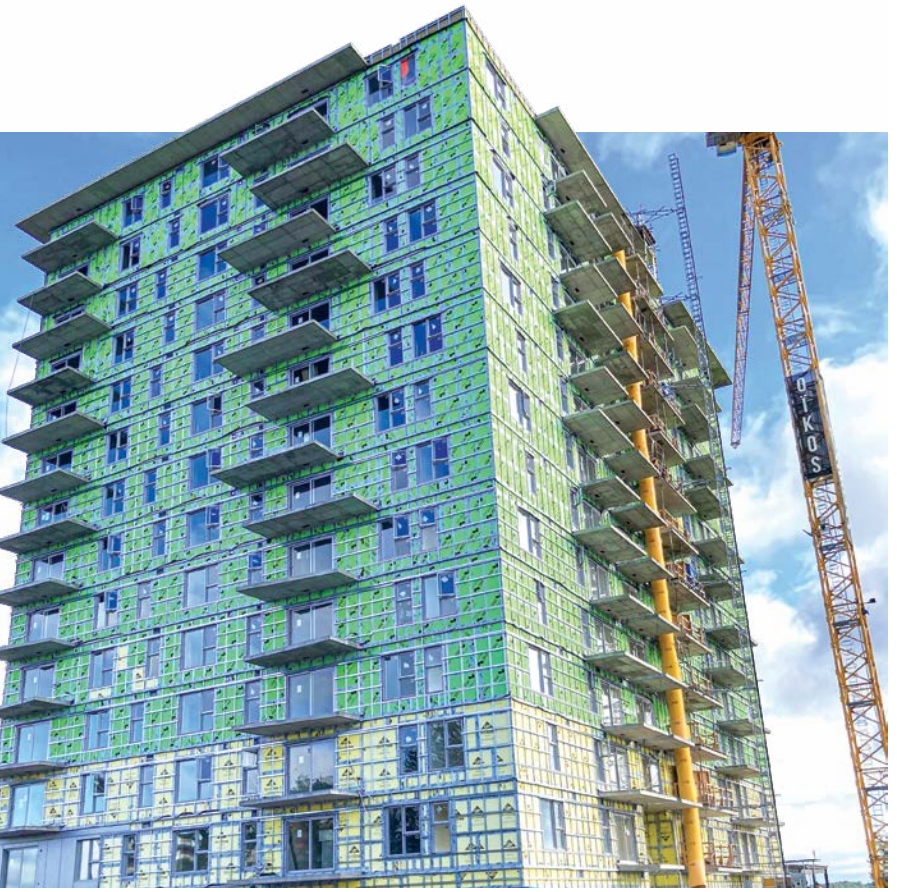
The operational impact of SPF extends beyond dollar savings from less HVAC use. Many builders choose to "oversize" HVAC systems to compensate for the high risk of energy loss; but tightly sealed buildings allow for safe downsizing without sacrificing occupant comfort. That translates to smaller equipment, better load matching, and reduced peak energy demand across a range of building types, from custom homes to multi-tenant commercial spaces.

A consistent and well-insulated envelope also makes it possible to use advanced mechanical systems such as heat recovery ventilators (HRVs), variable refrigerant flow (VRF) systems, and low-load heating technologies effectively. These systems are designed for high-efficiency buildings where heat and airflow can be precisely managed. Without a tightly sealed, predictable envelope, their performance suffers—they may become oversized, inefficient, or unable to maintain comfort. SPF helps create that level of control, enabling smarter system design and more reliable, long-term efficiency.

All in all, SPF supports greater design accuracy. With fewer unknowns in the envelope's performance, HVAC designers and energy consultants can model system loads more confidently, reduce margin for error, and streamline commissioning—contributing to better life-cycle outcomes and more reliable occupant comfort.

**Left:** Sprayfoam insulation (SPF) adapts well to retrofits, upgrading older buildings with air, thermal, and moisture control in space-limited assemblies.

**Right:** High-performance insulation such as closed-cell sprayfoam insulation (SPF) supports space efficiency in multi-unit residential projects, balancing comfort and energy goals.




Sprayfoam insulation's (SPF's) high R-value per inch makes it ideal for tall building envelopes, improving airtightness without adding bulk.

## Moisture management

Moisture intrusion is a common yet often overlooked building issue, often taking a backseat in the design phase. However, poor planning for both can significantly impact material durability, long-term maintenance costs, and occupant comfort. SPF steps in and addresses these two issues effectively.

In managing moisture, closed-cell SPF helps by serving as both an air and vapour barrier. It blocks warm, humid air from entering the building envelope and condensing within walls, floors, or roofs. In above-grade walls, it also stops water from entering crevices or pockets, even without additional layers or membranes, making it especially effective in buildings or other assemblies exposed to seasonal humidity, wind-driven rain, or below-grade conditions.

When used together with proper exterior moisture protection, such as flashing, drainage planes, or waterproofing, SPF can take care of interior moisture control on its own. By taking on insulation, air sealing, and vapour control, it eliminates the need for other interior layers. The result is a tighter, drier envelope that supports long-term material performance and reduces the risk of mould, corrosion, or structural degradation.

## Enabling sustainability goals

A well-insulated, airtight envelope is one of the most impactful ways to reduce a building's carbon footprint—both operational and embodied. Insulation is not just about saving energy anymore; it is expected to deliver measurable environmental benefits, support carbon goals, and stand the test of time. SPF's inherent airtightness and thermal resistance make that possible. By combining insulation, air sealing, and vapour control in one step, SPF simplifies construction while boosting overall performance.

The environmental profile of SPF has also come a long way. Many modern formulations now use ultra-low global warming potential (GWP) blowing agents, cutting embodied carbon significantly compared to earlier products. When paired with decades of energy savings and little need for maintenance, SPF becomes a powerful asset in reaching net-zero and carbon-neutral building goals.

Its long-term durability only strengthens that impact. Unlike some traditional materials that can sag, shift, or need replacement, sprayfoam holds its shape and performance for the life of the building. That means less material waste, fewer disruptions, and a lower total cost of ownership. For project teams focused on life-cycle sustainability, that kind of reliability really matters.

## Adapting to retrofit and renovation challenges

Retrofit projects often require more from insulation systems, with less space to work with, less tolerance for disruption, and tighter constraints on design flexibility. SPF rises to the challenge by delivering high performance in limited conditions, allowing teams to upgrade existing buildings without compromising the original design or constructability.

Older structures frequently have irregular framing, aging materials, and uneven surfaces. SPF adapts easily to these realities, conforming to cavities, bonding directly to a range of substrates, and delivering multiple control layers in one step. Air sealing, thermal resistance, and moisture management are all built in, making it an ideal fit for assemblies that cannot be fully rebuilt or reconfigured.

Due to its high R-value per inch, SPF can improve performance without thickening walls,

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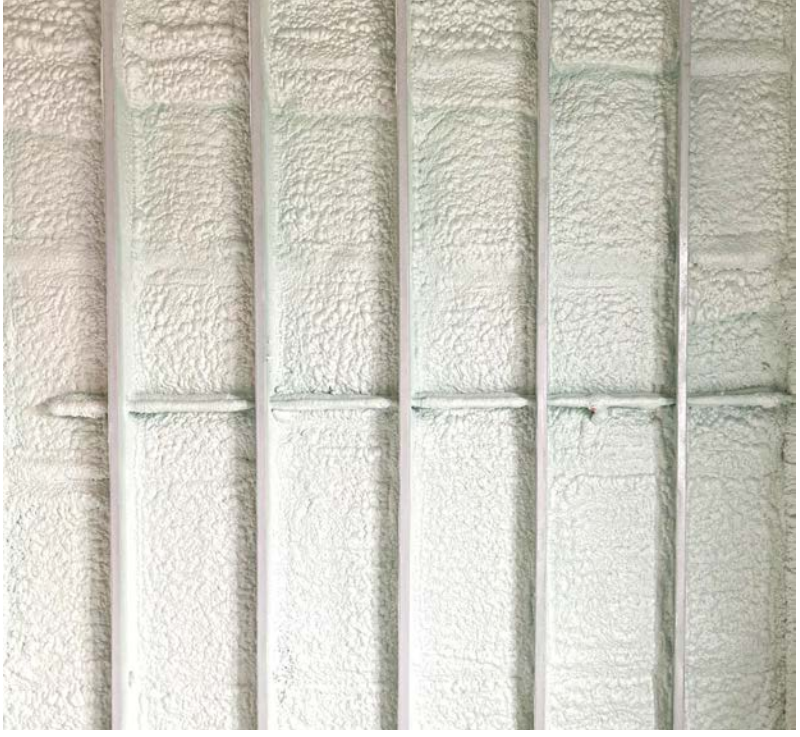

Closed-cell sprayfoam delivers thermal resistance, air sealing, and vapour control in one layer—streamlining wall assemblies.

an especially important advantage in urban infill projects, where preserving facade details or maximizing interior space is essential. It also performs well in tricky assemblies with dissimilar materials, tight transitions, or restricted access, where conventional insulation methods often fall short or require heavy detailing.

For contractors and building owners pursuing deep energy retrofits or working within incentive programs, SPF supports air sealing goals, improves blower door test results, and contributes to verifiable energy savings. And with fewer layers to install and simpler sequencing, it helps keep projects on schedule, minimizing downtime in commercial and institutional settings where disruption can be costly.

## Working with the right expertise

Getting the most out of any high-performance insulation takes more than choosing the right product—it requires skilled application and thoughtful integration into the broader building strategy. With SPF in particular, success starts well before installation, with careful planning around sequencing, detailing, and co-ordination between trades.

Experienced installers bring much more than technical ability. They know how to evaluate substrates, manage material transitions, and ensure continuity at critical points in the envelope. Their understanding of building science, code requirements, and performance testing helps avoid common pitfalls and supports quality assurance—especially on projects targeting certifications or advanced energy standards.

The best outcomes often come from early collaboration between architects, envelope consultants, manufacturers, and insulation contractors. When used strategically, sprayfoam can take the place of multiple control layers—serving as insulation, air barrier, radon barrier, weather resistive barrier and vapour barrier—streamlining assemblies and reducing the chance of performance issues later.

In an era of increasingly strict codes and performance expectations, having qualified professionals on board ensures that insulation systems not only meet technical requirements but also deliver long-term value. That expertise helps optimize cost, simplify scheduling, and support sustainability goals across the life of the building.

## Conclusion

SPF may start at the building envelope, but its impact reaches beyond the walls. It helps reduce HVAC size and complexity, manage moisture, enhance occupant comfort, and support long-term sustainability goals, making it a key player in high-performance construction.

Its ability to combine insulation, air sealing, and moisture control in a single material brings efficiency to both design and construction. And with long-term durability built in, that performance holds steady well after the building is occupied.

For teams focused on whole-building outcomes—energy savings, comfort, compliance, and resilience—sprayfoam delivers more than just insulation. It is a tool for building smarter, stronger, and more sustainably from the inside out.

**Maxime Duzyk** is the senior global director of building science and engineering at Huntsman Building Solutions. He holds a background in architecture and has been in the sprayfoam insulation business for the last 15 years. Duzyk is involved with different building envelope committees and associations in North America such as CSC, SFC, SPFA, CCMC, and ULC Standards.

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# Durability Meets Design

## The Rise of Modular Textile Construction

By David Peragallo, assoc. AIA

As the world grapples with the increasingly extreme impacts of climate change, architects and builders continue to prioritize materials and building techniques that help manage the effects of wind, rain, flooding, and fires. This is especially true for athletic stadiums and sporting venues, which require extensive funding and labour to design and construct; thus, they must last and serve the needs of owners and visitors. As stadiums evolve into multipurpose, fan-centric destinations, the demand for innovative materials that enhance durability, weather resistance, and energy efficiency has never been greater. These cultural hubs for regional teams and community use must be built to resist harmful weather conditions, which will last for years to come.

Due to their magnitude and capability to host thousands of guests, today's stadiums in North America have become more than just destinations for sports fans. Considering the changing landscape of the entertainment industry, with technologies such as virtual reality and new venues such as the Sphere in Las Vegas, Nev., venue owners and managers have looked to repurpose their properties whenever possible. Hosting top-selling bands and artists and expanding the stadium's use for more than

The Nîmes Sports Hall (Halle des Sports de Nîmes) in southern France is a contemporary architectural achievement that seamlessly integrates cultural heritage, sustainability, and artistic expression.

PHOTOS COURTESY SERGE FERRARI GROUP

one team has increased their overall revenue and helped keep visitors in seats year-round with four-season sports programming and various entertainment.

One solution that experts in this industry have explored as a new option to address these concerns is the use of modular textile construction materials, a lightweight but durable alternative to traditional architectural frameworks. This lightweight solution is typically installed over a metal or aluminum frame, where the mesh is tensioned and securely fixed to the profiles, ensuring long-term stability without the need for re-tensioning. This type of composite membrane delivers high mechanical resistance to sustain even the most extreme weather conditions. Modular construction solutions help ensure that venues remain visually striking and structurally resilient for years to come, while also prioritizing an improved spectator experience and enhanced environmental performance. This material is expertly engineered to withstand extreme weather conditions, from the intense UV exposure and high temperatures of the Southern U.S. to the heavy snow loads and harsh winters of the Northern U.S. and Canada. Its exceptional durability and resilience make it a reliable choice for even the most demanding climates.

