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On the Cover

Rising above traditional campus design, York University's Markham Campus reimagines academic space in a 10-storey, 37,161-m² (400,000-sf) vertical hub. Diamond Schmitt's bold architecture and co-ordinated ceiling systems unify the building's interiors, enhancing wayfinding, acoustics, and spatial clarity while reflecting the flow of the surrounding urban landscape. The result is a vibrant, multifunctional learning environment for 4,000 students that stands as a modern beacon of post-secondary design.

PHOTO COURTESY MAXXIT GROUP

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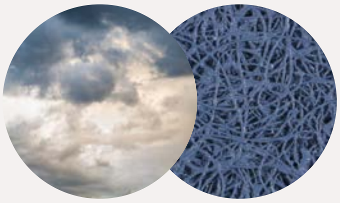

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Ceilings that Connect

Baffles Unify Design and Manage Acoustics

By Steve McElwee

PHOTOS COURTESY MAXXIT GROUP

York University's Markham Campus building in Markham, Ont., stands in stark contrast to the red-bricked symmetry usually seen on college campuses. The new 37,161 m^2 (400,000 sf) academic centre is a satellite of the university's main campus in Toronto. Positioned strategically at a transit hub within the urban community, the Markham Campus serves 4,000 students and offers various academic programs, all housed within a 10-storey building.

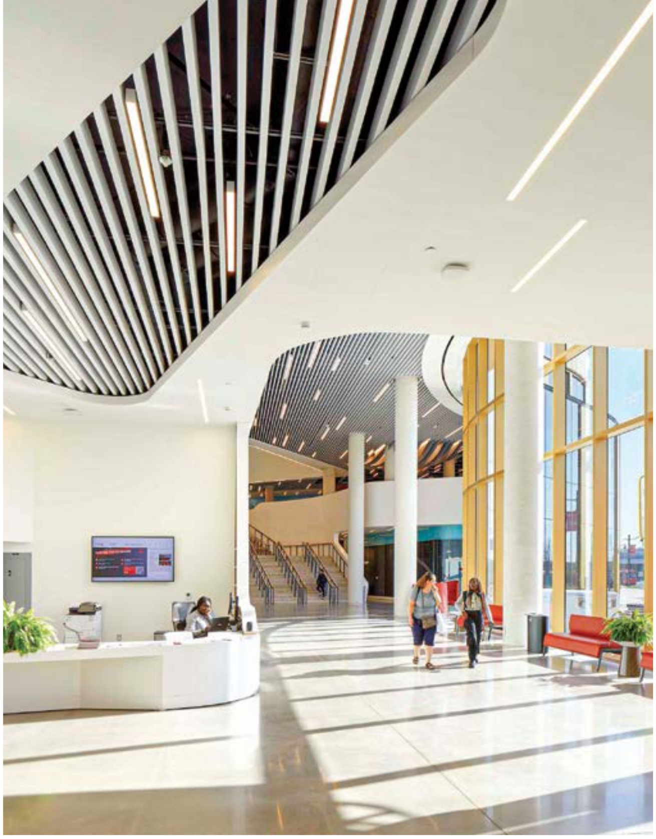
At first glance, visitors probably would not guess that the Markham Campus building belongs to a university, a deliberate decision by project architect Diamond Schmitt, a leading North American firm in post-secondary construction. Unlike traditional campuses with separate buildings dedicated to individual disciplines, Diamond Schmitt designed the Markham Campus to rise instead of expand outward, housing all its multidisciplinary, multifunctional teaching and learning spaces within a single vertical structure.

To unify the campus and landscape, exterior and interior, and form and function, Diamond Schmitt aimed for an interior design strategy that could act as a unifying element throughout the building. A co-ordinated ceiling approach—merging metal baffles with acoustic infill and polyethylene terephthalate (PET) felt blade and wave baffles—became one of the main methods used to enhance visual continuity and acoustic comfort across the interior spaces.

Working closely with the ceiling contractor, Oakdale Drywall & Acoustics Ltd., and a ceiling systems supplier, the team put in place a solution that balances visual continuity, durability, and acoustic performance throughout the building.

Creating cohesion with ceiling design

The York University building in Markham has become a striking focal point in the city,



Left: Inside the Markham Campus building, ceiling systems employ a combination of baffles and borders to create the connective tissue that links the building's interior and exterior design.

Right: In large, open areas such as the atrium, metal baffles with acoustic infill deliver durable, low-maintenance performance and a 0.85 noise reduction coefficient (NRC) to reduce echo and improve speech intelligibility.

characterized by wavy, multidimensional floors, each showcasing random patterns of vertical glass and bronze-anodized aluminum cladding. Its unconventional design injects energy into the exterior, with rounded details that echo the curves of the surrounding grounds known as Campus Green.

That same flowing harmony extends to the interior, where a multistorey atrium acts as the focal point. Lower levels accommodate student programs and services, while upper floors host academic programs arranged by subject and wing.

Associate Architect Marcin Ludwik Sztaba, a member of the Diamond Schmitt team, recalls the complexity of the design: "The challenge lay in how we connected the landscape and spatial experience within the building. The building itself evolves and grows, changing shape as it rises in elevation. We needed to create a connective tissue within the building."

To create that "connective tissue," designers co-ordinated ceiling systems throughout the building to establish wayfinding and define space. Dramatic baffle patterns, created through the use of colour and shape, add a logical visual pathway of movement and light, while also helping to control sound travel across open floors and concourses.

Achieving cohesion within the large interior space posed unique challenges when selecting ceiling systems that met both esthetic and acoustic needs. Diamond Schmitt project manager and senior associate Jessica Cheung explains, "We chose to use feature ceilings to demarcate public gathering spaces like student lounges, reception, and information areas. They're markers that students and the community can see from a distance. These spaces tend to be more open and can be loud. So, the ceilings we implemented provide acoustic absorption as well."

Before finalizing ceiling specifications, Cheung, Sztaba, and the design team identified several project requirements that the ceiling contractor and the chosen ceiling products and systems needed to meet.

Appearance

To support the architect's forward-thinking esthetic and intentionally move away from traditional

Left: In student study areas and lounges, felt wave baffles add warmth and visual rhythm while managing acoustic absorption and enhancing the building's sense of movement and order.

Right: By translating the surrounding urban landscape into interior ceiling systems that support wayfinding, acoustic comfort, and spatial clarity, the Markham Campus demonstrates the potential of vertical construction in education.

academic symmetry, the ceiling systems needed to be highly adaptable, offering a broad range of sizes, shapes, and colours that would complement the overall interior design palette.

Acoustics

The building's expansive multistorey atrium with high ceilings, open stairways, and concourses required high-performance sound control to reduce echo and improve speech clarity. To meet this challenge and define each space both visually and acoustically, ceiling baffles needed to meet multiple technical criteria, including baffle thickness and spacing to achieve a noise reduction coefficient (NRC) rating of 0.85 and maintain acoustic comfort in the dense, vertical environment.

Adapting to lighting, HVAC, and other ceiling components

The ceiling baffles and their suspension systems had to allow the architect flexibility in controlling the number and placement of lighting features. The system also needed to accommodate HVAC components and other mechanical elements housed within the ceiling area without disrupting the visual effect and continuity of the ceiling design. Lastly, it had to provide easy access to the ceiling space for routine maintenance.

Installation

Early in the design process, Diamond Schmitt evaluated several ceiling system options for the project. However, the ceiling contractor, Oakdale Drywall & Acoustics Ltd., identified several concerns with this approach. One was that each baffle manufacturer had a different attachment system, which would make it difficult to create the smooth, fluid visual effect that was central to the building's interior design. Similarly, changing attachment systems throughout the building could slow the installation, as the installers would have to switch tools and processes between products. Co-ordinating three different manufacturers to supply what would amount to 24 km (15 miles) of linear ceiling products also risked delays, since lead times and delivery schedules varied among manufacturers. To achieve visual cohesion, simplify installation, and protect the construction schedule, the team ultimately selected a single ceiling system supplier.

Simplifying the specification strengthened the design

Ultimately, the project team chose a single ceiling system supplier to meet the esthetic, acoustic, and logistical requirements of the design while making installation and co-ordination easier.

Esthetics and acoustics

In large, open areas such as the atrium and main circulation zones, the project employs a visually cohesive system of metal baffles with acoustic infill. The baffles enhance durability and ease of maintenance while achieving an NRC rating of 0.85, helping reduce echoes and improve speech clarity. Esthetically and practically, their light-reflective finish enhances daylight distribution throughout the interior.

In student study areas and lounges, PET polyester felt wave baffles add warmth and visual rhythm in select ceiling spans. Tested according to ASTM E1264 and C423, their 12 mm (0.5 in. nominal) thickness and 152 mm (6 in.) spacing contribute to acoustic absorption while reinforcing the building's sense of movement and order. The felt wave baffles feature a gentle downward-curved profile that breaks up the linear visual plane created by the metal baffles and helps define smaller zones within open floors. Like the metal baffle systems, the felt wave baffles achieve a 0.85 NRC while introducing visual texture to study areas.

One simple suspension system

Selecting a single ceiling system supplier allowed both the metal and PET felt baffle ceilings to be installed using a unified suspension system. Installers depended on a consistent system of 610-mm (24-in.) cross tees, 24-mm (0.93-in.) main tees, and 12-gauge galvanized carbon-steel hanger wire, removing the need to switch tools or methods between ceiling types. Sourcing all ceiling components from a single supplier simplified delivery co-ordination and helped keep the project on schedule.

Convenient ceiling access

The ceiling's attachment hardware allows easier access to the plenum for building staff to service lighting, HVAC, and other mechanical parts. To reach the space between the baffles and the ceiling structural slab above, facility managers simply unhook the baffles from the suspension system, reducing the time and effort required for routine maintenance.

The ceiling systems used in the project meet fire performance standards, including CAN/ULC-S102.0. PET felt options are also available with up to 60 per cent post-consumer recycled content, no volatile organic compounds (VOCs), and environmental product declaration (EPD) and GREENGUARD Gold certification.

A beacon of modern academia

From initial concept to community focal point, the York University Markham Campus building embodies a bold new approach in post-secondary architecture. By translating the surrounding urban landscape into interior design strategies and employing ceiling systems to enhance wayfinding, acoustic comfort, and spatial clarity, the project demonstrates how vertical campus design can foster collaborative learning environments within dense urban areas.

"Seeing the Markham Campus go from what we imagined it to be to becoming what it actually is speaks to the way the contractor and ceiling manufacturer understood our vision and helped us achieve it," says Sztaba. "It's great to go from virtual to reality without losing the intent and key features of what we set out to do."

Steve McElwee is the founder and CEO of Maxxit Group, a Toronto-based provider of architectural ceiling, wall, and interior solutions across North America. Before founding Maxxit, McElwee gained extensive experience in the millwork industry, developing a strong foundation in architectural detailing, specialty finishes, and the practical demands of construction, while delivering customized solutions for architects, designers, and contractors.

Occupant Thermal Comfort

The Blind Spot of the Building Industry

By Mohammad Fakoor, Parvin Asadi, Danielle Arciaga

Thermal comfort is defined as "that condition of mind which expresses satisfaction with the thermal environment," as formalized in ASHRAE Standard 55, *Thermal Environmental Conditions for Human Occupancy*, and related international standards.[1] Although inherently subjective, thermal comfort can be systematically evaluated using established analytical frameworks that account for environmental variables—including air temperature, mean radiant temperature (MRT), air velocity, and humidity—as well as personal factors such as clothing insulation and metabolic rate. These frameworks also address localized discomfort mechanisms, including radiant temperature asymmetry, vertical air temperature gradients, drafts, and floor/ceiling surface temperatures.[2]

The importance of interior surface temperatures is therefore not only a matter of thermal comfort theory but is also explicitly recognized in building codes. The *National Building Code of Canada (NBC)* states, "interior surface temperatures must be warm enough to avoid occupant discomfort due to excessive heat loss by radiation." Despite this clear requirement, design practice and code compliance efforts have historically emphasized condensation control and minimum thermal resistance, with comparatively limited attention given to radiative heat transfer and its direct impact on occupant comfort. This disconnect highlights the need for design approaches that explicitly consider MRT and localized thermal discomfort, particularly in perimeter and highly glazed spaces.

Despite this well-established theoretical and regulatory foundation, building design practice

FIGURE 1

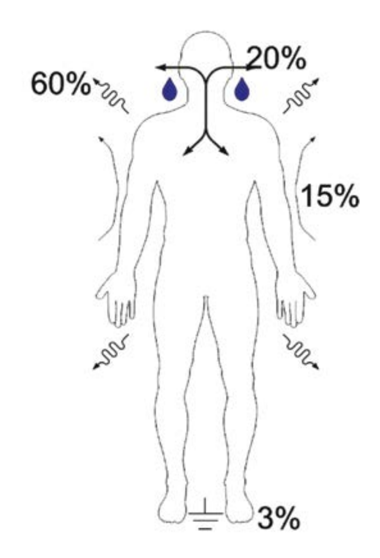


FIGURE 3

FIGURE 2

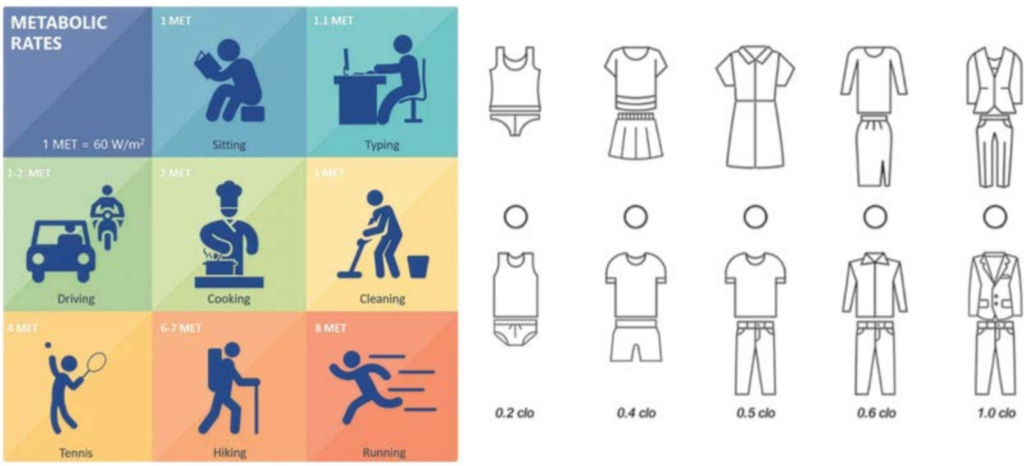


Figure 1: Heat transfer from the human body.[10]

Figure 2: Typical metabolic rates associated with common activities (left)[11] and representative clothing insulation values for standard clothing ensembles (right).[1]

Figure 3: Illustration of short-wave solar radiation effects on occupant thermal comfort in a glazed perimeter zone.[5]

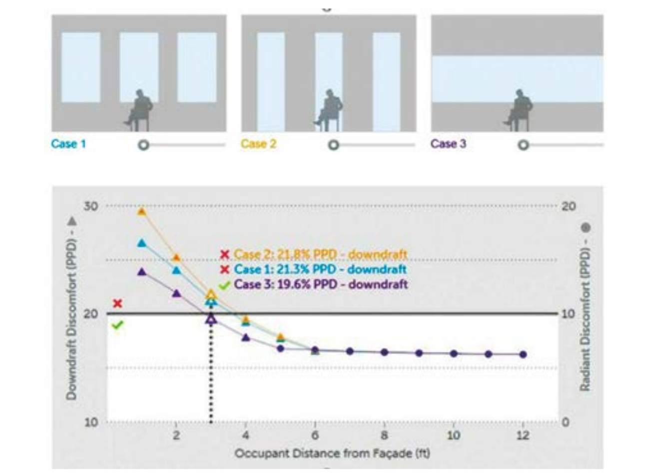
continues to rely heavily on air temperature as a proxy for thermal comfort, largely because it is straightforward to model, measure, and control. Early comfort models, including Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) framework, provided a robust basis for whole-body heat balance but were frequently applied using simplified assumptions that underrepresented radiative effects and localized discomfort parameters.[2] As a result, buildings may satisfy temperature-based compliance criteria while still exposing occupants to discomfort driven by enclosure surface temperatures and spatial asymmetry.

Practitioner-oriented research has long highlighted this gap between theory and application. Mora and Bean observed that thermal comfort analysis is rarely integrated into early design stages, with most projects prioritizing system sizing and code compliance over occupant experience.[3] Subsequent work further emphasized that thermal comfort is often treated as a post-occupancy concern, even though enclosure design decisions made early in the process strongly influence occupant perception.[4]

Among the environmental variables governing comfort, MRT and short-wave solar radiation have been shown to exert a dominant influence, particularly in perimeter spaces and high-performance buildings with large glazing areas. Arens, Hoyt, and colleagues demonstrated that direct solar radiation can materially alter occupant thermal sensation even when operative temperature and PMV values indicate compliance.[5] This research directly informed the development of simplified solar comfort models and contributed to later revisions of ASHRAE Standard 55.[1]

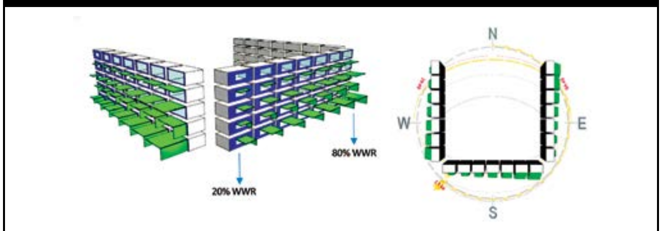
In parallel with the development of comfort theory, ASHRAE-sponsored research has advanced the computational representation of thermal comfort. Research Project 1383-RP introduced methodologies for calculating occupant-specific MRT, radiant temperature asymmetry, and spatial comfort distributions by explicitly modelling enclosure surface

FIGURE 4



Predicted downdraft discomfort as a function of occupant distance from glazed facades for different glazing configurations, illustrating localized thermal comfort impacts under winter conditions (adapted from Payette).[13]

FIGURE 5



Parametric facade configurations showing variations in window-to-wall ratio (WWR) and external shading configurations.

temperatures and view factors.[6] These capabilities were further expanded under 1766-RP, which integrated room-level load calculations with comfort-related outputs suitable for design-stage analysis.[7] Together, these efforts demonstrated that detailed comfort evaluation is technically feasible within modern simulation environments.

Air movement and distribution effects introduce additional complexity. Int-Hout highlighted that air velocity, stratification, and diffuser performance are among the most difficult comfort parameters to predict at the design stage, yet they significantly influence occupant satisfaction and compliance with ASHRAE Standard 55.[8] When these factors are not explicitly considered, comfort deficiencies are often addressed reactively through operational adjustments or occupant-controlled devices.

Field studies have reinforced the consequences of these limitations. The ASHRAE RP-821 investigation documented persistent discrepancies between predicted comfort conditions and occupant responses in mechanically ventilated office buildings, particularly in cold climates where radiant effects and air movement preferences were pronounced.[9] These findings underscore the limitations of relying on air temperature–based metrics alone and highlight the need for a more holistic approach to comfort evaluation.

Knowledge gaps and objectives

Based on the reviewed literature and observed industry practice, several gaps remain:

- Thermal comfort is frequently reduced to air temperature targets, with limited evaluation of MRT, solar exposure, and radiant asymmetry during design[1,5]
- Comfort analysis tools exist but are not well integrated into standard energy modelling workflows, limiting their practical adoption[6,7]
- Architectural decisions—such as glazing ratios, shading geometry, enclosure performance, and space proportions—are rarely evaluated through a comfort-first lens[3,4]
- There is limited guidance for practitioners on how to translate comfort metrics into actionable architectural and mechanical design decisions[8,9]

The objective of this paper is to demonstrate how thermal comfort analysis can be systematically integrated into architectural and energy modelling workflows, allowing designers to better align predicted performance with lived occupant experience—without relying solely on post-occupancy correction or energy-intensive mechanical solutions.

Analytical framework for evaluating thermal comfort

Overview of thermal comfort metrics

PMV and PPD are the most widely used whole-body thermal comfort indices in building design practice. Developed by Fanger, the PMV index predicts the average thermal sensation of a large group of occupants on a seven-point scale ranging from cold (–3) to hot (+3), based on a steady-state heat balance between the human body and its environment.[2] PPD is derived directly from PMV and represents the expected percentage of occupants dissatisfied with the thermal conditions, acknowledging that even under ideal conditions a minimum level of dissatisfaction persists. Under this framework, acceptable thermal comfort is typically defined by a PMV range of approximately –0.5 to +0.5, corresponding to a PPD of 10 per cent or less.

Key environmental variables influencing comfort include air temperature, MRT, air velocity, and humidity, as well as personal factors such as clothing insulation and metabolic rate.[2] Among these variables, MRT plays a particularly critical role in spaces where enclosure surface temperatures differ substantially from air temperature. Figure 1 (page 11) illustrates the dominant heat transfer mechanisms from the human body, showing that radiative heat exchange can account for up to approximately 60 per cent of total heat transfer between the human body and surrounding surfaces under typical indoor conditions. This highlights the strong influence of enclosure surface temperatures on perceived thermal comfort, particularly in high-performance or poorly balanced enclosures.


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TABLE 1

Thermal comfort factors	
General environmental factors	**Localized factors**
Dry-bulb temperature	Vertical air temperature
Mean radiant temperature	Radiant temperature asymmetry
Humidity	Ceiling and floor temperatures
Air speed	Drafts and ankle draft
Personal factors	
Metabolic rate	Clothing

Robert Bean's work synthesizes decades of physiological research and building science literature, emphasizing that humans experience thermal comfort primarily through radiant exchange rather than air temperature alone.[10] His analysis demonstrates air temperature (thermostat) is an incomplete proxy for comfort and that occupants are highly sensitive to the thermal characteristics of surrounding surfaces. Bean further notes that small deviations in surface temperatures—such as cold glazing, uninsulated slabs, or overheated ceilings—can dominate occupant sensation even when air temperature is well controlled. This reinforces the importance of managing mean radiant temperature through envelope design, insulation continuity, thermal bridge mitigation, and the use of radiant heating and cooling systems to achieve true occupant comfort.

Figure 2 (page 11) illustrates typical ranges of metabolic activity (MET) and clothing insulation levels (clo) commonly encountered in residential and commercial indoor environments. MET represents the rate of heat generation within the human body due to activity, where one MET corresponds to approximately 58–60 W/m^2 (18.4–19.0 Btu/h·ft^2) of body surface area, representative of a seated, resting individual. As activity levels increase, internal heat production rises, directly influencing thermal sensation. Clo quantifies the thermal resistance provided by clothing ensembles, where one clo corresponds to a thermal resistance of approximately 0.155 m^2·K/W (0.88 ft^2·h·F/Btu). Together, MET and clo govern the balance of heat exchange between the human body and its surrounding environment and must be considered alongside environmental parameters when evaluating thermal comfort at both global and local scales. ASHRAE Standard 55 evaluates thermal comfort for occupants with metabolic rates up to 2.0 met and clothing insulation levels up to 1.5 clo, corresponding to typical indoor activities and clothing conditions.

Localized discomfort mechanisms—such as radiant temperature asymmetry, vertical air temperature differences, drafts, and floor surface temperatures—are explicitly addressed in ASHRAE Standard 55 due to their disproportionate influence on occupant perception.[1] Local discomfort factors are of particular importance for lightly clothed persons (with clothing insulation between 0.5 and 0.7 clo) engaged in near-sedentary physical activity (with metabolic rates between 1.0 and 1.3 met). Table 1 summarizes the key thermal comfort factors to consider when evaluating occupant comfort at both global and local scales.