## Engineering durability for harsh climates

High-performance modular textile construction materials are developed with technology that ensures long-term durability against wind, rain, sand, and sun, resulting in a facade that can be installed anywhere from the desert to the rainforest.

High-performance textile membranes used in modular construction often consist of a polyester base fabric coated with polyvinyl chloride (PVC) or glass fibre fabrics coated with polytetrafluoroethylene (PTFE). These materials offer an ideal balance of strength, flexibility, and resistance to UV degradation. PTFE-coated fibreglass, in particular, is prized for its exceptional fire resistance, durability, and long service life. Meanwhile, advancements in PVC formulations now include phthalate-free plasticizers and fluorine-free coatings, reducing environmental impact. These chemical innovations not only support compliance with stringent fire safety codes but also enhance thermal comfort and contribute to lower lifecycle emissions.

High-performance modular textile construction materials are frequently specified for cultural and historical landmarks, where they help preserve building exteriors against unpredictable and often harsh regional weather conditions. Over time, a structure's colour will remain intact and will show minimal wear and tear from seasonal weather

The Yeni Sakarya Atatürk Stadium in Sakarya, Turkey, exemplifies modern stadium design, incorporating advanced materials to enhance both functionality and esthetics.

PHOTOS COURTESY YERÇEKIM ARCHITECTURAL PHOTOS

events, resulting in less overall maintenance and even fewer situations where replacement is required. This is especially important for stadiums where constant programming is scheduled, and shutting down the venue for repairs is often inconvenient. If repairs or replacements are needed, the structure remains intact while only the fabric is replaced. This enables a swift resolution for maintenance, colour updates, or design changes. By preserving the main structure and allowing for seamless fabric replacement, these solutions offer significant cost savings for future modifications.

Modular textile construction materials have become crucial for safeguarding stadiums against extreme weather, which is becoming increasingly frequent and intense throughout the U.S. During the Los Angeles wildfires, National Football League (NFL) games had to be relocated or rescheduled to protect players and fans from exposure to smoke and ash. Implementing modular textile construction materials that meet national and international fire standards is more important than ever. Ensuring these stadiums, if damaged, can be easily and quickly repaired will save millions of dollars in repair costs and prevent additional losses in revenue during maintenance.

One of the key benefits of modular textile construction systems is their ability to integrate form and function. While it is essential to balance esthetics and functional requirements, a visually striking stadium should also meet the practical needs of the space it covers. Thoughtfully designed modular textile construction will complement the architectural context of their surroundings, considering how end-users will interact with the structure. Due to the flexibility of these high-performance textiles, they are an ideal solution for a variety of venues as they can be designed, installed, and customized to reflect the home team's branding and include design elements that tie into the local culture.

## Why modular textile construction?

In comparison to traditional building materials such as steel and concrete, modular textile construction offers a more sustainable and reliable option that is overall less expensive to manufacture and install. When partnering with the right

builder and installer, working with modular textile construction materials can significantly reduce timelines and, therefore, cut back on costs. These architectural textile solutions often provide a more cost-effective alternative to traditional materials such as steel and concrete, both of which are unreliable in the long term and have a higher carbon footprint. Concrete, metal, and aluminum are particularly detrimental to the environment due to the amount of CO2 released during their creation. Modular textile construction materials can be sourced and produced using less overall energy and are lighter to transport and install, making them safer and easier to work with.

One of the most significant benefits of modular textile construction materials is that, once delivered, they are easy to maneuver and can be adjusted, offering more flexibility in design, future alterations, or dismantling for reuse or recycling. Working with the right partners, stadium architects, and builders can be sure that their modular textile construction system will fit their needs and can be reworked as those needs change over time.

## Energy performance in stadiums

As a result of exceptional heat and light regulation, stadiums that implement these high-performance architectural membranes experience higher energy savings than those built with traditional construction materials.

A 2018 study concluded that compared to only one glass facade and an opaque roof, an additional translucent and thermally insulated membrane roof increased the continuous daylight autonomy from 15 to 38 per cent.[1] This resulted in a 30 per cent reduction in the electricity needed for artificial lighting in the roof-covered area of the sports field used in this study. These results created a benchmark for planners, investors, and future buildings of this type as they showed the direct impact these materials have on the energy usage of these textile structures.

## Temperature control in outdoor arenas

Thermal and light regulation is also a priority for outdoor arenas, especially in warmer climates where events occur through the heat, humidity, and sun. To protect players and spectators, modular textile construction materials can take shape as a textile roof that is durable, structural, and lightweight. With the correct balance of the light needed to illuminate sporting events and concerts that will protect players or attendees, these structures offer the best possible protection from the sun, wind, and cold during the winter season. The breathability of the membranes also offers optimal ventilation, with air being able to pass through to

The Luanda Multisports Pavilion in Angola showcases contemporary sports architecture with an innovative, environmentally responsive facade featuring a high-performance mesh.

PHOTO COURTESY SERGE FERRARI GROUP

regulate the temperature of outdoor arenas in an energy-efficient manner.

Traditional building materials, such as steel, conduct heat and can raise the overall temperature within the structure, resulting in more energy use and an unpleasant experience for visitors. Tensile architecture promotes better airflow, keeping temperatures within the stadium lower and more comfortable, especially in hot climates. These passive cooling systems reduce the need for mechanical ventilation or air conditioning, creating a more pleasant environment for fans without overwhelming energy use.

## Tool for identity and branding

Modular textile construction solutions help ensure venues remain visually striking and structurally resilient while prioritizing an improved spectator experience and enhanced environmental performance.

Stadiums are also viewed as landmarks that reflect the history and people of the region. The range of design capabilities that modular textile construction provides allows operators and owners to dress these venues in colours, patterns, and shapes that evoke and tie into local themes. These customized and unique options offer more ways to adhere to brand standards and be creative than a traditional roof or awning.

## Enhancing visuals with less structure

In addition to modular, tensile architecture—a form of construction that uses tensioned membranes, cables, and lightweight structures to create large-span, flexible, and often visually striking architectural designs—also offers protection at stadiums. When used in tandem, these innovative solutions help enhance the spectator experience by providing ample shade and UV protection, while also improving the acoustics and sightlines throughout the venue.

They also use fewer supports and allow for larger spans of roof coverage without columns or beams, which provides spectators with unobstructed views of the field or stage, ensuring that more seats in the stadium offer premium visibility. With fewer visual barriers, spectators have a clearer line of sight to the action, improving the overall experience.

## Conclusion

High-performance modular textile construction materials are developed with technology that ensures long-term durability against wind, rain, sand, and sun, and can be installed anywhere, regardless of weather conditions. These textiles are increasingly sought after for today's stadiums as they are an innovative and sustainable alternative to traditional building materials with their flexible, durable, and sustainable characteristics. They can be used for a variety of applications and provide significant benefits in terms of energy efficiency, providing exceptional thermal regulation and light control that contribute to reducing energy consumption and lowering operational costs. These materials' long-term durability ensure that venues can withstand extreme weather conditions, offering protection and longevity for iconic structures worldwide. As demand for energy-efficient and sustainable solutions continues to grow, modular textile construction will play an increasingly important role in shaping the future of modern stadium design.

**Notes**

[1] Refer to mdpi.com/2075-5309/8/9/118

Throughout his professional career, **David Peragallo**, assoc. AIA, senior specification manager North America, Serge Ferrari Group, has created, organized, and led the implementation of projects for high-performance architectural textiles. Before joining Serge Ferrari Group in 2021, he served as specification and regional sales manager for Verseidag-Indutex GmbH, a German-based supplier of architectural textiles.

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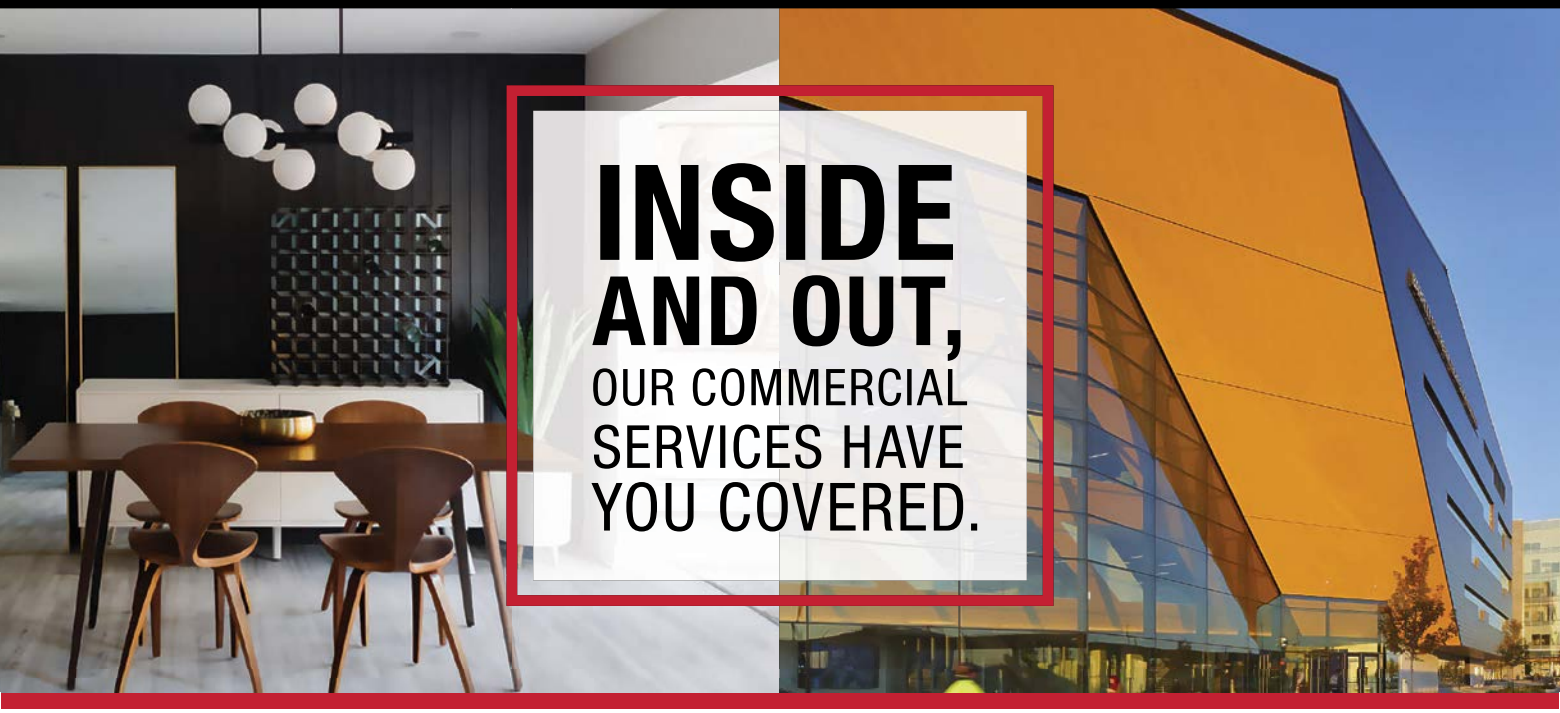

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# Specifying Weather-resistant Barriers

## Performance Measures for Building Wraps

**By Andrew Irvine**

PHOTOS AND ILLUSTRATION COURTESY TYPAR CONSTRUCTION PRODUCTS

In recent years, moisture management has become increasingly important for multifamily and commercial construction teams due to higher expectations for building performance and more stringent building codes and regulations. Many materials and installation practices contribute to air- and moisture-resistant building envelopes, with weather-resistant barriers playing a pivotal role.

Although the 2018 *International Building Code (IBC)* sets a prescriptive baseline for weather-resistant barriers (WRB) (*e.g.* one layer of No.15 asphalt felt), modern building science—and both U.S. and Canadian codes—now emphasize performance-based standards. In practice, a high-performing WRB must strike a balance of four key properties: bulk water holdout, air resistance, vapour permeability, and durability. While many WRBs are also vapour-permeable to allow outward drying, not all are, and not all assemblies require vapour-permeable layers. The optimal choice depends on climate, cladding type, and the drying strategy of the wall assembly. In Canada, performance is evaluated through CAN/ULC-S741 and S742 rather than by material type.

The performance of a WRB depends on the material's ability to maintain its integrity, no matter what comes into contact with it. This article will define the WRB performance characteristics specifiers need to know about and outline key tests and certifications that can help ensure the right material is selected for the project.

### Moisture management and drainability

As its most basic function, a WRB must hold out water. A high-performance building wrap will be able to pass both a "water ponding" test, which measures a building wrap's resistance to a 25.4-mm (1-in.) pond of water over two hours, and a more stringent hydrostatic pressure test where the material is subjected to a pressurized column of water for five hours.

However, as the trend for tighter building assemblies continues to grow, building wraps must be able to balance permeability with drainability to both prevent water from becoming trapped in the wall and allow any moisture that does become trapped to evaporate effectively.

The drainage efficiency of a building wrap is generally tested in accordance with ASTM E2273, *Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies.* During the ASTM E2273 test, a spray box with two small openings for

Today's most advanced building wrap products feature integrated drainage gaps through creping, embossing, weaving, or filament spacers. These new products eliminate the need for furring strips, helping reduce material costs and streamline installation.

water application is sealed to a wall assembly. Next, water is sprayed onto the wall for 75 minutes, with the water collected measured at 15-minute intervals. Water flow and dispersion are held constant throughout the test.

Once the 75 minutes are up, the wall sits idle for an additional hour before measuring the collected water drained from the wall assembly. If greater than 90 per cent of the total applied water has drained and been collected, the wall assembly is said to be in accordance with ASTM E2273. Section R703.9.2 of the 2018 *International Residential Code* (*IRC*) and Section 1407.4.1 of the 2018 *IBC* require the wall to have an average minimum drainage efficiency of 90 per cent when tested in accordance with ASTM E2273.

The *National Building Code of Canada* (*NBC*) does not have a minimum level of water resistance; it only requires that materials meet standards of pliability, tensile strength, and water vapour permeance. However, for materials to be voluntarily certified by the Canadian Construction Materials Centre (CCMC), they must pass a third test included in "Technical Guide for Sheathing, Membrane, Breather-Type," paragraph 6.4.5, in which a WRB is subjected to water for two hours at a depth of 25.4 mm (1 in.).[1]

Given the proliferation of drainable building wraps on the market, builders and specifiers should pay close attention to how quickly bulk water drains, as it can vary significantly. Some high-performance building wraps have been shown to achieve drainage efficiency of greater than 90 per cent, according to ASTM E2273, and some leverage innovative technologies to take this even higher.

### Clarifying terminology

Weather-resistant barriers (WRB), air barrier, or building wrap? These terms are often used interchangeably, but they serve different roles in the building envelope:

- Weather-resistant barrier (WRB): Resists bulk water intrusion and may also limit air and vapour movement depending on the product and application.
- Air barrier membrane: Designed and tested to limit air leakage through the enclosure; may or may not serve as a WRB.
- Building wrap: A sheet-applied WRB (often polymer-based) that may function as an air barrier if properly sealed and installed as part of a continuous system.

Today's most advanced building wrap products feature integrated drainage gaps through creping, embossing, weaving, or filament spacers. These new products eliminate the need for furring strips, helping reduce material costs and streamline installation. The cutting-edge drainable building wrap technology are products that create a drainage gap through an additional layer of polypropylene fibres. One of the leading commercial drainable building wraps uses this technology to create a drainage gap and has achieved 96.7 per cent drainage efficiency per ASTM E2273 while still handling and installing like a standard building wrap.

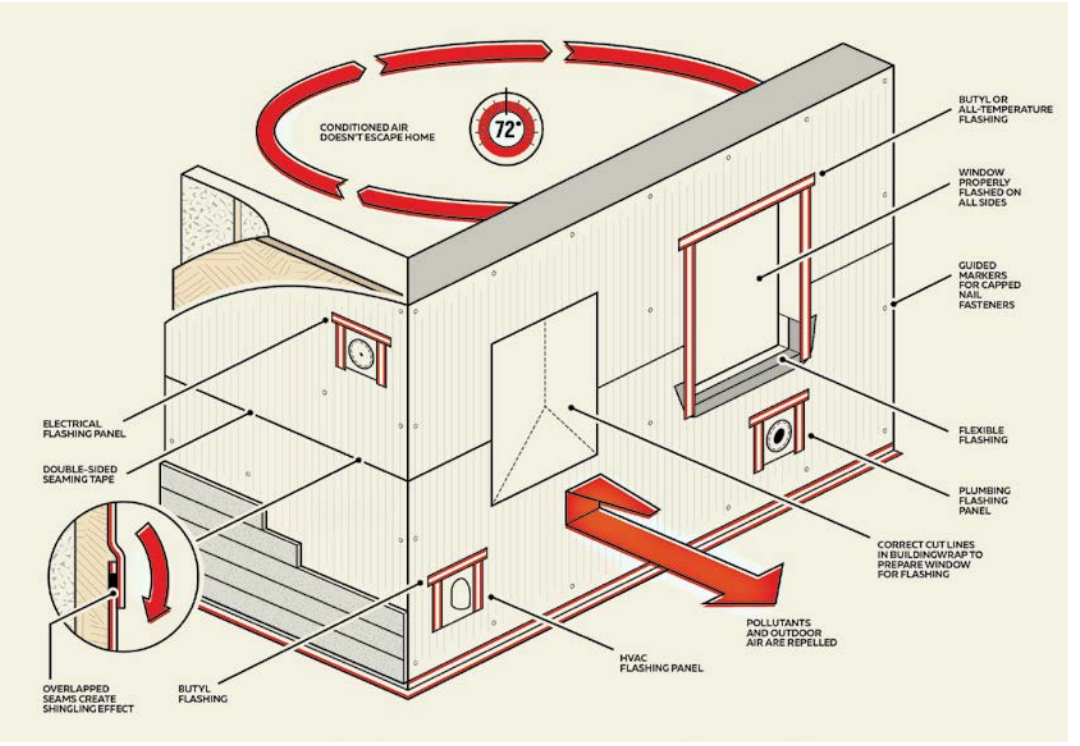
This added layer of protection is particularly important in coastal climates and areas subject to heavy wind-driven rainfall. These products can be installed in any direction without affecting performance.

## Permeability

A WRB must be able to breathe to prevent moisture vapour from getting trapped in the wall assembly. Permeability measures the amount of vapour transmission that a building wrap will allow over a period of time. ASTM E96/E96M, *Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials,* addresses two testing procedures for measuring permeability—desiccant and water methods.

In the desiccant method, the material to be tested is sealed to a test dish containing a desiccant or drying agent, and the assembly is placed in a controlled atmosphere. Periodic weighing determines the rate at which water vapour has moved through the specimen into the desiccant. In the water method, the dish contains distilled water, and periodic weighing determines the rate of vapour movement through the specimen from the water.

In most wall assemblies, outwardly driven moisture will not cause many problems (unless one is dealing with a material such as stucco painted with a low-perm paint, in which case bubbling and cracking would be visible). However, the inwardly driven moisture presents a problem, especially when conditioned indoor air is much cooler than the warm, moist




Installing a high-performance building wrap as part of a complete system with compatible tapes, flashings, and sealant ensures all components work as intended to maximize air and water holdout.

exterior. However, this is not the case in colder Canadian climates during long winter months, where the primary concern is outward vapour drive—from warm, moist indoor air moving toward the cold, dry exterior. As this moisture travels through the wall assembly, it may reach its dew point and condense on the first cold surface. If this occurs within the wall in an uncontrolled manner, the resulting trapped water can damage insulation, sheathing, and framing materials. These risks are addressed under the *NBC*, Part 5, which outlines requirements for environmental separation, including control of vapour diffusion and condensation within the building envelope.

This highlights the importance of selecting and positioning the vapour control layer appropriately within the wall assembly. In assemblies using a vapour-permeable WRB combined with an impermeable sheathing material such as extruded polystyrene (XPS), water vapour can initially pass through the WRB but will be blocked at the XPS layer. If condensation occurs at this interface, the assembly must be designed to either drain accumulated moisture downward or allow drying toward the interior, depending on climate zone, wall configuration, and material properties. The vapour control layer plays a critical role in both limiting further moisture transmission into the wall and supporting drying over time, especially during seasonal transitions.

Typically, inwardly driven moisture vapour is managed by separating the cladding from the rest of the assembly with a capillary break, a gap, or a sheathing material able to shed, resist, or redirect water. Impermeable sheathing, such as XPS, is one option for halting vapour migration. In these assemblies, inward vapour condenses on the XPS surface and, if properly detailed, drains downward.

However, in situations where a reservoir cladding is paired with a highly permeable sheathing like gypsum board (which can be as high as 50 perms) or a moisture-retentive material such as oriented strand board (OSB), an air gap may not be enough to slow vapour intrusion. In these applications, a well-selected WRB with suitable permeability is essential to reduce unwanted moisture accumulation while allowing the assembly to dry effectively.

The International Code Council (ICC) mandates that a product's permeance rating must be higher than five perms to be considered a WRB and not a vapour retarder. There are various ways to achieve permeability; however, a higher perm rating does not always mean better performance. In Canadian wall assemblies, products within the 10 to 20 perm range often strike the best balance between protection from moisture intrusion and outward drying potential, especially when assemblies are designed according to *NBC* and CAN/ULC-S741 performance standards.

"Inward Drive – Outward Drying," a paper written by building scientist Joseph Lstiburek,[2] recommends that specifiers aim for the "sweet spot" of 10–20 perms to achieve the desired moisture protection and breathability balance. Achieving the optimal perm rating ensures that while water is prevented from entering the wall cavity, ideal levels of moisture vapour are still allowed to escape. He writes that if it is too high, the moisture driven out of the back side of a reservoir cladding, such as brick or stucco, into the air space will blow through the layer and the permeable sheathing into the wall cavity. Too low, and the outward drying

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When discussing a weather-resistant barrier, look for a "balance of properties," including bulk air and water holdout, breathability, and durability. All four properties should be present in weather-resistant barriers (WRB) for optimal functionality and home/structure protection.

potential of the cavity is compromised. Fortunately, building wrap technology, mainly using a "systems" approach, can help builders hit the sweet spot for permeance.

## Air holdout

The Air Barrier Association of America (ABAA) defines an air barrier as a system of assemblies within the building enclosure—designed, installed, and integrated in such a manner as to stop the uncontrolled flow of air into and out of the enclosure. For several reasons, it is important to establish a continuous air barrier. As an air barrier isolates the indoor environment, it plays a significant role in the overall energy efficiency, comfort, and indoor air quality (IAQ) of a building. According to Natural Resources Canada (NRCan), air leakage represents about 20 to 30 per cent of heat lost from an older home, costing a homeowner $250 to $1,000 per year.[3] A continuous air barrier reduces heating and cooling costs, lowering greenhouse gas (GHG) production.

For an individual building material to be classified as an air barrier, its air permeance must be equal to or less than 0.02 L/(s•m$^2$) at 75 Pa (0.00394 cfm/sf at 1.57 psf) when tested following ASTM E2178, *Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.* However, this air permeance test only measures the amount of air migrating through the material itself, not through holes or gaps in the larger assembly. Therefore, it is important to consider a material's effectiveness as an air barrier largely depends on proper installation and the use of compatible tapes, fasteners, and sealants.

Understanding how an air barrier material performs when installed as part of a compatible system is much more valuable. To receive approval from ABAA, an air barrier must pass the organization's air leakage standards when tested in accordance with ASTM E2357, *Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies.* This type of test is intended to more accurately replicate how a wall system will perform in a real-world setting. It includes various elements, such as wind loading, making it a more reliable measure of the system's performance. When tested in accordance with this standard, the air barrier's tested air leakage must be less than or equal to 0.20 L/(s•m$^2$) @ 75 Pa (0.04 cfm/sf @ 1.57 psf) in both directions (*i.e.* infiltration and exfiltration).

Air barriers can also be defined through whole-building testing in accordance with ASTM E779, *Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.* This test method is intended to measure the airtightness of building envelopes of single-zone buildings. For this test method, many multi-zone buildings can be treated as single-zone structures by opening interior doors or inducing equal pressures in adjacent zones.

To align with Canadian codes and product evaluation practices, CAN/ULC-S741 and CAN/ULC-S742 are the two key standards used to assess air barrier performance—S741 for individual materials, and S742 for full assemblies. While these standards are specifically written for air barriers, they are frequently applied to commercial-grade WRBs when those products are intended to function as both moisture and air control layers. In such dual-role applications, WRBs are tested to meet air permeance and assembly leakage criteria under S741 and S742, in addition to separate evaluations for moisture management, such as ASTM E96 (vapour permeance), E2273 (drainage), and E2357 (assembly air leakage). However, it is important to note that S741 and S742 do not directly test water holdout, so WRBs must also be validated through dedicated water resistance testing.

After being exposed to surfactants and subjected to a weathering machine for two days, the left building wrap did not show any damage before or after a scratch test, while the middle and right one both became brittle.

This reinforces the industry's growing emphasis on assembly-level testing, where the combined performance of WRBs, flashings, tapes, windows, rainscreens, and sheathing is assessed as a system. As codes continue to evolve, proactive product design and verified system compatibility are becoming essential for meeting the increasingly stringent building envelope performance requirements found in both the *IBC* and the *NBC*.

## Taking a system approach

The key word in this discussion is assembly. A WRB material alone—no matter how advanced—cannot be counted on to protect a structure from unwanted air and moisture movement without considering the whole assembly. It is important to specify compatible materials to ensure all components work together.

For example, sealants with high solvent or plasticizer content can damage bitumen flashing products, causing functional and esthetic issues. When seams and tears are not adequately taped, windblown rain can infiltrate the assembly. Failure to use galvanized roofing nails or plastic cap nails to attach the WRB to the sheathing and framing can also compromise performance.

To counter this problem, some manufacturers have developed a system approach that includes compatible tapes for seaming and adhesive flashings for openings. When installed together, these systems are often assured through extended warranties from the manufacturer. When in doubt, always check the manufacturer's website for additional guidance.

## Durability

Construction sites can be challenging, and if the building wrap is not tested to withstand tears, scratches, prolonged exposure to UV light, and common construction chemicals, it will not perform how it needs to once installed.

When it comes to building wrap, the ICC tests durability on two primary indicators: tensile strength and tear resistance. These factors are critical because the wrap needs to withstand the handling and installation process without compromising its air- and water-resistive properties.