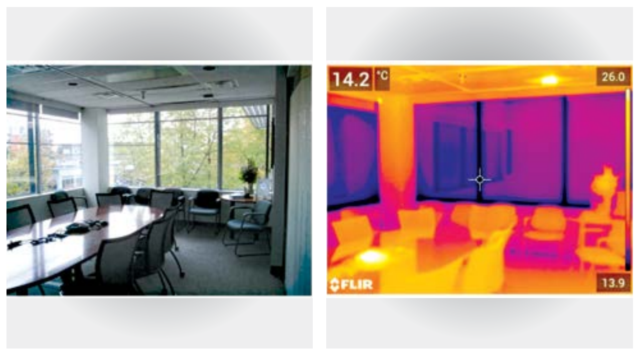
Research has consistently shown that occupants may experience discomfort driven by radiative and solar effects even when zone-level air temperature and PMV criteria are satisfied.[5] As a result, a comfort-focused analysis must extend beyond bulk air conditions to account for spatial variability, enclosure performance, and occupant proximity to radiant surfaces. ASHRAE Standard 55-2023, Table I-1, outlines acceptable limits for local thermal discomfort, including five per cent PPD for radiant-temperature asymmetry and vertical air-temperature differences, 10 per cent for warm or cold floor surfaces, and 20 per cent for draft.[1] Table 1 summarizes the key thermal comfort factors that should be considered when evaluating occupant comfort at both global and local scales. Figure 3 (page 11) illustrates the impact of short-wave solar radiation on human thermal comfort, demonstrating how direct solar exposure can dominate occupant thermal sensation despite otherwise acceptable indoor air temperatures. This example reinforces the importance of accounting for radiant heat transfer and localized environmental conditions when assessing comfort, particularly in perimeter zones with high glazing ratios or limited solar control.

Localized thermal comfort evaluation

To evaluate localized thermal comfort parameters, this study employed established, practitioner-oriented thermal comfort tools aligned with the analytical framework of ASHRAE Standard 55. The Payette localized thermal comfort tool was used to assess draft risk and radiant temperature asymmetry,[12] with particular focus on occupant locations adjacent to facades and glazing. These localized discomfort mechanisms are explicitly addressed in ASHRAE Standard 55 and are known to be strongly influenced by enclosure surface temperatures, glazing thermal performance, and occupant proximity to exterior assemblies.

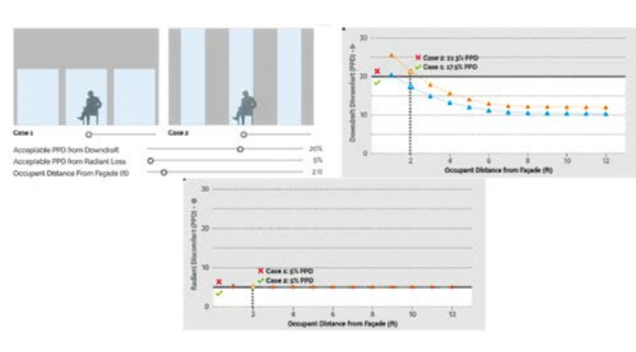
Figure 4 (page 12) presents the analytical approach adopted by Payette to quantify localized discomfort near glazed façades under winter conditions.[13] The figure demonstrates

FIGURE 6



Visual and infrared images illustrating enclosure-driven surface temperature variation in a perimeter space.

FIGURE 7



Predicted people dissatisfied (PPD) as a function of occupant distance from the facade for different window heights, illustrating the influence of downdraft.

the relationship between occupant distance from the facade and predicted downdraft discomfort (PPD) for different glazing configurations, highlighting how window geometry and thermal performance can result in elevated discomfort levels even when zone-level comfort criteria are met. The results underscore that localized discomfort—particularly cold downdrafts and radiant asymmetry—can dominate occupant experience within the first few feet of the facade.

The use of simplified analytical tools allows these localized effects to be evaluated without reliance on full computational fluid dynamics (CFD) modelling, which is often impractical during early design phases. Within this framework, localized comfort evaluation serves as a critical bridge between whole-body comfort metrics and architectural decision-making. By isolating the influence of glazing characteristics, enclosure performance, and occupant location, these tools enable a direct linkage between facade design parameters and predicted comfort outcomes, establishing the analytical basis for the results presented in the following section.

Integration with whole-building energy modelling

While localized comfort tools provide valuable insight into occupant-level conditions, they must be contextualized within the broader thermal behaviour of the building. To this end, whole-building energy modelling was performed using IES Virtual Environment (IES VE) to evaluate the interaction between envelope design, solar gains, and indoor thermal conditions.

IES VE enables dynamic simulation of building thermal performance, including zone-level air temperatures, surface temperatures, solar heat gains, and shading effects. Although conventional energy models are primarily used to assess energy consumption and compliance, prior research has demonstrated that model outputs—particularly surface temperatures and solar radiation data—can inform comfort-related analyses when appropriately interpreted.[6,7]

In this study, IES VE was used to conduct a parametric envelope analysis focusing on variations in window-to-wall ratio (WWR), glazing distribution, and solar shading. These parameters were selected for their strong influence on both energy performance and occupant comfort, particularly through their effects on MRT and short-wave solar radiation. By isolating envelope-driven effects, the analysis avoids conflating comfort outcomes with mechanical system performance, consistent with prior recommendations in the literature.[3,4]

Figure 5 (page 12) illustrates the parametric facade study used to evaluate the influence of WWR and external shading depth on building performance. WWR ranging from 20 to 80 per cent were evaluated, with each vertical column representing a discrete WWR configuration. For each WWR case, a series of horizontal external shading devices was modelled with increasing shading projection factor (PF), defined as the ratio of shading projection depth to window height. Shading conditions range from PF = 0 (no external shading) to PF=1.0, representing a shading projection equal to the window height.

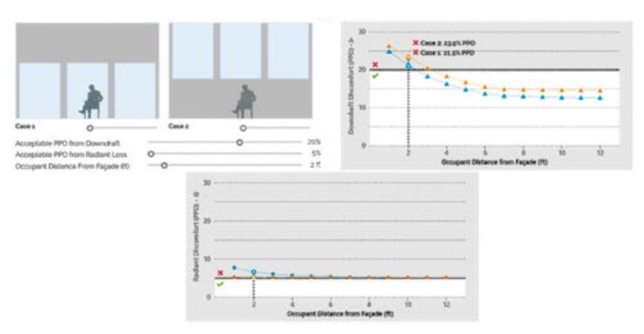
This parametric arrangement enables a systematic assessment of the combined effects of glazing area and solar shading on solar gains, mean radiant temperature, and occupant thermal comfort. By isolating WWR and shading depth as independent variables, the study framework supports comparative analysis of facade design strategies and their implications for both energy performance and localized thermal comfort, particularly in perimeter zones exposed to solar radiation.

Envelope-driven comfort analysis approach

The analytical approach adopted in this study emphasizes the role of architectural and enclosure decisions in shaping thermal comfort outcomes. Rather than treating comfort as a downstream validation step, the methodology evaluates how envelope design choices establish the boundary conditions within which mechanical systems must operate.

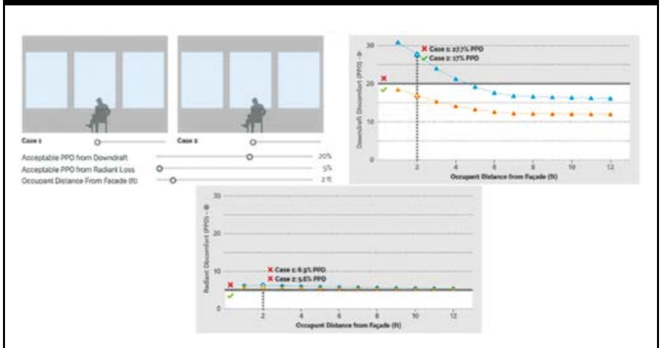
Previous ASHRAE research has shown that accurate representation of enclosure surface temperatures and view

FIGURE 8



Effect of window sill height on localized thermal discomfort, showing competing impacts on downdraft-driven and radiant discomfort as a function of occupant distance from the facade.

FIGURE 9



Effect of window U-value on localized thermal discomfort, showing a significant reduction in downdraft-related predicted people dissatisfied (PPD) with improved glazing thermal performance, while radiant asymmetry remains largely unchanged across occupant distances.

factors is essential for meaningful comfort assessment.[6] Field studies have further demonstrated that discrepancies between predicted and perceived comfort often arise from enclosure-driven effects that are not captured by air temperature–based metrics alone.[9] By combining localized comfort evaluation with whole-building energy modelling, the methodology establishes a consistent framework for assessing how changes in WWR and solar exposure influence occupant experience.

Figure 6 (page 15) illustrates this enclosure-driven comfort framework by comparing visual and infrared thermal imagery of a perimeter space. This thermogram was taken when the outside temperature was 9 C (48 F) and the thermostat showed an interior air temperature of 22 C (72 F). The thermal image reveals pronounced surface-temperature variations associated with glazing and exterior assemblies. These non-uniform radiant conditions directly affect mean radiant temperature and localized thermal comfort, demonstrating how enclosure design decisions can dominate occupant sensation independently of zone-level air temperature.

This approach does not directly optimize comfort in this section; rather, it defines the analytical basis for the results presented in the following section. The intent is to demonstrate how existing tools and workflows can be applied in a complementary manner to reveal comfort implications that are often overlooked in conventional design practice.

Results and discussion

This section presents the results of the thermal comfort analyses. The discussion first focuses on localized thermal comfort conditions near the building facade, as investigated by the Payette tool, where enclosure-driven effects are most pronounced. The section then presents the outcomes of the dynamic envelope simulations conducted in IES VE, examining the influence of facade design parameters on indoor thermal performance.

Thermal comfort study: Local factors —downdraft and radiant asymmetry

Four window-related parameters were identified as the primary drivers of localized thermal comfort conditions in the immediate vicinity of the facade. These parameters influence occupant comfort through two dominant mechanisms: (1) convective downdraft, caused by buoyancy-driven airflow as warm indoor air comes into contact with colder glazing surfaces, and (2) radiant thermal asymmetry, resulting from increased view factors between occupants and the window surface. For the analyses presented in this section, the WWR was held constant at 50 per cent across all cases. The opaque wall assembly was assumed to have a thermal resistance of RSI–2.64 (R–15 ft^2·h·F/Btu). Boundary conditions included an outdoor air temperature of -12 C (10 F), an indoor air temperature of 22 C (72 F), and an indoor relative humidity of 50 per cent.

Window height

Increasing window height was found to influence localized thermal comfort primarily through enhanced downdraft effects near the facade. As shown in Figure 7 (page 15), the two window-height configurations exhibited similar levels of predicted radiant discomfort, reflecting comparable occupant view factors to the glazing in both cases. Consequently, differences in the predicted PPD near the facade are predominantly driven by convective mechanisms rather than by radiant asymmetry. Taller window configurations result in greater localized discomfort near the facade, with PPD decreasing as the occupant's distance from the window increases. This finding is particularly relevant for architects specifying floor-to-ceiling glazing systems, as the results indicate that increased window height can exacerbate near-facade downdraft-driven discomfort even when radiant conditions remain unchanged. As illustrated in Figure 7 (page 15), the influence of window height diminishes with increasing setback from the facade, indicating that these effects are most pronounced within the immediate perimeter zone.