Tear resistance, as measured by trapezoidal tear tests (ASTM D1117/ASTM D5733), is a good measure for predicting a building wrap's ability to withstand the rigours of the job site and to stay on the wall after installation. "In-plane" is the best measurement of tear resistance. The trapezoid tear test, the best measurement of in-plane tear resistance, takes place when the building wrap is fastened to the wall and is subjected to tearing in the plane of the wall.

Some building wraps claim tensile strength based on ASTM D882, a test for thin plastic sheeting, not nonwoven fabrics. Since the product is never used this way, these measurements are not meaningful. However, the grab tensile measurement is meaningful. ASTM D5034, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)*, tests a 1.2 x 1.8 m (4 x 6 ft) material sample and clearly states it is designed for nonwoven fabrics, making it a much better metric for evaluating building wraps.

Another factor to consider is the ability of a building wrap to withstand incidental scratches from utility knives, nails, and other tools. While no ASTM standards govern scratch resistance testing for building wraps, some manufacturers commission third-party testing to demonstrate the performance of their products. A scratch-resistant wrap is less likely to suffer from surface damage that could weaken the material, ensuring it lasts longer and continues to perform effectively. Therefore, it is important to ensure the wrap being used has been tested for scratch resistance.

## UV resistance

Another primary performance attribute in a high-performance WRB is its ability to stand up to UV exposure. This is a critical point of differentiation between weather barriers, as prolonged exposure to UV radiation can cause material degradation, leading to loss of tensile strength, delamination of surface layers, and reduced water repellency. This is especially true in commercial construction, where there are already prolonged construction schedules that are often slowed by several factors. For these reasons, UV exposure of foremost consideration when selecting a system of weather protection products.

While the goal should be to clad the exterior of the building as quickly as possible, projects are often delayed, leaving WRBs vulnerable to longer-than-expected exposure to the sun. Many building wraps currently on the market only offer up to

This drainable achieves a drainage efficiency of 96.7 per cent through an integrated layer of polypropylene fibres.

120 days of UV resistance, with the best offering up to 12 months without degradation to their performance capabilities. This can be an incredibly important differentiator for commercial projects where extended project timelines often leave the WRB exposed for a considerable amount of time.

## Surfactant resistance

When evaluating WRBs, specifiers should seek an optimal balance of performance characteristics, including air and water resistance, durability, and sufficient permeability. However, one property, surfactant resistance, is commonly overlooked by building professionals. Builders and contractors who do not have a basic understanding of surfactants and how they impact the performance of a building wrap could potentially jeopardize the long-term durability of the exterior wall assembly.

Surfactants (surface active agents) are contaminants that lower the surface tension of a liquid, allowing it to penetrate deeper into the WRB material. Water soluble extractives in wood, such as tannins and wood sugars in redwood and cedar, are examples of surfactants that contaminate the surface of building wraps. In addition, surfactants can be found in detergents, soaps, and other cleaning solutions used to power wash siding, making surfactants almost impossible to avoid.

Why is this a problem? Surfactants promote the loss of water repellency, causing "wetting" of the building wrap surface. Once this occurs, water can more easily pass through the microscopic openings in the building wrap. Once moisture finds its way into the building envelope, it can threaten its structural integrity, causing exterior surfaces to deteriorate. Bulk moisture intrusion can also support mould and rot, which cause structural damage and pose serious health hazards to building occupants.

When choosing a building wrap, pay attention to its surfactant resistance capabilities. Not all wraps will provide the same surfactant protection, if any at all. Recent testing conducted by an accredited third-party testing facility with ISO 17025, Miami-Dade, American Architectural Manufacturers Association (AAMA), and AABA certifications compared three well-known weather-resistant barriers when subjected to a common surfactant (dish soap and water) and revealed that one outperformed the other two across the board.[3]

Although it is never advisable to expose WRBs to surfactants, most will be exposed despite best intentions. So, builders and contractors must select a wrap resistant to these chemicals. Due to the vast amount of building wraps and moisture management products on the market, it is more imperative than ever to make the right product selections to design and build wall systems that perform to today's high performance, durability, and moisture control standards.

## Conclusion

Specifying the right WRB is critical for achieving a high-performance building envelope that meets today's stringent building codes. Understanding the key performance measures—such as moisture management, permeability, air holdout, durability, UV resistance, and surfactant resistance—ensures a building wrap that protects against the elements and enhances the overall longevity and energy efficiency of the structure. Taking a systems approach and specifying WRB materials that strike an optimal balance between these various performance characteristics ensures informed decisions that contribute to the success and sustainability of projects.

**Notes**

[1] See Thomas K. Butt, FAIA. "Water resistance and vapour permeance of weather-resistive barriers." *Journal of ASTM International*, Vol. 2, No. 10, November/December 2005. Paper ID JAI12495. For more, visit www.astm.org.

[2] Refer to buildingscience.com/documents/building-science-insights-newsletters/bsi-061-inward-drive-outward-drying

[3] Refer to natural-resources.canada.ca/sites/nrcan/files/canmetenergy/pdf/housing/fixtheholeinyourwall.pdf

**Andrew Irvine** is a senior product manager at TYPAR Construction Products. He has extensive experience in the building and construction industry, including global product management, national account management, and finance. Irvine is responsible for the building and construction portfolio, including the TYPAR product line.

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# Hybrid Carpet

## Flooring That Lasts

**By Antonio Bucca**

PHOTOS COURTESY TARKETT

There are many expectations from indoor spaces today; they must look esthetically pleasing but be strong enough to withstand heavy use, be easy to clean but not feel sterile and unwelcoming, and feature healthy, sustainable materials that support human and environmental health. There are dozens of boxes to check and considerations to be made when designing and specifying a commercial environment. These spaces need to work harder and smarter for those who use them.

Flooring is the foundation of any interior, visually and functionally setting the tone for the space. While there are many high-performance flooring solutions, including some custom options for specific uses, one surface stands above the rest in terms of versatility: hybrid carpet.

The first hybrid carpet hit the market in 1967. Decades later, these innovative floors remain a smart and efficient solution for many commercial spaces, balancing comfort for occupants and long-term performance for facility managers and building owners.

But what exactly is a hybrid carpet, and where should they be specified?

### What is hybrid carpet?

Hybrid carpet refers to flooring that combines the comfort and acoustic benefits of carpet with the durability of a resilient floor. It includes three essential layers: a polyvinyl chloride (PVC) cushion backing, a vinyl precoat, and nylon yarn tufted into a nonwoven, primary backing. The three layers are fused together to create a durable floor cover that looks like carpet but performs like a resilient sheet. This combination gives hybrid carpet extreme longevity and easy maintenance. Depending on the manufacturer, hybrid carpet is available in rolls and tiles, and with or without a factory-applied adhesive. Seams are chemically welded during installation to create a wall-to-wall impermeable moisture barrier.

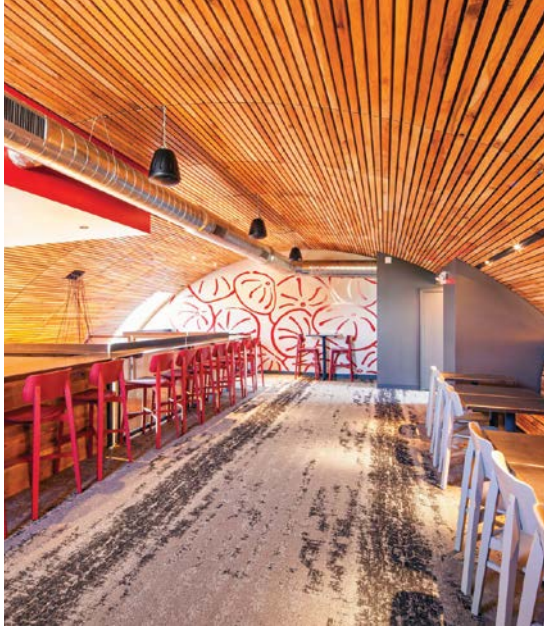
### How does hybrid carpet address common concerns?

*Acoustics*

In education, health care, or workplace settings, acoustics play an important role. Evidence-based design indicates that a calm, quiet environment is critical to supporting cognitive well-being, and flooring can significantly contribute to or reduce unwanted ambient noise. With its added cushion layer and a tufted surface, hybrid carpet absorbs more noise than hard surfaces, reducing echo and ensuring speech is clearer and easier to understand. Some hybrid carpets can perform more than 200 per cent better than hard surfaces in Impact Insulation Class (IIC) ratings, which measure how well a flooring absorbs impact vibrations within a room and between floors of a building.

*Well-being and comfort*

Hybrid carpets provide firm support underfoot, which studies[1] suggest can reduce discomfort and reduce the risk of trips and



**Left:** Today's hybrid carpet is offered in hundreds of colour and pattern combinations, including customizable options, making it a perfect solution for any high-use space expected to perform admirably for decades—and look good.

**Middle:** Resilient surfaces are popular choices for commercial spaces because they are easy to clean, less likely to harbour allergens and contribute to better indoor air quality (IAQ). However, when a soft surface is still desired for certain spaces to soften acoustics and provide a more textural esthetic, hybrid carpet checks all the boxes.

**Right:** Education facilities are some of the best candidates for hybrid carpet. Asthma has been shown to be one of the leading causes of school absences among children, and a hybrid carpet that is proven to reduce dust and allergens in a space can significantly impact students and staff.

falls. Hybrid carpets can also support respiratory comfort. In 2022, Allergy Standards Ltd. certified one manufacturer's hybrid carpet as the world's first Asthma & Allergy Friendly® soft-surface flooring, making it scientifically proven to reduce exposure to asthma and allergy triggers and contribute to better indoor air quality (IAQ).

Allergens in the air can trigger asthma and allergy symptoms; it is important to be able to remove the allergens using a standard maintenance routine. Hybrid carpet's low pile height and unique structure easily release the particles during vacuuming. In fact, Allergy Standards Ltd.'s scientific testing proved 95 per cent of allergens were removed from the certified product with a simple dry vacuum.[2] The testing standard requires the flooring to be cleaned according to the manufacturer's instructions, which do not call for a special vacuum or filter. As a result, a standard commercial vacuum was used during testing.

*Moisture mitigation*

When a concrete slab releases excess moisture, major issues, such as mould, can start to grow. When installed over high-moisture substrates, hybrid carpets with a permanent wall-to-wall moisture barrier insulate the moisture in the slab from the drier air above. Moisture vapour emissions from high-moisture substrates naturally migrate toward drier air above to reach equilibrium. The hybrid system insulates the moisture in the substrate from this drier air and thus interrupts the process. As a result, moisture vapour emissions from the substrate are greatly suppressed to a rate roughly equal to the material's own permeability. This virtually ceases all moisture vapour, mitigating dissipation into the space and virtually eliminating conditions that would be favourable to microbial growth. This allows hybrid carpet to be installed without calcium chloride or in-situ relative humidity (RH) testing, provided that no free liquids or moisture-stained concrete are present on the substrate. pH testing is required according to ASTM-F710 and levels must be between 7.0 and 9.0 for installation. It is important to review manufacturer instructions prior to installation.

In addition to fixing moisture issues from the slab up, hybrid carpets can also address moisture issues from the top down. A hybrid carpet with a closed-cell cushion leaves no paths for water or other contaminants to seep through (unlike open-cell, which does allow water to seep through). A closed-cell cushion hybrid carpet with welded seams is impermeable to liquids, including spills and leaks. For optimal impermeability, speak with the manufacturer's representative about the hybrid carpet's performance in the industry's Moisture Penetration by Impact Test, which can be used to test for impermeability on the body of the carpet and at the seam after 10,000 impacts at 68 kPa (10 psi), as well as impermeability at the seam after 50,000 cycles of Phillips Chair traffic.

*Maintenance upkeep*

Since hybrid carpets stop liquids in their tracks, preventing them from soaking through to the subfloor, cleaning up spills and leaks is a breeze. From an everyday maintenance standpoint, hybrid carpets are designed to look new with less effort. Low pile heights ensure dust and allergens are easily removed with a dry vacuum, and resistance to crushing gives the floor long-term durability.

The top tufted layer is typically made with solution-dyed, premium cationic nylon, which carries a negative charge to provide permanent resistance against staining agents commonly found in food and beverages. It is also treated with a non-toxic, third-party certified chemistry that resists soiling from oils and organic materials. In addition to this built-in protection, many hybrid carpets are covered under lifetime warranties for resistance to acid-based stains often present in health care, education, and food service environments. For ongoing maintenance, cleaning products certified under the Carpet & Rug Institute Seal of Approval Testing Program are recommended.[3]

Throughout corridors, sitting areas, and dining rooms, a hybrid carpet offers long-term resilience and easy maintenance of traditional resilient flooring while also providing the comfort and warmth of carpet.

**Top:** In workplace settings, a hybrid carpet can make the office more comfortable and more productive for employees.

**Bottom:** This elementary school installed a hybrid carpet in its building in 1967 (the year these resilient carpets were first introduced). More than a half-century later, the welded seams performed like new. A 19-L (5-gal) bucket of water poured over the 55-year-old seams cleaned up easily, with no moisture making it through to the sub-floor.