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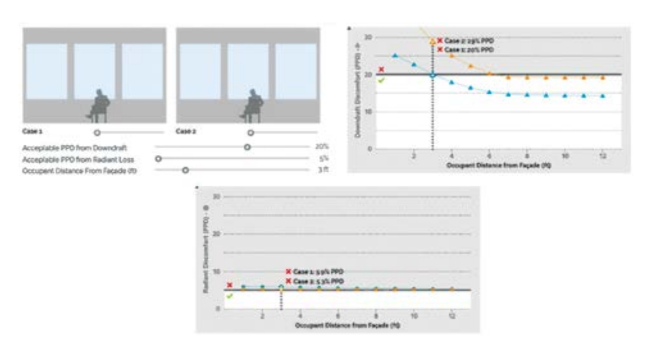
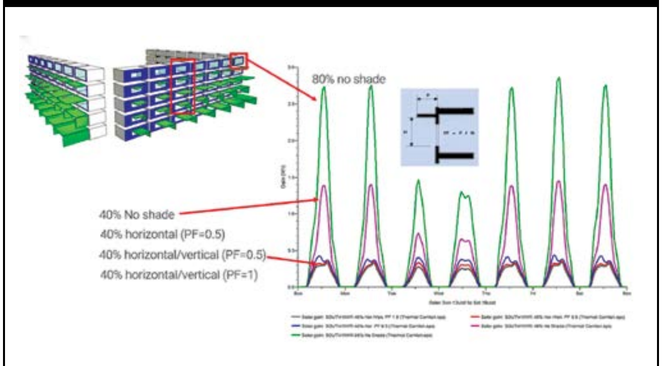
FIGURE 10



Effect of interior low-emission (low-e) coating on downdraft and radiant asymmetry predicted people dissatisfied (PPD) as a function of occupant distance from the facade.

FIGURE 11



Effect of interior low-emission (low-e) coating on downdraft and radiant asymmetry predicted people dissatisfied (PPD) as a function of occupant distance from the facade.

Window sill height

The window sill height was found to influence localized thermal comfort through competing convective and radiative mechanisms. As illustrated in Figure 8 (page 16), increasing sill height reduces radiant discomfort by lowering the occupant's view factor to the glazing, thereby decreasing radiant heat exchange between the occupant and the cold window surface. This effect is reflected in the relatively small differences in predicted radiant discomfort between cases, particularly beyond the immediate facade zone.

Conversely, the results indicate that higher sill configurations can exacerbate convective downdraft effects near the facade. By concentrating colder glazing surfaces at higher elevations, buoyancy-driven airflow intensifies as cooled air descends along the window surface and enters the occupied zone. As shown in Figure 8 (page 16), this results in increased predicted discomfort from downdrafts near the facade, despite the reduction in radiant exposure. The combined results highlight that adjustments to sill height can shift the dominant source of localized discomfort rather than eliminate it, underscoring the need to consider both convective and radiative effects when evaluating facade geometry.

Window thermal transmittance (U value)

Variations in window U-value were found to influence localized thermal comfort predominantly through changes in downdraft-related discomfort. As shown in Figure 9 (page 16), the case with improved glazing thermal performance (Uip–0.18 versus Uip–0.35 Btu/ft^2·h·°F) exhibits a substantial reduction in predicted downdraft discomfort in the immediate vicinity of the facade. At an occupant distance of 0.61 m (2 ft), the PPD due to downdraft decreases markedly between the two cases, with the difference gradually diminishing as the occupant distance from the facade increases. This behaviour reflects higher interior glazing surface temperatures associated with lower U-values, which weaken buoyancy-driven downward airflow along the window surface.

Although the predicted radiant asymmetry results shown in Figure 9 (page 16) for the 50 per cent WWR cases differ only marginally between glazing configurations, additional analyses indicate that the influence of glazing U-value on radiant discomfort becomes more pronounced at higher WWRs. At increased WWRs, larger exposed glazing areas increase occupant view factors to the window surface, amplifying the sensitivity of radiant asymmetry to glazing thermal performance. Consequently, while downdraft effects dominate localized discomfort at moderate WWRs, radiant asymmetry becomes more significant as glazing area increases.

Interior side low-e coating

The presence of an interior low-emissivity (low-e) coating was found to influence localized thermal comfort through opposing convective and radiative mechanisms. As shown in Figure 10, the inclusion of an interior low-e coating results in increased predicted downdraft-related discomfort in the immediate vicinity of the facade. This behaviour is attributed to the reduction in interior glass surface temperature associated with the low-e coating, which enhances buoyancy-driven downward airflow along the glazing surface. The impact of this increased downdraft is most pronounced within the near-facade zone and diminishes with increasing occupant distance from the window.

In contrast, the interior low-e coating produces a modest but consistent reduction in radiant discomfort. As illustrated in Figure 10, predicted radiant asymmetry values are slightly lower for the low-e case across all occupant distances. This improvement is attributed to the reduced emissivity of the interior glass surface, which limits long-wave radiant heat exchange between the occupant and the glazing. Although the reduction in radiant discomfort is smaller in magnitude than the increase in downdraft-related discomfort, the results highlight the competing nature of convective and radiative effects introduced by interior low-e coatings and underscore the importance of evaluating both mechanisms when assessing localized thermal comfort near facades.

Thermal comfort study: Envelope effects —WWR and exterior shades

Before examining the impact of WWR and exterior shading on MRT, it is important first to assess how these parameters influence solar heat gains and resulting cooling demand. Figure 11 evaluates the effect of facade configuration on zone-level thermal conditions. Dynamic simulations were conducted to quantify incident solar gains under varying WWRs and exterior shading geometries.

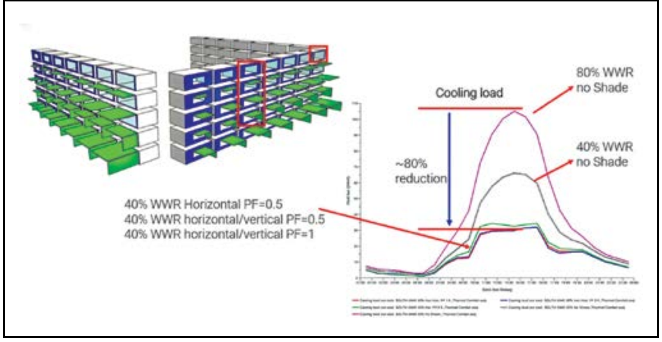
The results further demonstrate the moderating effect of exterior shading devices. For the 40 per cent WWR configuration, introducing horizontal shading (projection factor, PF=0.5) results in a marked reduction in peak solar gain relative to the unshaded case. The combined horizontal and vertical shading configuration provides additional attenuation, particularly during periods of high solar altitude. The case with increased projection factor (PF=1) yields the greatest reduction in peak gains, indicating the sensitivity of solar exposure to shading geometry. These findings illustrate the strong dependence of envelope-driven heat gains on both glazing ratio and shading design. While WWR primarily governs the magnitude of solar exposure, exterior shading effectively modulates peak intensities and the temporal distribution of gains, thereby influencing MRT and overall thermal comfort conditions within the perimeter zone.

To further evaluate the implications of facade configuration on building performance, dynamic simulations were conducted to assess perimeter-zone cooling loads under varying WWR and exterior shading configurations. As shown in Figure 12, increasing WWR substantially amplifies peak cooling demand. The unshaded 80 per cent WWR case exhibits significantly higher peak cooling loads compared to the 40 per cent WWR configuration, reflecting the strong dependence of cooling demand on solar heat gains through glazing.

The introduction of exterior shading devices produces a pronounced reduction in peak cooling load. For the 40 per cent WWR cases, horizontal shading (PF=0.5) reduces peak cooling demand relative to the unshaded configuration, while the combined horizontal and vertical shading arrangements further attenuate peak loads. The case with PF=1 demonstrates the greatest reduction in peak cooling demand, indicating the sensitivity of cooling performance to shading depth and geometry.

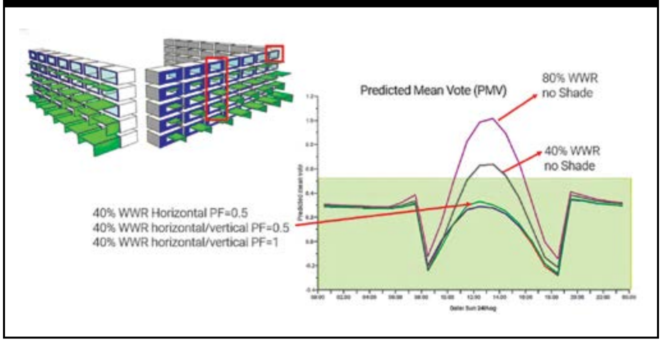
As illustrated in Figure 12, the shaded 40 per cent WWR configurations achieve an approximate 80 per cent reduction in peak cooling load relative to the unshaded 80 per cent WWR case. These results highlight the strong coupling between facade design, solar exposure, and mechanical system demand, reinforcing the importance of integrating glazing ratio and shading geometry considerations at early design stages.

FIGURE 12



Simulated cooling load for varying window-to-wall ratios (WWR) and exterior shading configurations.

FIGURE 13



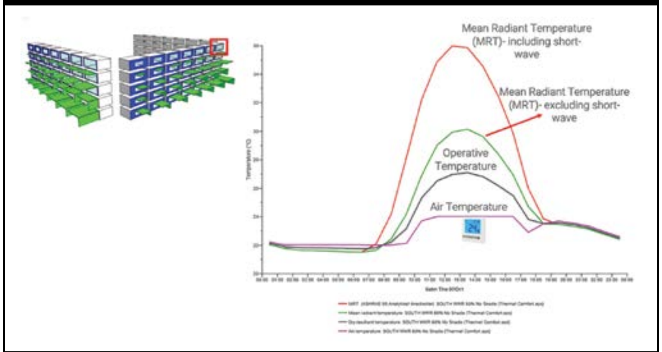
Predicted mean vote (PMV) for varying window-to-wall ratios (WWR) and exterior shading configurations.

To assess how variations in glazing ratio and exterior shading affect whole-body thermal comfort, PMV values were calculated for the same facade configurations discussed previously. As shown in Figure 13, increases in WWR substantially elevate peak PMV values during periods of high solar exposure. The 80 per cent WWR unshaded case exhibits the highest midday PMV, approaching or exceeding the upper comfort threshold. In contrast, the 40 per cent WWR configuration demonstrates more moderate values under identical boundary conditions.

The introduction of exterior shading devices significantly moderates peak PMV. For the 40 per cent WWR cases, horizontal shading (projection factor, PF=0.5) reduces peak thermal sensation relative to the unshaded case, while the combined horizontal and vertical shading configurations further attenuate peak PMV values. The configuration with increased projection factor (PF=1) produces the lowest peak PMV among the cases examined.

These results demonstrate that facade design directly influences occupant thermal sensation by modulating solar gains and altering MRT. Higher glazing ratios amplify solar-driven increases in MRT, leading to elevated PMV during peak hours, while appropriately designed exterior shading effectively maintains PMV within the acceptable comfort

FIGURE 14



Comparison of mean radiant temperature (MRT) calculated with and without short-wave solar radiation under the 80 per cent window-to-wall ratios (WWR) unshaded condition.

range for a greater portion of the day.

Figure 14 illustrates the influence of short-wave solar radiation on MRT and resulting operative temperature under the unshaded 80 per cent WWR condition. The comparison highlights the difference between MRT calculated in accordance with ASHRAE 55-2023, which explicitly accounts for short-wave solar radiation incident on the occupant, and MRT calculated excluding short-wave effects, consistent with earlier methodologies such as those commonly aligned with ASHRAE 55-2013.

As shown in Figure 14, the inclusion of short-wave radiation results in a substantial increase in peak MRT during periods of direct solar exposure. While the zone thermostat maintains an air temperature setpoint of 24 C (75 F), the short-wave-adjusted MRT rises significantly above both air temperature and long-wave-only MRT. Consequently, operative temperature—defined as the combined effect of air temperature and mean radiant temperature—also increases markedly during peak solar hours.

The results demonstrate that reliance on air temperature alone, or on MRT calculations excluding short-wave solar effects, can substantially underestimate occupant thermal sensation in perimeter zones with high solar exposure. Even with a controlled air temperature of 24 C (75 F), operative temperatures exceed comfort thresholds when short-wave radiation is considered. This finding underscores the importance of incorporating direct solar effects in comfort assessments, particularly in high-glazing configurations.

Conclusion

This paper examined the influence of facade design parameters on thermal comfort in perimeter zones. The following conclusions can be drawn:

- Window geometry strongly affects localized discomfort. Increasing glazing height and area intensifies the downdraft near the facade, while altering sill height alters the balance between convective and radiative effects.
- Glazing thermal performance primarily influences comfort through downdraft mechanisms at moderate WWRs, with radiant effects becoming more significant at higher glazing ratios.
- Interior low-e coatings introduce competing effects: reduced emissivity improves radiant asymmetry, while lower interior glass temperatures may increase downdraft discomfort.
- Increasing WWR substantially elevates solar gains and peak cooling loads. Exterior shading effectively reduces both solar exposure and cooling demand.
- Facade configuration directly impacts PMV through changes in MRT, with high-glazing unshaded cases producing elevated peak thermal sensation.
- Inclusion of short-wave solar radiation in MRT calculations (ASHRAE 55-2023) significantly increases peak operative temperatures, indicating that comfort assessments excluding short-wave effects may underestimate thermal stress in highly glazed zones.

Overall, the results demonstrate that enclosure design decisions establish the thermal boundary conditions governing occupant comfort and mechanical system demand. Early-stage evaluation of facade parameters is therefore critical for achieving both energy and comfort objectives.

Notes

See notes online at constructioncanada.net/occupant-thermal-comfort

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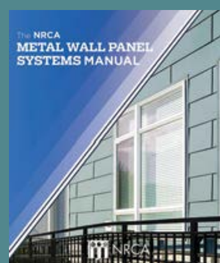

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Commercial Roofing Storm Resilience

Lessons from Installers Working in Harsh Climates

By Kyle Linhares

PHOTO COURTESY IKO NORTH AMERICA

Storm damage is not unusual in commercial roofing; it is a design reality. Preventing storms themselves is impossible, but roofs can be designed and installed to better withstand their impact. The challenges storms bring will always be a consideration for designers, consultants, and contractors when selecting roofing materials for structures. The same applies to the installers of commercial roofing systems.

Designing for storm exposure

Across North America, commercial roofs are increasingly exposed to more frequent and severe weather events, including high winds, heavy rainfall, rapid freeze–thaw cycles, and intense storms. These conditions put significant stress on flat roofing systems, testing the materials, design, detailing, and installation quality. For building owners, storm damage can lead to costly repairs, operational disruptions, and long-term asset deterioration if not addressed proactively.

The key issue is not whether storms occur, but whether the roof system is designed and installed to withstand them.

For commercial roofing professionals, storms act as a continual test, revealing weaknesses in design assumptions, installation practices, material choices, and system co-ordination. Failures attributed to "extreme weather" highlight the importance of careful design, proper fastening, and selecting system components suited to the building's environment.

In this article, two experienced commercial roofing installers share their insights on how to protect a flat roof from storm damage.

Wind uplift and code requirements

Wind uplift resistance is a critical consideration when designing commercial roofing systems exposed to severe weather. The Canadian Standards Association (CSA) A123.21 guideline provides the standard test method for evaluating the dynamic wind uplift resistance of low-slope

membrane roofing systems. Wind design loads for roof coverings are calculated using load resistance factor design (LRFD), as specified by the *National Building Code of Canada* (*NBC*).

While wind uplift remains the primary design focus, modern roof resilience requires a broader evaluation of system performance. For vegetated roofs, CSA A123.24, *Standard Test Method for Wind Resistance of Vegetated Roof Assemblies*, establishes laboratory procedures to determine how these systems resist dynamic wind flow and uplift. Meanwhile, CSA A123.26, *Performance Requirements for Climate Resilience of Low-Slope Membrane Roofing Systems*, introduces enhanced performance criteria for roofing systems based on climate severity, providing resilience requirements beyond baseline building-code provisions to address climatic stresses such as wind, precipitation, and temperature extremes.[1]

Phillip Kerri, chief operations officer of RoofTech Systems Ltd. in Mount Pearl, Nfld., says the first step is to confirm the dynamic wind uplift required for the roof in its specific geographical area.

“Once this is determined, we ensure that the roof type and fastening methods meet the CSA A123.21 Wind Uplift Resistance Guideline,” he notes.

In Canada, wind uplift requirements are typically established through engineering calculations based on the *NBC*, specifically Part 4, which defines wind loads on building components and cladding. Design wind pressures are calculated using factors such as building height, roof geometry, terrain exposure, the building’s importance category, and the reference wind velocity pressure for the location. The resulting design pressures are then used to select a roofing assembly with a tested uplift resistance that meets or exceeds those loads.

Manufacturers demonstrate this resistance through laboratory testing in accordance with CSA A123.21, which evaluates the ability of a roof assembly to withstand simulated wind uplift pressures.

To assist with these calculations, the National Research Council Canada (NRC) provides an online tool, the Wind Load Calculator for Roof and Parapet Cladding. The tool applies *NBC* wind provisions and prompts users to enter project data, including location, building height, roof configuration, and terrain exposure. It then calculates factored wind pressures for the roof field, edge, and corner zones, and determines the associated zone dimensions used to define fastening patterns and required uplift resistance levels.

Wind resistance cannot be achieved solely through membrane selection. Proper attachment, edge detailing, and securement at transitions are equally essential. Even the best materials depend on proper perimeter fastening, well-executed flashing details, and secure tie-ins as key elements in overall system performance. In high-wind regions like coastal Newfoundland, for example, these details often determine whether a roof system performs as intended during a storm.

Installation practices that improve performance

On the west coast of British Columbia, BestWest Group president Brock Maglio uses additional methods to reduce flat-roof storm damage, including:

Left: Proper attachment, edge detailing, and secure tie-ins are essential elements in the overall performance of commercial roofing systems during storms.

PHOTO ©ВЛАД ГЕРЧЕНОВ/ADOBE STOCK/COURTESY IKO NORTH AMERICA

Right: Rapid temperature shifts after snowfall can block roof drains and lead to flooding on flat roofs when rain follows.

PHOTOS COURTESY IKO NORTH AMERICA

Proper fastening, flashing details, and secure transitions help ensure roofing systems perform as intended during storms.

- Plans for high-wind exposure using wind uplift calculators
  - Use of fastening systems that meet or exceed specified wind loads
  - Use of fasteners compatible with the selected roofing system
  - Use of fastening patterns that include additional fasteners in corners and along roof perimeters

- Price quotes that include higher-performance building materials
  - Styrene-butadiene-styrene (SBS) modified bitumen membranes
  - Heavy-gauge sheet metal
  - Substrates such as plywood or engineered roof board materials

- Enhanced warranty options
  - Extended warranty coverage available for certain roofing assemblies
  - Additional inspection or technical review during installation

He says, "We tend to stick to similar planning protocols and roof system types regardless of the specific group involved. From an installer's perspective, roofing warranties and long-term system performance are closely linked to proper design, specification, and installation. Protecting the roof from storm damage helps ensure the assembly performs as intended and reduces the likelihood of warranty claims."

Maglio recalls facing problems with other products early in his career. In those cases, granule loss was the main concern.

"The winter season is when we handle warranty issues," he explains, "mainly due to rain, and the biggest challenge we face is the time spent figuring out the problem, which may or may not be the roof."

Determining whether water ingress originates from the roofing system, mechanical penetrations, or wall interfaces can be time-consuming, especially during active storm conditions. These investigations often highlight the importance of building-envelope co-ordination rather than viewing the roof as an isolated system.

Climate challenges in the field

The RoofTech team frequently installs two-ply modified bitumen roofing systems.

"Modified bitumen membranes have a granular surface that can perform well in regions with frequent rainfall and strong winds," says Kerri. "They also provide good puncture and tear resistance, which can help limit damage from windborne debris."

Similarly, since BestWest is located in the heart of Metro Vancouver, it regularly experiences heavy rain and strong winds.

Roof repairs and, when needed, reroofing after storm events can be quite challenging depending on the situation. Kerri from RoofTech has not seen a major roof blow-off on his commercial roof installations. Most of the issues he encounters occur on older roofs where installation practices did not fully align with current code requirements.

One of the BestWest team's most important tasks is repairing storm-damaged roofs to withstand future storms.

"One of our region's unique climate-related challenges is the rapid temperature shift that can occur after a snowstorm," says Maglio. "When it's snowing, and the roof is frozen, the drains usually become ice-blocked. We often encounter roof flooding when temperatures rise above zero degrees Celsius, and heavy rain follows on top of snow and ice. Drainage on flat roofs can remain blocked during this period, causing water levels to rise and expose weak points in the system."

When ice blocks are present, leaks often occur, causing significant water damage. "Since these conditions happen quickly and are usually temporary, locating the points of entry can take time and effort," says Maglio.

Repairing and preparing for future storms

When repairing the roof for future storms, he says their solutions need to be more comprehensive than those of the existing or previous roof system. "This sometimes requires changes to the roof design, such as adding extra slope and drainage," he adds.

For example, designers may use tapered insulation systems to create a gradual slope toward drains or scuppers, preventing water from ponding on the roof. Additional measures may include installing roof drains, scuppers, or overflow drains to increase the roof's capacity to quickly remove precipitation.[2,3]

In its 20-year history, BestWest Group has faced similar challenges after storms. Maglio recalls one case: "It was a new roof with an internal drain failure, which meant a lot of water poured directly into the building."

He mentions that the volume of rain Vancouver receives is daunting. "Being close to the ocean, we don't get much snow, but it can be significant when we do. After the snow, temperatures may rise quickly, turning to rain. In this situation, the drainage can't keep up with the volume of water," Maglio explains. Additionally, Vancouver's frequent and heavy windstorms often cause power outages, leading to other issues.

Weather can remain a barrier after storm damage, making it difficult to carry out roof repairs. All roof installations require dry conditions; therefore, temporary fixes are often necessary. Liquid membranes work well for quickly sealing roof defects.

"In other scenarios, we may use leak-seal products or tarping techniques to divert water away from the entry points," Maglio notes. "Scheduling permanent repairs can be challenging because owners face urgency. In winter, weather breaks are rare, and circumstances are often worsened by having multiple clients in the same situation at once." Serving everyone satisfactorily can be a challenge, he says.

In Maglio's experience, customer knowledge of products and their applications varies depending on the circumstances. "The roofing industry is competitive, and building owners may not always be familiar with the technical differences between roofing systems," he says, "so that's where we come in."

When competitors offer lower-cost options, customers are attracted to what they perceive as saving money, but often, the roof design and execution are inferior. He notes persuading owners to choose quality over price can be tricky, but these decisions often come to light during storm season.

Protecting commercial flat roofs from storm damage requires informed design, appropriate material selection, skilled installation, and regular inspection. Co-ordination among designers, consultants, contractors, and manufacturers also plays an important role in ensuring roofing systems perform as intended. While storms cannot be prevented, their impact can be reduced through careful planning, adherence to code requirements, and consistent roofing practices.

Author's note: This article was developed with input from Phillip Kerri, chief operations officer of RoofTech Systems Ltd., and Brock Maglio, president of BestWest Group, both experienced commercial roofing installers.