With an uptick in emotional support animals on college campuses, the higher education space may see an increased need for hybrid carpet. This university recently installed hybrid carpet in its dorm rooms, allowing the facilities team to easily and effectively clean animal accidents without needing to replace the flooring.

*Sustainability*

The specific sustainability attributes of a hybrid carpet will vary depending on the manufacturer. Still, many on the market are made with some level of recycled content and can be diverted from landfills at their end of life through a manufacturer's flooring take-back and recycling program. Since their day-to-day maintenance does not require harsh chemicals, hybrid carpets help reduce volatile organic compounds (VOCs). During Allergy Standard Ltd.'s third-party certification testing, a sample of textile flooring is installed in an environmentally controlled chamber, where VOCs released are measured over a 14-day period. Emission levels after 24 and 336 hours are compared to established thresholds to ensure they remain low throughout. If the flooring is designed to be installed with adhesive, the adhesive is also included in this chamber test to evaluate the complete system's impact on IAQ. Careful material selections that are free of ortho-phthalates and per- and polyfluoroalkyl substances (PFAS) will also support healthier indoor and outdoor environments.

*Made to last*

Another benefit of hybrid carpet is its proven durability, even in demanding, high-traffic environments. For example, an elementary school installed a hybrid carpet in its building in 1967 (the year these resilient carpets were first introduced). In 2023, the school was demolished to make way for a new building. Before demolition, the manufacturer of the hybrid carpet visited the school to test how the floors were still holding up after all those decades. The results? Soil still lifted easily from the fibres, and the welded seams performed like new. A 19-L (5-gal) bucket of water poured over the 55-year-old seams cleaned up easily, with no moisture making it through to the sub-floor.[4] On another note related to sustainability, the team removed the carpet before demolition so it could be recycled.

## Where can hybrid carpet be specified in various segments?

Today's hybrid carpet is offered in many colours and pattern combinations, including customizable options, making it usable in any high-use space. There is room for hybrid carpet in nearly any segment.

*Education*

Education facilities are some of the best candidates for hybrid carpet. From an acoustic standpoint, the carpet can dampen echoes and ambient noise in classrooms and hallways. Classrooms can also greatly benefit from hybrid carpet's contribution to IAQ. Asthma is one of the leading causes of school absences among children, accounting for more than 10 million missed school days annually.[5]

With an uptick in emotional support animals (ESAs) on college campuses,[6] the higher education space may also see an increased need for hybrid carpet. Facility staff at some colleges have faced the challenge of replacing carpets frequently due to animal-related accidents in residence halls. Seeking a more durable solution, some teams have turned to hybrid carpet with closed-cell backing. This type of flooring allows for easier and more effective cleaning, reducing the need for frequent replacements and offering a more sustainable approach for campus facilities.

*Workplace*

Poor IAQ is a significant concern in Canadian workplaces, impacting employee health and productivity. Research indicates that improving IAQ could enhance labour productivity by approximately $7.5 billion annually in Canada.[7] Common indoor pollutants, such as radon, tobacco smoke, and wildfire particulates, can cause fatigue, headaches, and cognitive impairments.[8]

One effective solution to support a healthy and productive office environment is the use of hybrid carpets. These carpets help reduce dust and allergens, limit microbial growth, and allow for quick and effective cleaning without harsh chemicals. By improving IAQ, hybrid carpets contribute to a more comfortable and efficient workspace.

Acoustic comfort is another critical factor influencing employee well-being and productivity. Noise is a leading source of employee complaints in offices, with studies showing that even low levels of background noise can cause a 66 per cent decrease in focus and a 20 per cent drop in productivity.[9] Distractions in the workplace can contribute to a loss of more than 90 per cent of an organization's productivity.[10]

Hybrid carpets can enhance acoustic comfort by reducing noise levels and providing a quieter environment for employees. This improvement in acoustic conditions can lead to better focus, reduced stress, and increased overall productivity.

*Health care*

While resilient sheet products remain a preferred flooring solution for many acute health care settings due to infection control requirements, there are areas in health care and senior living that can benefit from the performance attributes of hybrid carpet, where infection control is less of a concern.

Studies have shown noise can negatively impact a patient's well-being, and is one of the most stressful and distracting non-clinically relevant elements in a health-care setting.[11] The acoustic benefits of a hybrid carpet make it suitable for lobbies and waiting areas, where dampened noise levels can offer a more calming first impression. Similarly, hybrid carpets in staff wellness rooms or break rooms can offer visual and physical comfort and a quiet place to recharge.

Senior living communities are also good candidates for hybrid carpet. Throughout areas where accidental spills and pets can cause moisture concerns, such as corridors, sitting areas, and dining rooms, a hybrid carpet offers long-term resilience and easy maintenance of traditional resilient flooring while providing the comfort and warmth of carpet. A hybrid carpet in these spaces can also help reduce slip, trip, and fall accidents, often exacerbated by slippery surfaces, glare, and too much cushion underfoot. The low pile height of a hybrid carpet allows for easy rollability, so people who use wheelchairs or walkers can easily maneuver.

*Multi-family*

As gathering and amenity spaces gain importance for multi-family residents, hybrid carpet provides the soft texture of carpet, while its cushion helps dampen sound between floors. Similar to education environments adopting more animal-friendly flooring, the moisture barrier of a hybrid carpet is ideal for common rooms, hallways, and pet-friendly residences within a multi-family complex. Hybrid carpet, backed by a certification such as Asthma & Allergy Friendly,® can also be a great selling point for prospective residents with asthma and allergy concerns in a pet-friendly building.

The list of suitable environments for hybrid carpet includes hotels, restaurants, airports, etc. In high-traffic areas where acoustics and moisture mitigation are top concerns, hybrid carpet has emerged as a valuable consideration.

## Conclusion

Resilient surfaces are popular choices for commercial spaces for their easy cleaning routines, lowered ability to harbour allergens, and contributions to better IAQ. However, when a soft surface is still desired for certain spaces to soften acoustics and provide a more textural esthetic, hybrid carpet checks all the boxes. This tried-and-true classic flooring remains innovative and flexible for the needs of buildings today.

**Notes**

[1] Refer to "Compliant flooring to prevent fall-related injuries in older adults: A scoping review of biomechanical efficacy, clinical effectiveness, cost-effectiveness, and workplace safety," at doi.org/10.1371/journal.pone.0171652.

[2] Learn more at allergystandards.com/certified_products/powerbond-rs-hybrid-resilient/

[3] For a complete listing of certified products, visit www.carpet-rug.org

[4] To see more, watch vimeo.com/790101284

[5] Read "Asthma-Related School Absenteeism, Morbidity, and Modifiable Factors" at doi.org/10.1016/j.amepre.2015.12.012

[6] Refer to "With Emotional-Support Animals on the Rise, How Are Colleges Responding?" at www.chronicle.com/article/with-emotional-support-animals-on-the-rise-how-are-colleges-responding

[7] Review scc-ccn.ca/system/files/privateations/SCC_RPT_Air-Quality_FINAL_2017-04-21.pdf

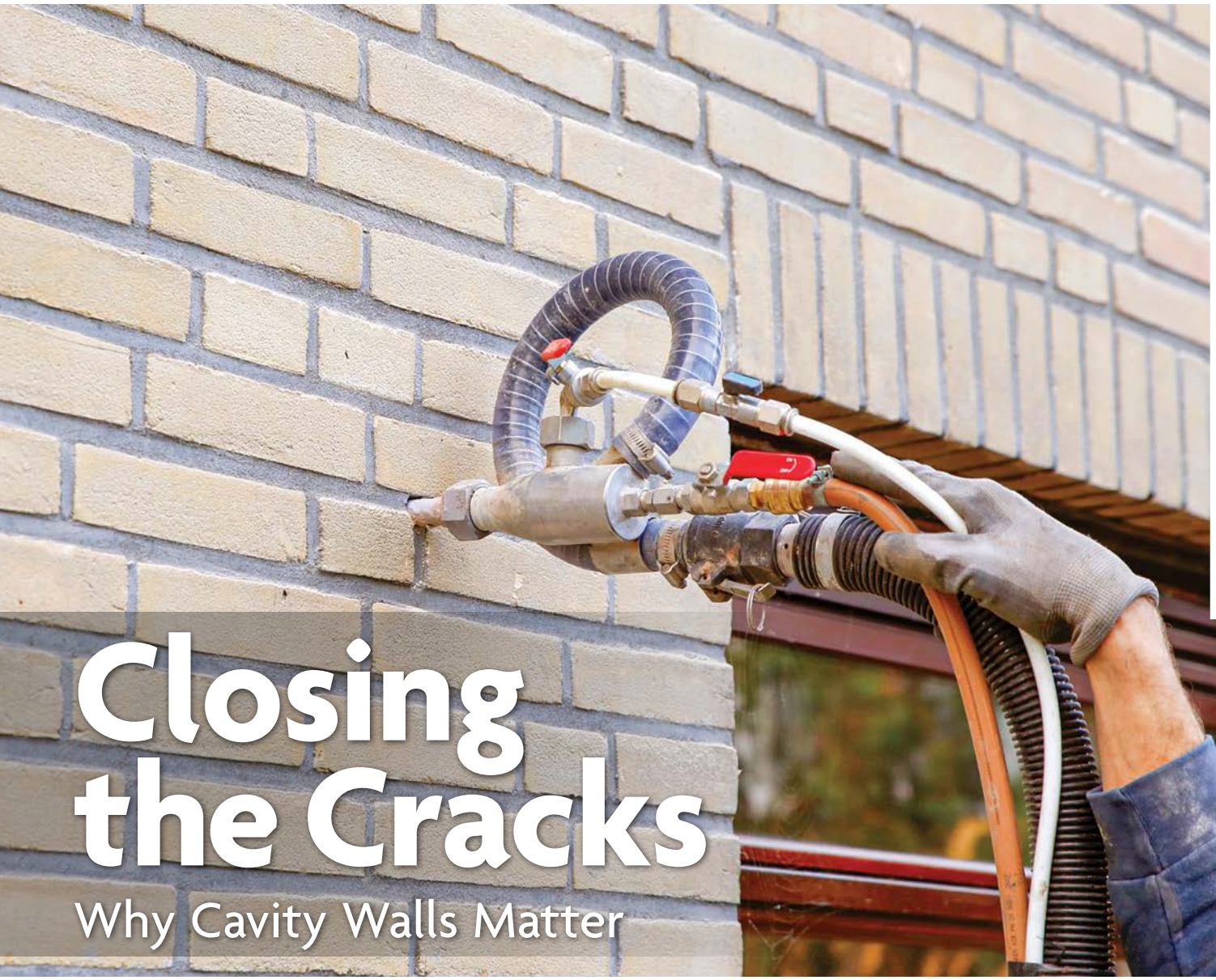
[8] To learn more, visit policyoptions.irpp.org/2025/07/indoor-air-quality/

[9] See studioforma.ca/the-impact-of-soundproofing-in-office-interior-design/

[10] Refer to i-m-t.com/workplace-acoustics-can-affect-productivity-business

[11] Learn more by reading "Health Inequity by Design: Waiting Rooms and Patient Stress" at doi.org/10.3389/fcomm.2021.667381

**Antonio Bucca** is senior director of soft surface product management at Tarkett North America, where he leads commercial strategy and innovation across carpet tile, broadloom, and woven product lines. Having started in Tarkett's marketing support department, he gained foundational experience in product launches and sample operations, before progressing through leadership roles in sales, operations, and product management. With more than a decade of industry experience, Bucca excels in aligning design, supply chain, and market intelligence to drive sustainable growth and differentiation in a highly competitive soft surface market.



# Closing the Cracks

## Why Cavity Walls Matter

**By Emily Newton**

PHOTO ©CLAFFRA/COURTESY ISTOCKPHOTO.COM

Whether working on a house or alongside a team for a commercial property, insulation is always a priority for energy efficiency and cost savings. Contractors and clients alike often forget to invest in cavity walls—which have an air gap between two layers for heat retention—as they do with solid walls.

Establishing a quality cavity wall requires as much attentiveness, despite its performance advantages. When installed properly, cavity walls provide a golden opportunity to minimize escaping heat and moisture accumulation. These best practices will help ensure a successful installation process.

### Use the right materials

Households and professionals are trying to find ways to save their wallets and carbon footprints by leveraging cavity wall insulation. Cavity walls are often exposed to water and varying air temperatures. Therefore, the materials must consider these influences. High R-values and thermal performance are key factors which vary based on location and wall characteristics. For example, cavities with 2x4 and 2x6 studs only have a value of R–5.5 for the space they take up, depending on the wood's characteristics.[1]

*Mineral wool*

Mineral wool is commonly used in industrial facilities with cavity walls due to its insulation

Cavity wall construction in progress: insulation panels placed between brick and block layers help reduce heat loss, manage moisture, and improve overall building efficiency.

PHOTO ©BEN-SCHONEWILLE/ COURTESY ISTOCKPHOTO.COM

properties. The installation process is straightforward, and the product is generally more suited for commercial budgets than residential options despite a higher price point. It has quality thermal performance, fire resistance, and sound absorption, which are crucial for environmentally susceptible parts of the building.

*Polyurethane foam*

Polyurethane foam is recognized for its high R-value relative to its thickness. It can be applied in thin layers while providing effective air-sealing properties comparable to thicker insulation materials. It also resists water well, meaning the cavity is less likely to develop mould and mildew. Since the foam can be sprayed, filling in crevices and injecting it into the cavity without too much destruction is painless.