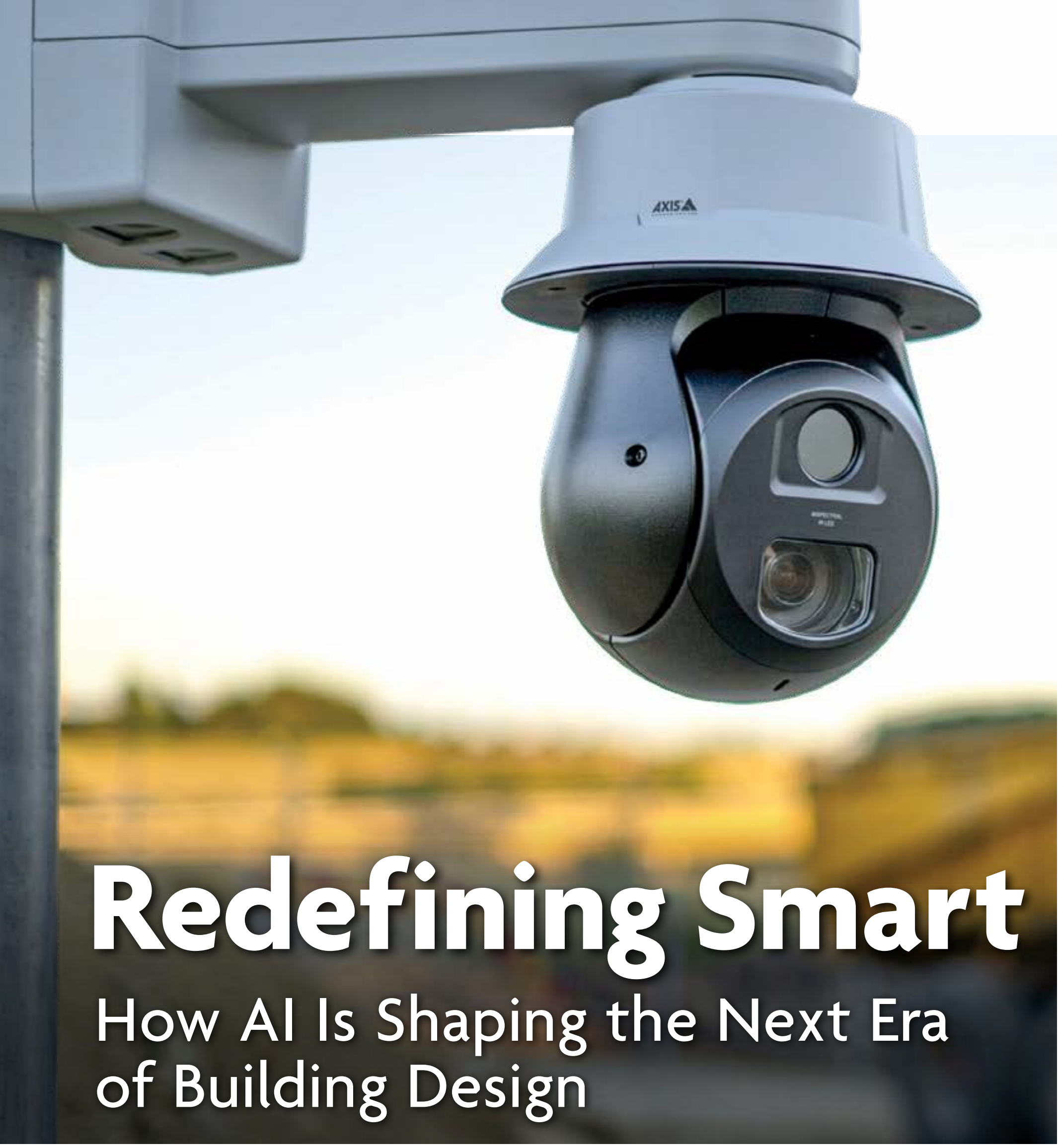
Notes

[1] To read more on CSA A123.24 and CSA A123.26, visit scc-ccn.ca/standardsdb/standards/4030962

[2] See the advantages and reasons why roofs should be designed to drain rather than pond by visiting iko.com/comm/wp-content/uploads/sites/7/2024/02/MM3L005-16_IKO_PIB_Roof_Drainage.pdf

[3] To find out more on what drainage systems are available for flat roofs, visit ikoknowledgecenter.com/en/docs/flat-roof-systems/what-drainage-systems-are-available-for-flat-roofs/


Kyle Linhares has more than 13 years of experience in commercial product management, including over five years with IKO North America. In this role, he supports product portfolios through market research, regulatory compliance, and cross-functional collaboration across Canadian markets.



Redefining Smart

How AI Is Shaping the Next Era of Building Design

By Sophie Laplante

PHOTOS COURTESY AXIS COMMUNICATIONS, INC

Top right: In a multi-tenant office environment, metadata derived from video analytics can help identify recurring congestion points in shared corridors or lobby areas.

Middle right: In many facilities, this convergence is already shaping how spaces are monitored, managed, and optimized on a daily basis.

Bottom right: Buildings designed to support shared data, distributed analytics, and interoperable systems are better positioned to interpret activity, anticipate patterns, and guide informed responses.

For years, the conversation around smart buildings has centred on connectivity. Cameras, access control, HVAC, lighting, and energy systems were networked, with the expectation that more data would naturally lead to better building performance. Yet many owners and operators now oversee environments where information is plentiful but actionable insight remains difficult to extract.

The issue is no longer whether buildings can collect data—it is whether they can interpret it to support timely, confident decisions. As facilities grow larger and more complex, operational teams often find themselves navigating multiple dashboards, investigating disconnected alerts, and manually piecing together context. A building may be fully connected yet lack the awareness needed to respond effectively to real-world conditions.

Artificial Intelligence (AI) is helping reshape this dynamic by enabling data to be analyzed as it is generated rather than after the fact. What is becoming clearer is that intelligence is not simply layered onto a building once construction is complete. It is heavily influenced by choices made much earlier in the process—by owners, designers, and engineering teams—from how systems are specified and integrated to the quality, consistency, and reliability of the data those systems produce.

Several emerging technologies are supporting this shift, not as standalone features, but as design tools that shape how buildings interpret and act on information. Connectivity establishes the foundation, but a building's ability to support informed decision-making depends on how deliberately that foundation is structured.

When systems connect but do not communicate

On paper, many modern buildings appear fully integrated. Systems are connected, networks are robust, and data is continuously generated. Yet once occupied, these same environments often behave less like cohesive ecosystems and more like collections of independent technologies.

The root of this disconnect often lies in how building design and delivery projects are organized. Mechanical, electrical, life safety, security, and automation systems are typically delivered within clearly defined scopes that emphasize individual performance.

While this approach simplifies procurement and co-ordination, it can leave operational teams without a unified view of building activity.

Instead of the building providing clarity, people are left translating signals across platforms. Patterns that span multiple systems remain difficult to detect, and response strategies tend to follow isolated alerts rather than broader conditions.

Greater visibility emerges when data is allowed to move across these boundaries. Approaches supported by open platform architectures, systems designed to share data through standardized interfaces, and cross-system analytics, which interpret information from multiple technologies, are enabling a more holistic understanding of building conditions. With that shared perspective, teams can begin to see not only what is happening but also how events relate to one another across the environment.

Buildings that achieve this level of awareness rarely do so by accident. More often, integration was treated as a design priority from the outset rather than a technical step near project completion. Allowing systems to communicate, however, is only the beginning. The next challenge is ensuring that this shared data can be interpreted quickly enough to inform real-world decisions.

From data capture to intelligent insight

As expectations for responsiveness grow, attention is shifting toward how intelligence is distributed throughout a building. The rise of edge-based analytics, which analyze data directly on devices such as cameras and sensors rather than relying on centralized platforms, reflects a move to process information closer to where it is generated.

Analyzing conditions at the point of capture allows environments to respond with greater immediacy. In settings where timing can influence outcomes, including health-care facilities, transportation hubs, and large campuses, this localized interpretation strengthens both operational continuity and safety.

Yet speed alone does not guarantee better decisions. For intelligence to be actionable, the data itself must be organized in a way that systems can interpret. When devices produce structured metadata, descriptive data that converts raw inputs into searchable information such as occupancy patterns or movement flows, networks can be designed around meaningful insight rather than sheer data volume. Using metadata brings forth results in more efficient bandwidth use and infrastructure that scales more predictably as demands evolve.

For example, in a multi-tenant office environment, metadata derived from video analytics can help identify recurring congestion points in shared corridors or lobby areas. Rather than relying on anecdotal feedback, building teams gain measurable insight that can inform layout adjustments, traffic flow strategies, or scheduling decisions. Over time, visibility supports environments that are not only more efficient, but better aligned with how occupants actually use the space.

Keeping certain forms of intelligence closer to the source can also support stronger cybersecurity strategies by limiting unnecessary data movement. As digital risk becomes inseparable from building performance, these architectural choices carry growing weight. But where intelligence resides is only part of the equation. Its effectiveness ultimately depends on the quality of the information behind it.

Buildings generate enormous amounts of information, yet volume alone does not create understanding. What supports better decisions is data that arrives in a form systems can interpret. This is where structured metadata becomes particularly valuable, providing a shared language through which technologies can communicate. Over time, this clarity allows operational strategies to evolve from reactive responses to more informed, proactive planning. Rather than relying on assumptions, building teams can identify emerging patterns, anticipate needs, and refine performance in ways that support both immediate operations and long-term resilience.

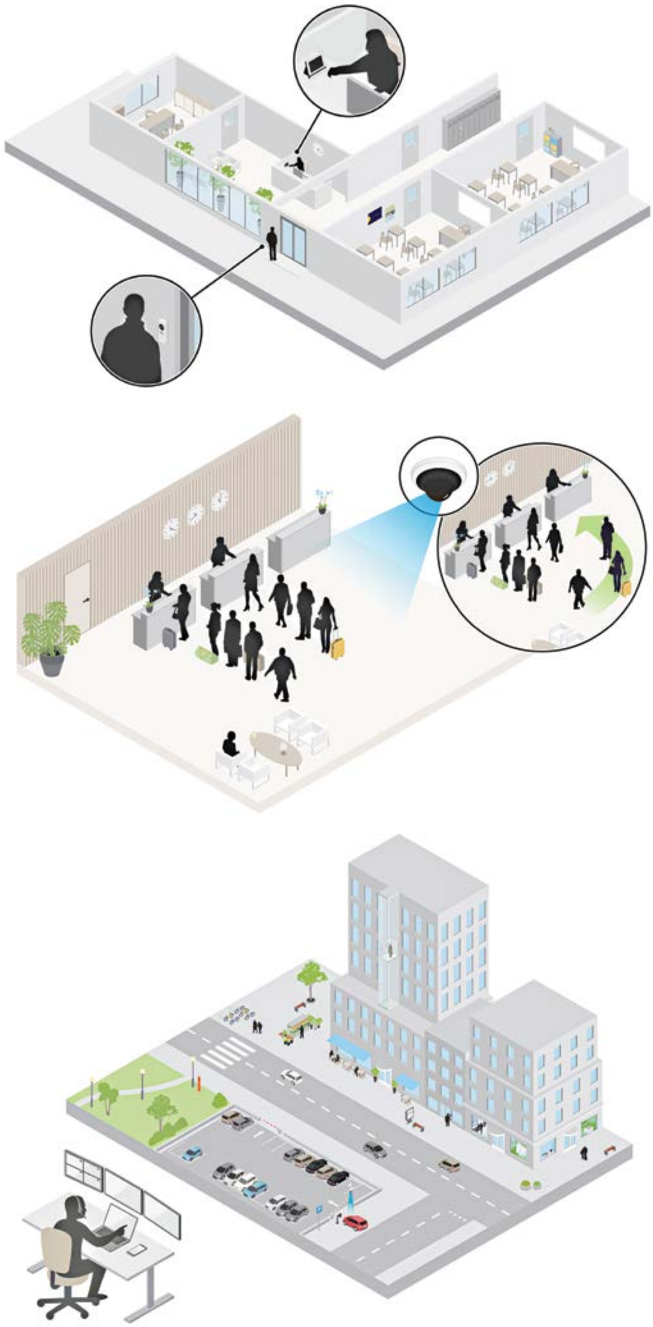
Designing for this level of intelligence requires looking beyond the presence of devices and considering the usefulness of the information they produce, as environments that generate well-structured data tend to adapt more easily as priorities shift and operational expectations grow.

Designing for adaptability

As building intelligence matures, interoperability is taking on new significance. Systems that cannot share information inevitably limit what AI can reveal, regardless of their individual sophistication.

Frameworks built on open platforms and open application programming interfaces (APIs), application interfaces that allow different technologies to exchange data without being locked into a single vendor ecosystem, enable structured information to circulate across security, facilities, energy, and automation environments. The result is a more unified operational perspective and greater flexibility to incorporate emerging tools over time.

From a life-cycle standpoint, adaptability is less about predicting every future requirement and more about preserving



Frameworks built on open platforms and open APIs, application interfaces that allow different technologies to exchange data without being locked into a single vendor ecosystem, enable structured information to circulate across security, facilities, energy, and automation environments.

the ability to respond when needs inevitably change. Buildings designed with interoperable foundations tend to remain relevant longer, while those shaped by closed ecosystems may discover that what once felt efficient gradually narrows their options. As a result, design decisions that prioritize openness today often determine how effectively a building can evolve tomorrow, with operational priorities that were once managed separately starting to intersect in ways that were previously difficult to recognize.

Intelligence, trust, and integrated performance

Safety, sustainability, and occupant experience have traditionally been treated as parallel objectives, each supported by its own technologies and workflows. Shared intelligence is revealing how closely these priorities are linked.

In many facilities, this convergence is already shaping how spaces are monitored, managed, and optimized on a daily basis. Capabilities such as scene intelligence, a form of computer vision that enables systems to interpret activity within a space rather than simply record it, and computer vision analytics, which analyze visual data to identify patterns and anomalies, allow buildings to understand behaviour with greater context. Routine activity can be distinguished from situations that may require attention, helping teams respond with precision while also informing energy management strategies, such as HVAC and lighting adjustments, that align system performance with actual occupancy instead of fixed schedules.

Insights into how spaces are used often lead to adjustments that improve comfort, accessibility, and functionality, allowing the building to operate less like a static asset and more like a setting that can recalibrate itself. As buildings take on a more responsive role, confidence in the underlying technology becomes essential. Technologies such as secure device identity, encrypted data handling, and secure-by-design architectures help ensure that intelligent environments remain both innovative and accountable, particularly when these considerations are embedded early in the design process.

A quiet redefinition of smart

As AI becomes more embedded in building operations, the meaning of smart building continues to evolve. Connectivity laid the groundwork, but intelligence is what allows that foundation to perform under real-world pressures.

Buildings designed to support shared data, distributed analytics, and interoperable systems are better positioned to interpret activity, anticipate patterns, and guide informed responses. What emerges is not simply a smarter building, but one better equipped to support the continuous decisions that shape performance over its lifetime. In that light, a smart building is no longer defined by the sophistication of the systems it contains, but by how effectively it supports the countless decisions that influence how the environment functions every day it is in use.

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Ask The Expert

Do you have a question regarding the specific use of a product, material, or technique for a project that you are currently working on? If so, these experts may have the answers you are looking for. These leading manufacturers and suppliers have provided solutions to some of the more common questions asked by AECO community. From the simplest questions relating to which product may be best suited for inclusion in specifications to how materials can assist in achieving green certification, you will find the answers here. In addition, you can also discover best practices related to installation to ensure product longevity.

Q: Why is vehicle mitigation becoming an increasingly important consideration in site and building design?

Protection doesn't need to compete with design intent, but it does need to be part of the conversation from day one.

Across North America, vehicles are breaching buildings, plazas, and pedestrian areas more frequently, whether from driver error, mechanical failure, or intentional acts. The consequences go beyond property damage. Storefront crashes, compromised building entrances, and unprotected gathering spaces create real liability exposure for owners, designers, and municipalities. Insurers and regulators are now expecting clear evidence that vehicle mitigation was considered early in the design process, not added after an incident.

For architects, this changes how projects are scoped. It's no longer enough to design for movement, experience, and aesthetics without also considering how a space performs under impact. The good news is that modern crash-rated systems are engineered to do both. Independently certified bollards meeting standards like PAS 68, IWA 14-1, and ASTM F2656/F3016 provide verified stopping power while integrating into architectural environments. Shallow-mount options with foundation depths as low as 300mm make retrofit and constrained-site applications practical without major excavation.

The key is specifying certified protection, not just engineered claims. Independent third-party certification eliminates guesswork, protects your client, and gives you a defensible specification.

If you're in the early stages of a project, that's the right time to bring vehicle mitigation into the design.

AUTHOR **INFORMATION**

Shawn Lowry is a sales leader at Ontario Bollards, helping clients choose effective protection solutions for residential and commercial spaces. He combines technical expertise with modern tools to simplify quoting, design, and planning. Focused on practical, lasting results, Shawn delivers clear, reliable guidance to help clients protect what matters most.

ännT

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Q: What is a thermally broken roof hatch, and why is it important for today's building design?

A thermally broken roof hatch is designed with an insulated frame and cover that minimizes heat transfer between interior and exterior metal surfaces. With R-20+ insulation and a low-conductivity design, it helps prevent condensation while significantly improving overall energy efficiency. This makes it especially important in today's buildings where energy performance and easy access are top priorities.

Q: How does a thermally broken roof hatch improve energy efficiency compared to a standard roof hatch?

Unlike standard roof hatches, a thermally broken design incorporates continuous insulation and a barrier between interior and exterior metal components to reduce thermal bridging. This reduces heat loss in colder conditions and heat gain in warmer climates, helping maintain interior temperatures and lowering HVAC demand. The R-20+ insulation and tight gasketing system further enhance performance by limiting air leakage and improving overall building efficiency.

Q: What types of projects or applications benefit most from using a thermally broken roof hatch?

Thermally broken roof hatches are ideal for projects where energy efficiency and moisture control are critical, such as commercial buildings, healthcare facilities and high-performance or LEED-focused designs. They are especially beneficial in climates with extreme temperature differences where condensation can be a concern. With availability in standard and custom sizes, they can be incorporated into a wide range of new construction and retrofit applications.

AUTHOR **INFORMATION**

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Q: How does Saint-Gobain Canada make contractors' lives easier?

Saint-Gobain has over 360 years of history in delivering not just products, but systems and solutions as a one-stop shop. We support contractors from pre-design through commissioning, acting as a true project partner. With leading brands like CertainTeed, Bailey, Agway, Kaycan, GCP, and Building Products of Canada, we offer integrated solutions from the foundation right up to the roof.

Q: Can you give us an example of a Saint-Gobain Canada system?

Let's say you are building a hospital, and you need 2-our fire-rated exterior wall with an STC of 50+. With Bailey's B18® studs + CertainTeed's Type X drywall + Lanaé Noisereducer insulation + finishing compounds, you can easily achieve this. On the exterior, you put GlasRoc® Sheathing + GCP Perm-A-Barrier® + Agway's HF series cladding. It's a great example of how our brands work together to deliver a complete, code-compliant solution.

Q: What sets Saint-Gobain Canada apart from other manufacturers?

What sets us apart is that science based resilience and sustainability are now truly embedded in our organization. We talk the talk by investing in Canada – e.g. we recently launched Infinaé CarbonLow™ range of plasterboard from North America's first zero-carbon (scopes 1 & 2) gypsum plant in Montreal, which significantly reduces the embodied carbon of a project. With the release of LEED v5 and its focus on embodied carbon, this product positions contractors to win more high value projects.

AUTHOR **INFORMATION**

Shefali Panse is a System Solutions Manager for the non-residential sector. She has worked in building materials manufacturing for over 7 years in R&D and Product Management roles. For her work on sustainable solutions, she was awarded the Canada Green Building Council's (CAGBC) 2024 Emerging Green Leader award.

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The Sustainability Gap

Carbon Tools Promise Clarity; Construction Reality Disagrees

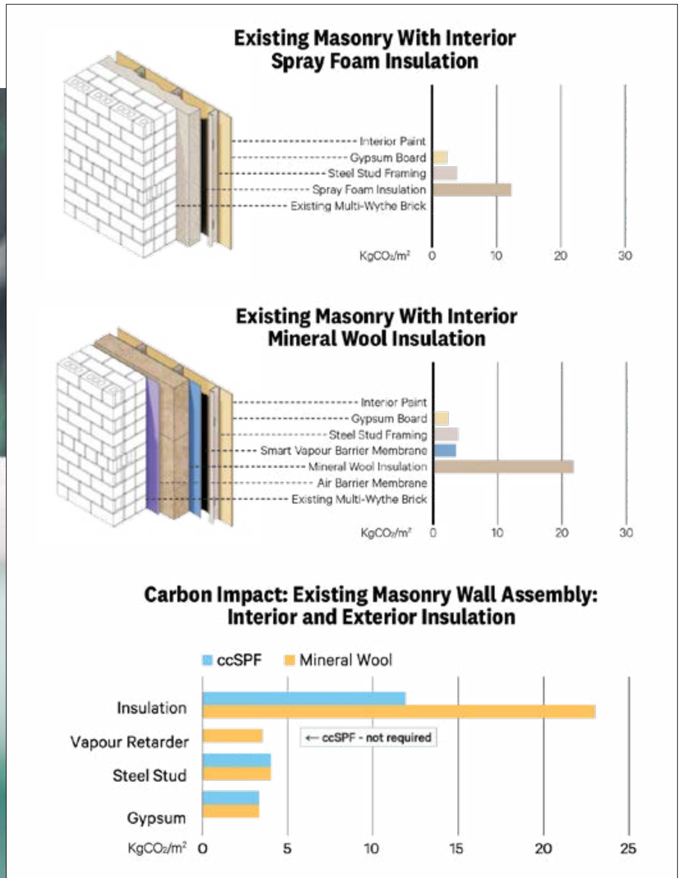
By Rockford Boyer, B.Arch.Sc., MBSc., BSS

PHOTO ©THAI NOIPHO/ISTOCK/COURTESY ELASTOCHEM

Much like value engineering (better known as de-value engineering), sustainability has become one of those overused words that means everything and nothing at the same time. It is mentioned in the early phases of design, highlighted in proposals and owners' requirements, and in some cases, it does not reappear until near the end of the project, wearing a panicked and malicious expression. Somewhere between the initial concept sketches and the final tender package, sustainability either gets integrated into the building from the start or is quietly swept under the rug due to "scheduling," "budget reasons," and/or "lack of effort."

For architects and designers, the pressure to meet realistic sustainability targets is high. Carbon targets and operational energy use are now increasingly tied to building design, approval processes, procurement, and funding. Clients and building owners are now asking pointed sustainability questions about goals. Local municipalities are tightening their "green" requirements or at least trying to. Professional consultants are showing up to meetings with performance spreadsheets. With all this "new" information and requirements, the architect still needs to connect and align all expectations into a coherent, buildable solution that does not blow the budget or schedule out of proportion.

Enter stage right… carbon tools. The design industry now features more carbon calculators, dashboards, plugins, frameworks, and checklists. Some of these tools are genuinely useful; however, some are only academic exercises where common



Tools are available to assist in comparing and calculating the embodied carbon of various building materials in assemblies.

PHOTO COURTESY RDH BUILDING SCIENCE (2023)/NEW DESIGN RESOURCES FOR EMBODIED CARBON TARGETS

sense could have improved the overall outcome. In the author's experience, many practitioners feel like these tools were created by application designers who have never had the chance to watch a contractor trying to meet a construction schedule in Sault Ste. Marie, Ont., during the Bon Soo winter festival.

The real question for architects is not whether they should use these sustainability tools, but rather which ones actually help, when to use them, and how to keep sustainability practical to meet the realities of construction. Do not overcomplicate it.

From 'green' to 'carbon': A subtle but important shift

For decades, sustainability within the architectural community existed in a comfortable, safe environment where checklists and payments to organizations determined how sustainable a building was. Energy efficiency, daylighting, water use, and recycled content are important aspects of sustainability, but they do not provide the full picture. Carbon, in the form of embodied and operational emissions, has shifted the conversation and influenced how buildings are designed more efficiently and effectively.

Embodied carbon is a different challenge. Its impact on the building's footprint and environment occurs even before the building is occupied; the effects of carbon are locked in the moment the raw materials are extracted, manufactured, and delivered to the site. Embodied carbon for materials such as concrete, steel, insulation, cladding, and finishes varies greatly. Therefore, these decisions matter early, and once they are made, there is no way to undo that carbon footprint.

This is where carbon tools can have a significant impact on the project. The whole carbon tool ecosystem can feel like the Wild West. There are excellent tools out there, but there is also a lot of noise.

Typical tools for carbon calculation fall into a few specific categories:

These tools have a role, but they cannot be used as a substitute for actual design thinking.