Although this material increases fire risk in a building, flame retardants can help reduce these characteristics. Some researchers are testing the ability of options such as metakaolin, a geopolymer, to change the insulation's pore sizes to make it less susceptible to these dangers.[2]

*Expanded polystyrene (EPS)*

EPS is one of the most lightweight insulation materials on the market.[3] Often, it comes in blocks, making it effortless to slide into cavities with a wide enough opening. It is also one of the most affordable. It still has a notable R-value for creating optimal efficiency.

*Extruded polystyrene (XPS)*

XPS has many of the benefits of EPS for cavity walls, including moisture control and thermal performance. It may be favoured over EPS because it has fewer air pockets and naturally minimizes compression. Even if the cavity insulation needed to be tended to, the boards are simple to slot into the wall.

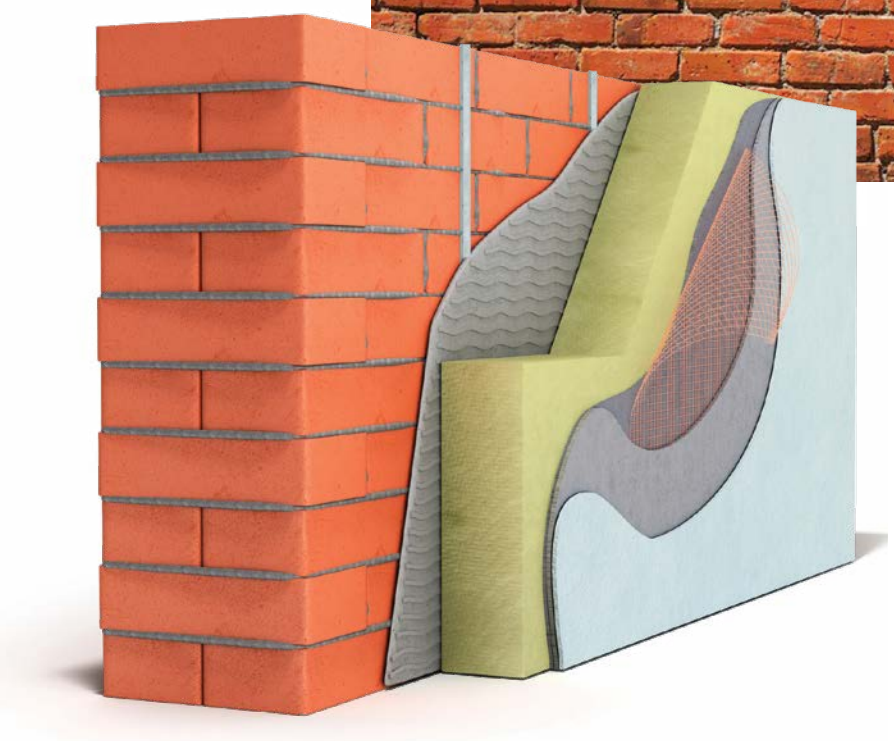
XPS may also be preferred because of its recyclability and ability to reduce energy consumption. These features lower a structure's overall greenhouse gases. Manufacturers can remelt XPS boards and reclaim thermoplastic resin to fashion it into more insulation or roofing components if necessary.[4]

Infrastructure for this is minimal throughout North America, with reclamation rates varying by manufacturer. However, some successful projects, including a recycling effort at an international airport, were able to salvage 90 per cent of XPS for repurposing.[5]

The material could be a popular choice among customers, especially as recent surveys show that 37 per cent of buyers are willing to pay a

**Top:** A brick wall, half covered in white paint.

PHOTO ©MARL CLEVENGER/ COURTESY UNSPLASH.COM



**Bottom:** A layered brick wall thermal insulation concept.

PHOTO ©NOSUA/COURTESY ISTOCKPHOTO.COM

five per cent premium for eco-friendly alternatives.[6] These insights should be shared with clients, as cavity wall insulation interest may align with energy-efficient or sustainable building goals.

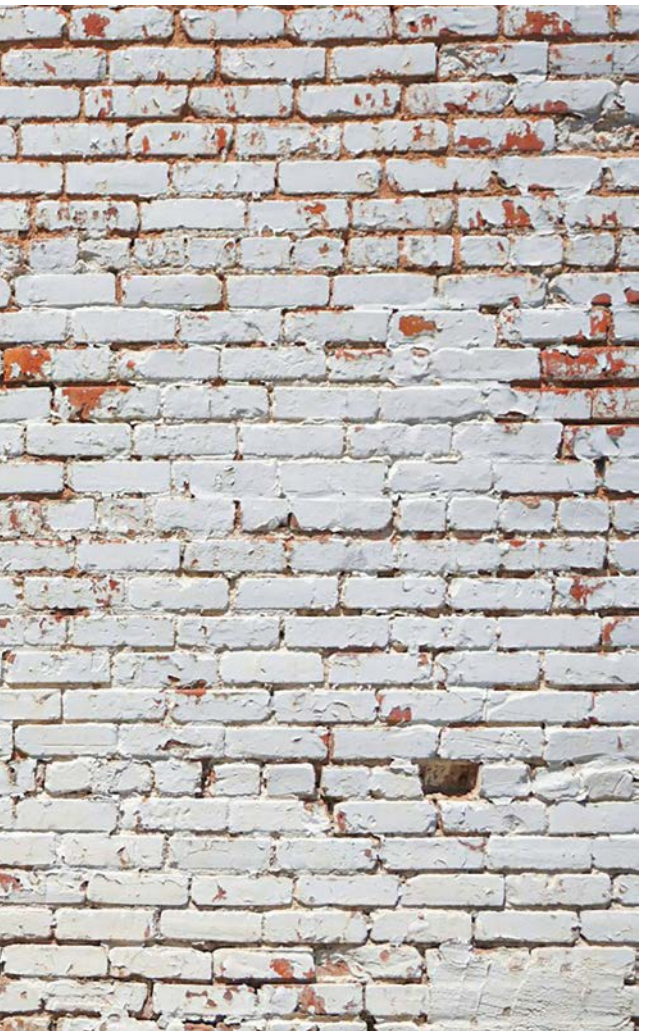
## Install insulation correctly

The quality and choice of materials matter only if they are installed appropriately. The process slightly differs from that of solid walls. First, ensure there is enough space to insert insulation. When inserting boards or spraying, confirm every gap is covered and uniformity is present. Haphazardly filling the space or neglecting a review may leave open cold spaces, compromising the rest of the insulation's integrity.

Also, review national guidelines for greener, more effective installation. The PERSIST initiative is one example, and many of its priorities apply to all insulation types. The strategy highlights the importance of a rainscreen in making buildings airtight and dry.[6]

## Leverage technology

Sensors and artificial intelligence (AI) are changing every industry, including insulation. AI in structural design could discover performance



variances from every step, mitigating material weathering and waste by identifying optimal design. Studies prove AI is helpful for enhancing a building's energy efficiency by considering the structure's comprehensive elements, including how windows could lower an envelope's effectiveness.[8] Most studies reviewing AI's ability to aid insulators analyze diverse parameters, demonstrating its versatility, such as thermal conductivity, heat transfer coefficients, reflectance and heat inertia.

For example, AI sensors may find damp spots that need to be addressed before anything is put inside. Using computer vision and advanced cameras, installers could easily detect weep holes that require filling without laborious and time-consuming manual inspections. Machine learning algorithms are increasing in speed and accuracy, notably in dark environments where quality control is harder to discern. Studies show that semantic segmentation algorithms had an accuracy of 63.1 per cent in these challenging conditions.[9]

Performance analysis for buildings, particularly large structures, is commonly conducted for both new and retrofitted projects. AI can use the building's data and specifications, including orientation and historical weather data, to assess the specific needs of each cavity wall. A wall exposed to more sun or water could have a more considerate composition than the opposing part of the facade.

After the insulation is in the space, contractors may use AI for ongoing maintenance and structural health monitoring. It can review how well the structure copes with concerns such as thermal bridging, visualizing analytics shifts over time. Connectivity with smart software solutions makes cavity walls straightforward to observe without peeling away their layers. These technologies have been available for years, but seek to enhance capabilities with complements like AI.

## Choose water and fire resistance

Cavities are prone to other environmental influences compared to solid walls. Therefore, the insulation must contain qualities that outsmart its environment. For example, a crack in a brick is enough for problematic water ingress. Long-term performance can be protected by choosing water-resistant insulation types, such as XPS, mineral wool, and sprayfoams. Incorporating a drainage solution as a fail-safe should also be considered, and it is often a code requirement, depending on the location. The right insulation is critical, primarily if the area is known for heavy rains or is near a water body.

The same is true for fire resistance. The insulation type should slow fire spread (*e.g.* mineral wool). This is why many masonry chimneys and cavity walls use mineral wool—it does not promote combustion.[10]

Another bonus best practice is reinforcing the external cavity walls, whether the job is a retrofit or a new build. The outside layers are another obstacle to keeping flames from worsening. Focusing as much on the facade's strength as the insulation during the design process of the base structure can increase the value of cavity wall insulation and its climate-resistant qualities.

Contractors may also use AI to assist in structural design to find temperature variances

An individual with a nozzle device, spraying a brick wall with liquid.

PHOTO ©ÖMER HAKTAN BULUT/ COURTESY UNSPLASH.COM

and pools of moisture. Even if installers make mistakes, the equipment could discover early mould growth or overly dry regions to warn operators of potential fires before they exacerbate.

## Ventilate thoroughly

To ensure optimal cavity wall performance, it is important to install more than insulation. Moisture and thermal movement are inevitable, no matter what material is present. Supplementary ventilation will stop deterioration and encourage a longer service life.

Fixtures such as ventilation holes remove water buildup that may have entered from the outer leaf. While drains and openings are ideal for this, consider assets such as air bricks. They connect the insulation to make it sturdier while managing the enclosed environment. Air bricks support wooden joists while preventing moisture accumulation that would cause unwanted odours, rot, or disruptions to internal condition regulation.

## Cavity wall insulation, thermal resistance, and AI in structural design

Cavity wall insulation is a solution that owners, designers, architects, engineers, etc., should deploy more frequently. Substantial environmental and financial savings can be discovered, along with boosted indoor comfort.

Many have avoided insulating cavity walls in the past because of literal barriers getting in the way, such as high costs to remove potential debris, or mould while addressing supplementary ventilation. With these best practices and novel technologies, it is possible to effectively fill any cavity to preserve a building's efficiency and resource management.

**Notes**

[1] See snbsc.ca/application/files/4316/8909/5123/Required_Insulation_.pdf

[2] Read sciencedirect.com/science/article/pii/S0959652624008345

[3] Refer to revolutionized.com/lightweight-insulation-materials

[4] Review xpsa.com/benefits/sustainability-and-lifecycle-analysis

[5] Read xpsa.com/wp-content/uploads/2020/05/Fabian_Hoffee_Herrenbruck_Earthtech_2004.pdf

[6] Refer to sitelogiq.com/blog/creating-value-esg-sustainability

[7] Learn more at alberta.ca/system/files/custom_downloaded_images/tr-dtseries01persist2016.pdf

[8] See eng.uwo.ca/electrical/faculty/grolinger_k/docs/AI-driven-design-optimization-for-sustainable-buildings.pdf

[9] Learn more at sciencedirect.com/science/article/pii/S0196890424001845

[10] Refer to natural-resources.canada.ca/energy-efficiency/home-energy-efficiency/keeping-heat-section-3-materials-insulation-house-wrap-barriers-weatherstripping


**Emily Newton** has more than 10 years of experience creating compelling content for the construction, manufacturing, and supply chain industries. Her work has been published in a range of industry magazines and online platforms. As the editor-in-chief at *Revolutionized*, she enjoys researching the latest scientific breakthroughs.


# By Others

## The Legend of the Ghost Builder

**By Ibrahim El-Hajj, M.Sc, Arch., BQC, EQI, CCCA, OAA, MCGIC**

AI-GENERATED IMAGE (CHATGPT/DALL·E)

The largest and most elusive contractor in North America is not a company with a website or office; it is the infamous "By Others." This fictional entity has been created, acknowledged, and perpetually promoted by architects, engineers, specification writers, designers, fabricators, manufacturers, and long-standing construction practices throughout the industry.

The term "By Others" is commonly used, but its lack of a clear definition creates confusion regarding its scope. Uncertainty about who is responsible for what contributes to the problem, which is being highlighted in this article. Teams should collaborate and seek to understand the goals, objectives, and adjacent scopes of their counterparts.

After 25 years of scrutinizing construction documentation, this author has consistently witnessed how "By Others" infiltrates drawings, specifications, and contracts, silently embedding itself wherever design is weak, requirements are vague, or responsibilities are undefined.

The failure to clearly define where one scope ends and another begins, and to account for the space in between, has become a defining vulnerability in the industry.

Ironically, the true art of contract documentation lies in doing the opposite: Defining responsibilities, liabilities, deliverables, and terms of the construction relationship, and leaving nothing "By Others."

To unpack how "By Others" persists in practice, this article is organized into the following sections: a satirical biography of the phantom contractor, the dilemma, tactics by which "By Others" enters documentation, the role of design ambiguity and professional obligations, a case study illustrating the consequences, and finally, remedies, standards, and strategies to reduce reliance on this fictional figure.

.9 all reinforcing members, bracing, brackets, anchors, screws, bolts, etc. necessary for installation and to ensure glazed aluminium assemblies compliance with specified performance criteria; preparation and installation of window washing tie back receivers (supplied by others); verification of building lines and levels as required for the proper layout and installation of all work included in this section, including initial checking that embeds are in correct position prior to commencing work on site;

IMAGES AND ILLUSTRATIONS COURTESY IBRAHIM EL-HAJJ

## Brief biography

Credentials of the untraceable:

*a. Place of origin*

"By Others" has been widely cited in architectural and engineering drawings, cut sheets, construction contracts, shop drawings, RFIs, addenda, submittals, specifications, and more.

*b. Experience*

"By Others" brings expertise across the entire building envelope, from below-grade to structural framing to finishing details, covering virtually any type of construction work.

*c. Qualifications*

"By Others" appears on the most complex projects across the continent, thriving where others are disqualified for lack of expertise, manpower, or financial capacity.

*d. Strength*

Firmly embedded in contract documents, "By Others" is entrusted with the toughest, most undefined tasks, typically those no contractor wants or dares to claim.

*e. Reliability*

"By Others" is routinely called upon to supply components, perform installations, and grant approvals to proceed. However, they never actually showed up on any construction site and did not complete their assigned scope.

*f. Reputation*

While "By Others" is widely known in the industry, concerns persist about their chronic absence and incomplete work. A growing backlog of lawsuits appears perpetually pending, but no one can find them to serve the papers.

*g. Accountability*

Despite being named in thousands of documents, "By Others" has never attended a pre-bid meeting, submitted a tender, responded to a request for information (RFI), or negotiated a contract.

*h. Status*

"By Others" holds an unshakable recognition across the construction industry. Yet it is entirely untraceable and never accountable. Still, it persists, haunting the margins and footnotes where responsibility quietly disappears.

*i. References*

Provided upon request. "By Others" is trusted by a broad network of architects, engineers, builders, manufacturers, and contractors who regularly collaborate on a wide range of projects.

*j. Address*

"By Others" has no fixed address, office, website, or contact number. However, they permanently reside in the documents.

Notably, Canadian Construction Documents Committee (CCDC) 2–2020 makes no reference to the phrase 'By Others.' Its absence underscores how the term has developed informally in practice rather than through contractual definition.

## The dilemma: Facing the invisible brilliant contractor

The repeated use of the term "By Others" has led to widespread confusion and misinterpretation across construction documentation and contract administration.

Some creative construction participants have even introduced an advanced version of "By Others": "NBU," short for "Not By Us."

Different name, same vague terms and conditions, and the same ghost contractor still lurking in the documents.

"By Others" is more than a harmless label; it is a convenient escape hatch that shifts responsibility into a contractual void. It slips into drawings, specs, submittals, and contracts wherever ambiguity exists. It is not announced, but it is deeply felt in scope gaps, miscommunication, and costly rework.

The more ambiguous the design or documentation, the larger the territory this phantom contractor claims.

Too often, ambiguity is chosen over clarity, hoping things will somehow fall into place. However, instead of refining the design, assigning responsibility, or resolving the unknowns, vagueness prevails. And in that vacuum, "By Others" quietly takes control, unnoticed until it is too late.

all brackets, screws, bolts, etc. necessary for installation and to ensure glazed aluminium assemblies compliance with specified performance criteria; preparation and installation of window washing tie back receivers (supplied by others); verification of building lines and levels as required for the proper layout and installation of all work included in this section;

## Common tactics of 'By Others'

*Direct specification*

Sometimes, "By Others" is explicitly introduced into contract documents by assigning responsibility to an undefined party. This appears in general notes/conditions, addenda, schedules, specifications, shop drawing comments, and more, effectively shifting responsibility without identifying who is accountable.

In shop drawings, "By Others" is often used by subcontractors to indicate that a product, material, or activity is required but not within their scope. While this may clarify what they are excluding, it still leaves open the larger question of who is responsible. Any party involved in the project should know who is doing what; when adjacent systems or scopes are not clearly co-ordinated, issues inevitably arise later in the process, creating delays, confusion, and potential disputes.

Familiar examples include:

- Proceed with work upon approval "By Others"
- Submit sample for review "By Others"
- Expansion joint "By Others"
- Electrical control switch "By Others"
- Bore data sheets "By Others"
- Anchor plates to be built-in "By Others"

This approach may seem convenient during design or procurement, but it often leads to disputes during contract administration, commissioning, or auditing.

Their name appears wherever design stops short of decision-making. It is these misalignments, where intent, responsibility, and execution fail to meet, that "By Others" finds fertile ground.

It is important to note that the architect's professional obligations for services of contract documents are meant to convey the design intent clearly enough to allow construction, bidding, and regulatory compliance. They are not expected to provide step-by-step instructions for every activity. However, the documents must still be complete enough to enable contractors to execute the design accurately and consistently. This balance between clarity and reasonable limits is essential context for understanding how "By Others" fills the void of omitted responsibility.

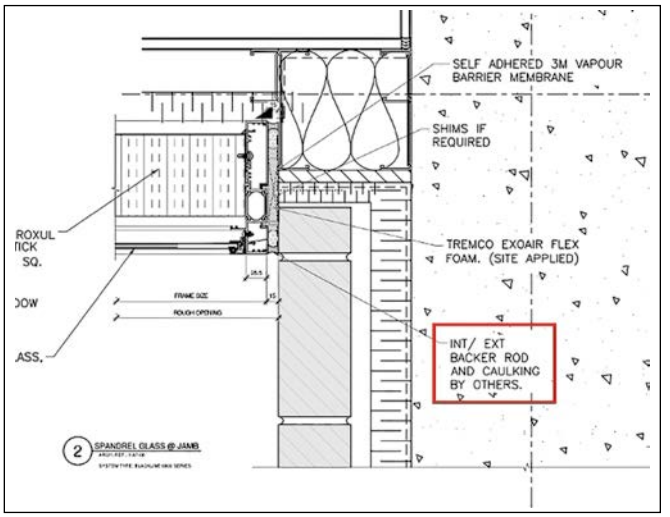
*Ambiguity in design*

Ambiguity in design, as explored below, connects directly to these professional obligations. When responsibilities are not clearly allocated within the design team, gaps emerge in the documentation. CCDC 2-2020 reinforces that dividing work among subcontractors is the constructor's role, not the contract documents'—which means the design team must resolve grey areas among themselves before documents are issued.

Design development is often rushed, leaving critical gaps through vague language, incomplete detailing, or omitted responsibilities. These omissions create fertile ground for ambiguity, and "By Others" fills the void. Without clearly defined scopes, responsibility quietly multiplies in the background only to surface during bidding, construction, or even occupancy, when it is far too late for seamless resolution. Incomplete design inevitably leads to a surge of RFIs from contractors seeking clarity, followed by a stream of avoidable site instructions that disrupt workflow, delay progress, and burden all parties with layers of reactive paperwork. Thorough design review and interdisciplinary co-ordination are essential to uncover these issues early before they spiral into confusion, disputes, and administrative fatigue on-site.

While it is recognized that architects and engineers are not responsible for producing construction documents that are literally exhaustive or instruction-manual precise, the scale of the problem in practice is hard to ignore. On some projects, each discipline is generating thousands of RFIs—far beyond what could reasonably be considered normal clarification. This volume of back-and-forth signals systemic gaps in design communication and co-ordination, creating significant confusion and inefficiencies for everyone involved. Addressing this requires a balanced approach: acknowledging the limits of design documentation while still strengthening review processes and interdisciplinary collaboration to reduce the reliance on "By Others" as a catch-all.

Ambiguity in design is not just about missing details; it is also about unclear boundaries of responsibility. The professional design team must establish among themselves where grey areas lie, ensuring that design documents present a co-ordinated and consistent framework. At the same time,




it is important to respect that contract documents should not attempt to assign work to particular subcontractors or trades. Under CCDC 2-2020, the division of work among subcontractors and suppliers rests with the constructor, guided by trade jurisdictions and industry practice. In other words, design teams must clarify design intent and eliminate scope gaps, while constructors determine how that work is allocated in execution.

*Compatibility of documents*

Beyond unintentional omissions, there are systemic issues in contract document preparation. This is illustrated through two key examples:

From the specifications perspective

- Inconsistent language or terminology
- Outdated standards or formats
- Overreliance on copy-paste content/practice
- Missing project-specific details
- Loosely worded instructions that leave scope and responsibility open to interpretation

From the drawing's perspective

- Poorly managed computer-aided design (CAD) or building information modelling (BIM) standards
- Incomplete co-ordination between specs and drawings
- Weak or absent linking between contract documents

While often associated with construction documents such as drawings and technical specifications, the influence of "By Others" runs deeper into the core of contract documentation.

The gaps are not just about missing details or vague notes; they often emerge between the documents themselves: mismatched scopes of work, conflicting specifications, misaligned general conditions and trade packages, or undefined requirements for delegated design and component selection.

It is in these misalignments where intent, responsibility, and execution fail to meet that "By Others" finds fertile ground.

*The language problem: Ambiguous acronyms and phrases*

Vague terms such as "By Others" do not operate alone; they often travel with equally ambiguous acronyms and phrases that compound confusion in construction documents.

Common culprits include acronyms such as To Be Determined (TBD) and NBU, and phrases such as "as required," "if necessary," "where applicable," "as needed," or "unless noted otherwise."

These shorthand expressions may seem harmless or even helpful during early design, but when left unresolved, they evolve into contractual blind spots. They obscure accountability, postpone decision-making, and open the door for inconsistent interpretation across teams and trades. Too often, these terms survive into issued-for-construction documents, where their presence becomes a liability.

To address this persistent issue, project teams should implement two foundational practices:

- Acronym and phrase legend—Incorporate a comprehensive "legend of terms" within every specification and drawing set to clearly define all abbreviations and ambiguous phrases. This ensures consistent interpretation across all disciplines.
- Responsibility pairing—Require that every instance of TBD, NBU, or "By Others" is accompanied by:
  - A clearly identified responsible party, or
  - A defined resolution process with a binding deadline.

When properly documented and managed, placeholder terms can serve as temporary tools for co-ordination. However, when left undefined, they introduce ambiguity, increase risk, and often lead to scope gaps, delays, and contractual disputes.

## Case study: Curtain wall anchors 'By Others' gone wrong

- Project—High-rise mixed-use development in downtown Toronto
- Issue—Curtain wall anchorage co-ordination failure
- Offending note—Anchorage to be provided "By Others"

*Root cause analysis*

Architectural documentation—Performance specifications were provided for the curtain wall system, but the slab-to-facade interface was left intentionally vague. The drawings neither detailed anchor points nor clarified dimensional constraints, deferring integration details to "others."

Structural drawings—Standard slab edges were shown with no embedded plates, sleeves, or co-ordination zones for anchorage. There was no structural alignment with the facade system or anticipation of load transfer requirements from the curtain wall.

Curtain wall subcontractor—Interpreted the "By Others" note as an indication that anchors were outside their scope and expected the structure to be prepped for direct attachment.

General contractor (GC)—Assumed the curtain wall subcontractor was fully responsible for anchorage and interface detailing. No pre-pour co-ordination or clash detection was conducted.

Site execution—The concrete structure, including floor edges and balcony slabs, was completed before any party flagged the disconnect between design intent and execution reality.

*Impacts*

- A five-week work stoppage due to unresolved interface conditions, resulting in critical path delays, liquidated damages exposure, and interest-accruing cost claims.
- Emergency retrofit using post-installed anchors, requiring structural calculation, co-ordination and sign-offs.
- $298,000 in disputed change orders involving the facade subcontractor, GC, and structural team.
- Extended scope disputes and blame-shifting between the architect, GC, envelope consultant, and various trades.
- Professional liability concerns due to unclear delegation of design responsibilities for critical load-bearing components.

*Key takeaways*

The phrase "By Others" created a scope vacuum with no assigned accountability for a critical interface.

Lack of cross-disciplinary co-ordination resulted in a fundamental misalignment of a design professional's responsibility.

The issue remained dormant until physical construction revealed the disconnect, by which point, seamless resolution was no longer feasible.

This case underscores the importance of explicitly defined responsibilities for building envelope interfaces. Vague notes and deferred decisions must be replaced with co-ordinated detailing and documented ownership across all disciplines to avoid systemic failure.

## Consequences: What happens when no one claims the work?

The consequences are both predictable and painful: project delays, scope gaps, claims, legal action, and cost overruns. Relationships among stakeholders strain as parties argue over intent, responsibilities, and compliance. When design is unclear and documents are vague, contractors tend to interpret requirements in their favour, often at the project's expense.

## Practical remedies: How to banish 'By Others' from a project

Solving the "By Others" problem goes far beyond graphical polish. While consistent fonts, sheet layouts, and symbols

| | | |
|---|---|---|
| .12 Walls: | 1st coat: | Latex flat sealer |
| | 2nd coat: | Vinyl wall covering (by others) |
| .13 Ceilings:* | 1st coat: | Flat Latex Sealer |
| | Finish Coat: | Refer to Drawings |

matter, visual consistency is not enough. What is needed is a return to fundamentals: accountability, clarity, co-ordination, and rigorous quality assurance and quality control (QA/QC) processes that verify that drawings, specifications, and models are not only complete and accurate but also compatible across disciplines and systems. However, technical alignment is only part of the solution. True resolution requires that the scopes of work are clearly defined, responsibilities are contractually assigned, and no critical interface is left to assumption or omission. When documentation, scopes, and contracts are developed in silos or without robust co-ordination, the gaps are quickly filled "By Others."

What is needed is a return to fundamentals: accountability, clarity, co-ordination.

The three Cs for a successful project:

- Clarity—Define scope allocations and responsibilities to eliminate ambiguity.
- Compatibility—Ensure all drawings, specs, and contract documents speak the same language.
- Consistency—Align every document to reinforce a unified design and execution narrative.

## When scope is clearly defined, everyone benefits

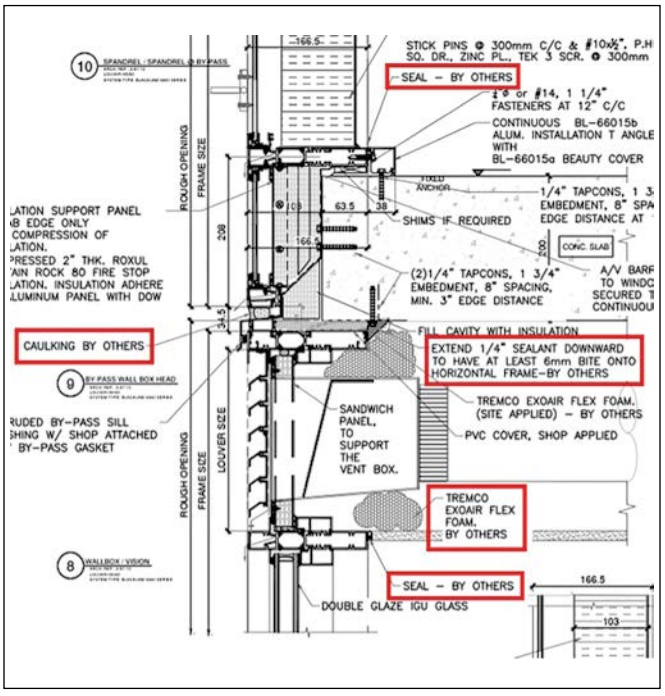
- Authorities having Jurisdiction (AHJs)—Expedite reviews and approve permits with greater confidence.
- Contractors—Build with clarity, precision, and reduced reliance on costly RFIs and change orders.
- Engineers and third-party consultants—Validate design intent and ensure compliance with fewer ambiguities.
- Builders—Meet milestones, control costs, and achieve occupancy targets with minimal disruption.
- Architects—Earn stakeholder trust, reinforce design integrity, and significantly reduce risk and liability.

## Unified standards to guide the way

Adopting robust international standards is key to eliminating omissions, redundancies, and ambiguity.

Relevant standards for consideration:

- ISO 12006/22263—Scope classification and structure
- ISO 29481/128—Co-ordination between drawings and specifications




- ISO 7200—Consistent title blocks and formatting
- ISO 16739 (IFC)—Data-rich, interoperable BIM models

While the following Standards are satirical, they reflect very real documentation issues.

- CSA 2025 (Common Sense Association) Series

Speaks to challenges in scope and responsibility that remain curiously unspoken in most official standards.

- CSA 2025-1.1

"No task shall be deferred to mythical subcontractors without prior written consent of Common Sense Association."

- CSA 2025-2.1:

"Any note containing terms such as 'as required,' 'if necessary,' 'By Others,' or 'not by us' must be accompanied by a signed acknowledgment from the responsible party, hereafter referred to as 'by them.'"

Implementation tip: Include a responsibility matrix as part of the co-ordination package to identify and document interfaces and unclear scope boundaries before tender.

- ANSI 2025 (Ambiguity Normalization Standards Institute) Series

Highlighting how ambiguity, once introduced, often becomes standard practice through repetition and silence.

- ANSI 2025-1.3

"Ambiguity shall be normalized and accepted unless explicitly challenged by the project team."

- ASTM 2025-1.4 (Another Standard To Manage)

A growing number of technical standards that, despite aiming for clarity, often add complexity and extra paperwork.

Design development and contract documentation demand time, deliberation, and professional judgment. No amount of ISO certification, ANSI guidelines, BIM modelling, or AI intervention can rescue a project from the consequences of a rushed or poorly conceived process.

No technical standard, not even an ASTM, can replace the value of thorough planning, co-ordination, and accountability exercised under realistic timelines.

When supported by these frameworks and enhanced by emerging AI tools, contract documentation can become more integrated, accountable, resilient, and compatible, laying the foundation for clearer communication, fewer disputes, smoother workflows, and ultimately, a more successful project delivered on time and within budget.

*Glossary and legend requirements*

To minimize interpretation disputes, include a glossary of terms for any acronyms, ambiguous phrases, or placeholders should be included in specs and drawing legends. Do not let "TBD" become "TBS" (To Be Sued).

## The question remains

The fate of "By Others" lies not in their hands, but in ours. Reclaiming full control of our construction documents requires deliberate effort, discipline, and accountability.

It demands that the industry stop relying on ambiguity and instead take ownership of every detail, scope, and interface in the documentation process.

Will the diligence of architects, designers, engineers, specification writers, construction managers, contract administrators, manufacturers, contractors, and builders finally restore the integrity of contract documents?

Will the industry learn from others' mistakes? Will it avoid the problems they left behind? Or will it all, once again, be left "By Others?"

**Ibrahim El-Hajj**, M.Sc, Arch., BQC, EQI, CCCA, OAA, MCGIC, is an architect with a master of science in architecture and more than 25 years of experience as a building envelope consultant and building scientist. He is building code qualified (BQC), a licensed EIFS auditor (EQI), accredited director, a certified construction contract administrator (CCCA) and Tarion Field review consultant. El-Hajj is the principal of I.E. Architects and the founder and vice-president of building science at DS Consultants. Renowned in the building industry for delivering cost-effective solutions, he helps architects, developers, and builders reduce defective work, enhance quality, improve building performance, and uphold warranty standards.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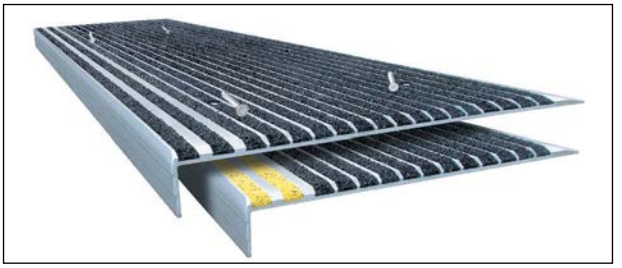

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**www.aluflam-usa.com**

Kelly Sawatzky, CSP, RSW

## Practical lessons for growing as a leader

We're a few months into the new term for all our hard-working chapter volunteers, subcommittees, executive, and board of directors. This column aims to help our volunteers navigate their roles and lead more effectively.

To me, leadership is best understood by looking inward and considering one's relationship to the world at large.

Good leadership is built on listening, compassion, integrity, vision, courage, and resilience. Though this list is not exhaustive, I aim to continue developing these qualities as I learn to lead and hope to never stop growing in this area.

Understanding your own values, hopes, desires, and shortcomings is essential to being an effective leader. Without this self-awareness, it's hard to truly listen, consider diverse perspectives, and make decisions that serve the greatest number. Keep your focus on the mission and values of our association, alongside your own personal values.

True leadership goes beyond empathy and sympathy. It requires understanding paired with a genuine desire to help. Listen carefully to others' opinions and challenges, and ask questions to deepen your understanding, even if you may not agree.

Equally important is extending that same care to yourself. Reaching out or asking for assistance is not a weakness but a true sign of strong leadership.

Make decisions that reflect mission and values. Integrity and vision are best understood through self-awareness. Analyze your opinions and desires to uncover your true motivation. Are you acting to avoid something unpleasant or to benefit a small group? Or, are you working toward a goal that's larger than yourself or your chapter/group?

Receive feedback—even criticism—with gratitude. Feedback is a gift, offering insight into another person's perspective. It can foster growth in our thinking or affirm the values and decisions we hold. Either way, it provides an opportunity to reflect and improve. At times, you may also have the chance to explain the reasoning behind your decisions. Do so when it's ethically appropriate.

I would love to hear what qualities you consider indispensable for leadership—and why. Becoming a good leader is a process, with always more room for improvement. Remember, you cannot be a good leader without first being a leader. Make mistakes. Learn. Grow.

I am CSC.

## Leçons pratiques pour grandir en tant que leader

Nous sommes à quelques mois du nouveau mandat pour tous nos bénévoles, sous-comités, dirigeants et membres du conseil d'administration de section qui travaillent fort. Ce communiqué a pour but d'aider nos bénévoles à naviguer dans leurs rôles et à diriger plus efficacement.

Pour moi, le leadership est mieux compris en regardant vers l'intérieur et en considérant la relation de quelqu'un avec le monde dans son ensemble.

Un bon leadership repose sur l'écoute, la compassion, l'intégrité, la vision, le courage et la résilience. Bien que cette liste ne soit pas exhaustive, je vise à continuer à développer ces qualités au fur et à mesure que j'apprends à diriger et j'espère ne jamais cesser de croître dans ce domaine.

Comprendre vos propres valeurs, espoirs, désirs et lacunes est essentiel pour être un leader efficace. Sans cette conscience de soi, il est difficile d'écouter vraiment, de considérer des perspectives diverses et de prendre des décisions qui servent le plus grand nombre. Concentrez-vous sur la mission et les valeurs de notre association, tout en gardant vos propres valeurs personnelles.

Le véritable leadership va au-delà de l'empathie et de la sympathie. Il nécessite une compréhension associée à un désir sincère d'aider. Écoutez attentivement les opinions et les défis des autres, et posez des questions pour approfondir votre compréhension, même si vous n'êtes pas d'accord.

Il est tout aussi important de vous accorder le même soin. Tendre la main ou demander de l'aide n'est pas une faiblesse, mais un véritable signe d'un leadership fort.

Prendre des décisions qui reflètent la mission et les valeurs. L'intégrité et la vision sont mieux comprises à travers la conscience de soi. Analysez vos opinions et désirs pour découvrir votre véritable motivation. Agissez-vous pour éviter quelque chose de désagréable ou pour bénéficier à un petit groupe? Ou, travaillez-vous vers un objectif qui est plus grand que vous-même ou votre section/groupe?

Recevoir une rétroaction — même des critiques — avec gratitude. Les commentaires sont un cadeau, offrant un aperçu du point de vue d'une autre personne. Ils peuvent favoriser la croissance de notre pensée ou affirmer les valeurs et décisions que nous avons. Dans un sens ou dans l'autre, il offre une opportunité de réfléchir et de s'améliorer. Parfois, vous pouvez également avoir la possibilité d'expliquer le raisonnement derrière vos décisions. Faites-le lorsque cela est éthiquement approprié.

J'aimerais beaucoup entendre quelles qualités vous considérez comme indispensables pour le leadership et pourquoi.

Devenir un bon leader est un processus, avec toujours plus de possibilités d'amélioration. N'oubliez pas, vous ne pouvez pas être un bon leader sans d'abord être un leader. Faire des erreurs. Apprendre. Grandir.

Je suis DCC.


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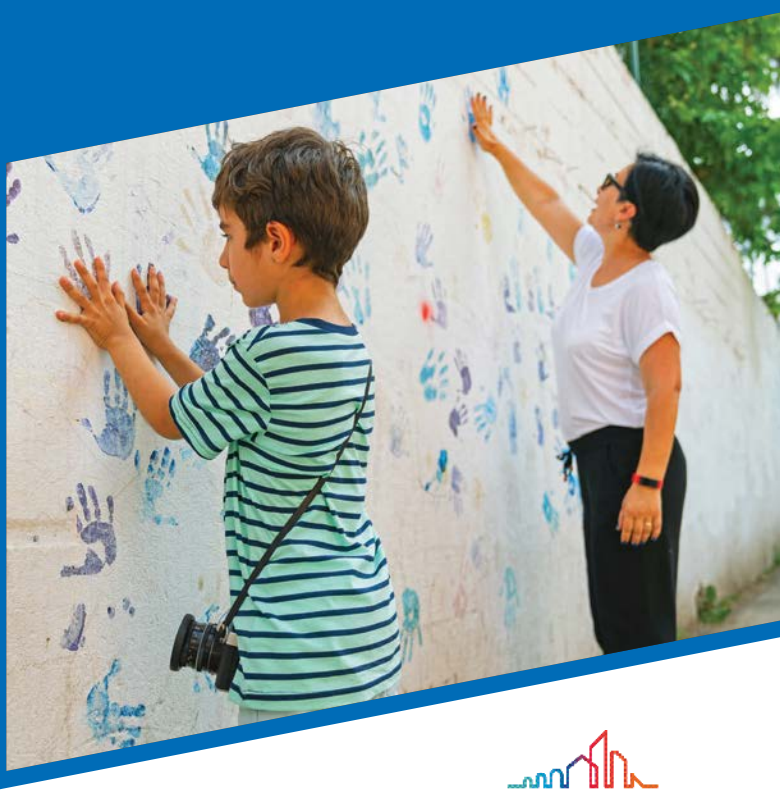

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