PHOTO ©CYANO66/ISTOCK/ COURTESY ELASTOCHEM

- Whole-building life-cycle assessment (LCA) tools
- Early-stage conceptual estimators
- Material-specific or Environmental Product Declaration (EPD)-based calculators
- Code- and policy-driven benchmarking frameworks

Each of these tools has a role, but the trouble begins when they are used at the wrong time, or worse, as a substitute for actual design thinking. Early-stage tools are excellent for massing studies and high-level decisions. These tools can indicate whether a concrete tower will exceed the carbon targets long before anyone has detailed a slab edge... but they are very blunt instruments. The tools cannot understand building science, constructability, supply chains, or local trade practices.

Detailed LCA tools are useful, but they require accurate and relevant inputs. Garbage in, garbage out applies more here than anywhere else. If assemblies are treated as generic placeholders, the resulting output may seem impressive but lacks meaningful value. Inputting realistic systems and components helps ensure that the carbon results accurately reflect the actual project being built.

There are also policy-driven tools that are increasingly influencing how projects are accepted and approved by the office. These tools are no longer optional; they are becoming part of the regulatory compliance landscape, whether architects or building owners like it or not.

One uncomfortable truth about carbon tools' output is that they are often presented with more confidence than they deserve. The data outputs often appear specific, particularly when they include decimal places that imply scientific certainty (a common tactic is to use large numbers or additional decimal places to make results seem more credible). Carbon modelling is predictive, not prophetic; it is an informed estimate based on assumptions, boundaries, and data that may or may not reflect what actually occurs on site.

Meticulously modelled wall assemblies can often get "field adjusted" with whatever material was available that week, or to save costs. There is already a gap between theory and practice. Carbon tools do not account for supply chain disruptions, winter pours, rushed substitutions, or the fact that the concrete truck showed up late and everyone was ready to go home.

These factors do not render the tools useless; rather, they mean they should be used with humility and adjusted in real time. Think of these tools less like a crystal ball and more like an unreliable weather forecast. While the tools can be helpful for planning and decision-making, they can be dangerous if treated as the absolute truth, and sometimes people sound very confident in project meetings while being completely mistaken.

The architect's real challenge: Tools versus responsibility

One of the quieter frustrations expressed by architects and designers is this: "We're being asked to deliver against carbon goals without actually being able to control all the project variables and contractor decisions." They are not wrong. Architects can specify low-carbon materials, but procurement and value engineering might substitute them for various reasons. If the specified materials are unavailable, CSC

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contractors may recommend replacements without considering the carbon. Architects can design efficient and effective assemblies, but construction sequencing may compromise the overall assembly performance. Practitioners can model an impressive carbon story, but site conditions and time frames may force last-minute changes.

Carbon tools do not solve this problem, but they do make responsibility more visible and relevant for future projects. When used properly, these tools allow architects and designers to:

- Clarify the document's intent
- Compare alternatives transparently
- Engage in informed conversations with clients and contractors
- Push back when substitutions compromise overall performance

Embodied carbon meets building science (finally)

An encouraging trend in the industry is that discussions about carbon are beginning to intersect with building science and in-situ performance rather than existing separately. For many years, assemblies were optimized solely for thermal, air, vapour, and water control (four control layers). Carbon was not considered a significant factor in that important equation, but due to climate change and a better understanding of carbon, more relevant questions are now being asked. Many of these questions posed by architects include:

- Do we really need that much concrete?
- Is the insulation serving as both an air barrier and insulation?
- Can one material replace three layers?
- How does a material's durability affect the carbon outcome?

To clarify further, this is what is important when it comes to durability. Durability has an impact on recurring embodied carbon. Materials that last longer can reduce the recurring embodied carbon associated with:

- replacement materials transportation
- demolition and disposal
- additional labour and construction activity

It is important to look at the lifespan of materials being used in the design assembly.

Questions like this offer architects a significant opportunity to focus on assembly performance. Assemblies that are simpler, more durable, and incorporate material integration typically perform better from a carbon perspective as well. Fewer materials mean fewer interfaces, which, in theory, reduces failures. Sustainability can also be about avoiding the use of redundant materials.

EPDs and carbon: Essential, imperfect, yet preferable to guesswork

EPDs have become the currency of carbon discussions, and like any currency, they come with fine print. EPDs offer transparency, but they are not all the same; industry versus individual, different assumptions, system boundaries, and manufacturing locations can produce significantly different numbers for what seem to be similar products. Comparing EPD results without understanding the context is like comparing an insulation's R-value without knowing the product's thickness.

EPDs used for construction decisions represent a significant advancement in the industry and provide architects with tangible data to inform their work. Carbon tools that incorporate EPD data enable more informed material choices, particularly when those decisions are made early in the building design process. The key is to view EPDs as decision-support tools rather than absolute truths; they should guide judgment, not replace it.

One of the most significant shifts happening quietly in the industry is that carbon is no longer just a topic in design offices. Contractors and building owners are being drawn into the discussion, sometimes willingly, sometimes less so. Low-carbon requirements, whether embodied or operational, are appearing in specifications and project requirements like never before. Reporting obligations are appearing in project contracts, and submittals are being reviewed through a sustainability lens.

Unfortunately, this creates friction among the project parties, but it also presents a great opportunity. When architects use carbon tools to support buildable, realistic solutions, contractors tend to become engaged and deeply involved. When these project-specific carbon targets seem disconnected from reality or, as previously mentioned, become little more than a checkbox, resistance is inevitable. The most environmentally successful projects are those in which these carbon tools and their enforcement are used collaboratively as a shared framework among the owner, architect, and contractor.

Sustainability is a process, not a product

There is often a temptation, especially when creating and reviewing marketing materials, to present sustainability as just a product feature. Many designers seek a quick fix when choosing products. Carbon tools, like overly promotional marketing literature, can unintentionally reinforce that mindset if caution is not exercised.

However, sustainability is not something added at the end of the project. It is a process that begins early in the project, continues through the schematic design and design development phases, and requires ongoing adjustments as constraints and project variables shift.

Carbon tools work best when integrated into that process:

- Early enough to shape form and systems
- Frequently enough to test assumptions
- Transparently enough to foster genuine project conversations

These tools are not meant to make decisions for architects. Instead, they are designed to make the impacts of carbon decisions visible to the project team. These tools are only intended to guide how to reduce the building's carbon footprint.

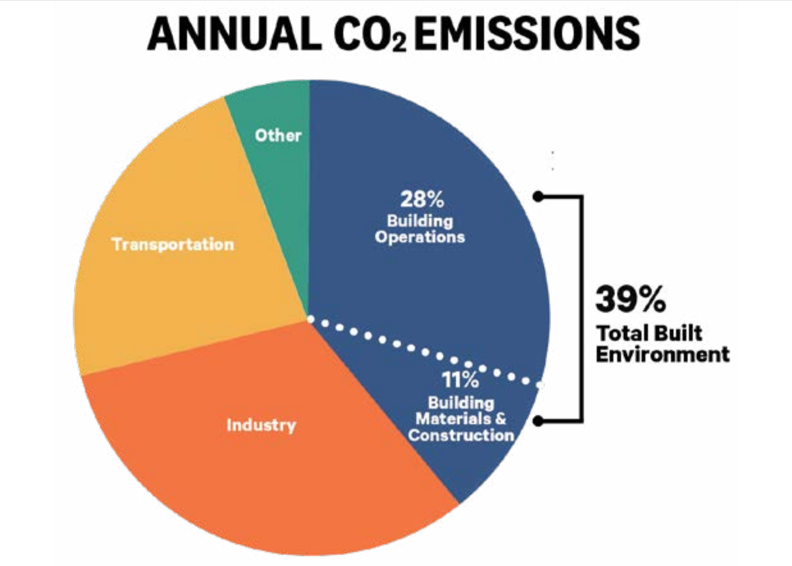
Tools can quantify, compare, and benchmark. They cannot:

- Balance aesthetics with performance
- Navigate client politics
- Resolve conflicting consultant priorities
- Design assemblies that actually get built as intended

The risk is not that architects will overuse these carbon tools. They will be asked to implement them without the authority to act on the outcomes.

Looking ahead: Fewer tools, better conversations

The next phase of carbon tools will focus less on flashy software or databases and more on integration and, believe it or not, common sense. Looking ahead, these tools need to concentrate on practical processes such as:



Buildings generate about 39 per cent of global carbon emissions, with embodied carbon in materials becoming a larger share as energy grids decarbonize.

PHOTO COURTESY 2024 GLOBAL STATUS REPORT FOR BUILDINGS AND CONSTRUCTION[1]

- Fewer standalone platforms
- More embedded workflows
- Better alignment between design, specification, and construction

The goal of these tools is not to identify the perfect carbon accounting, but to build better low-carbon buildings that are more durable, more efficient, more responsible, and more realistic about how they are actually constructed in Canada.

Sustainability and carbon reduction do not require a superhero story. They do not need architects to save the planet one building assembly at a time. Instead, they need clear thinking, good tools, and honest conversations about trade-offs among all parties. When used effectively, carbon tools can help architects do what they have always excelled at: making informed decisions in complex environments.

Notes

[1] Refer to unep.org/RESOURCES/REPORT/GLOBAL-STATUS-REPORTBUILDINGS-ANDCONSTRUCTION

Rockford Boyer, B. Arch. Sc., MBSc, BSS, is an experienced building science leader at Elastochem with more than 20 years of expertise in sustainable building design. He holds an undergraduate degree in civil engineering and architecture and a master's in building science. He is also a member of Passive House Canada and the Ontario Building Envelope Council (OBEC). He is also a part-time professor at Sheridan College, teaching in the architectural technology program and sharing his knowledge and expertise with future generations of architects and designers.


Tackling Thermal Bridging with Sprayfoam Insulation

By Mickel Maalouf

PHOTOS COURTESY HUNTSMAN BUILDING SOLUTIONS

Right: Insulated wall cavity prepared for drywall installation.

Thermal bridging is one of the most persistent and overlooked challenges in modern construction, particularly within wall and ceiling assemblies where framing components interrupt insulation layers. Even the most carefully planned insulation strategy can underperform when conductive materials create direct pathways for heat flow through the building envelope. The result? Increased energy bills, diminished occupant comfort, and, in some cases, moisture issues that can compromise building durability.

As energy codes and performance standards become more stringent, builders, designers, and specifiers are under growing pressure to address thermal bridging early in the design phase. Fortunately, advanced insulation solutions, particularly spray polyurethane foam (SPF), are helping construction professionals meet these demands by delivering continuous thermal, air, and moisture protection in a single application. As the industry shifts toward more holistic enclosure strategies, understanding how insulation types interact with entire assemblies has never been more important.

Understanding thermal bridging

Thermal bridging occurs when a highly conductive material bypasses or interrupts the insulation layer, allowing heat or cold to move more easily between the interior and exterior of a building. Common culprits include:

- Framing members such as wood studs, steel studs, and roof trusses
- Slab edges and foundation connections
- Balconies, canopies, and overhangs that penetrate the building envelope
- Mechanical and electrical penetrations through walls and roofs

Walls and ceilings often contain dense networks of framing members, making them especially vulnerable to thermal bridging when insulation continuity is interrupted. This vulnerability is amplified by the fact that materials such as steel and wood conduct heat much more readily than insulation; these components create "short circuits" in the thermal barrier. Even if only a small portion of the envelope is bridged, the overall effective R-value can drop significantly.

The implications for building performance

While thermal bridging is often discussed in the context of energy loss, its impact extends far beyond higher utility bills. One of the most noticeable consequences is reduced thermal comfort. Cold spots in winter or warm zones in summer are telltale signs of bridging, creating temperature inconsistencies that make spaces uncomfortable for occupants and more difficult to efficiently condition.

Thermal bridging also introduces moisture risks. By creating localized areas where interior surface temperatures drop below the dew point, it encourages condensation. Over time, this can lead to mould growth, corrosion, and the gradual degradation of materials. These repeated cycles of condensation and drying do not just affect appearance—they compromise the durability of the building envelope, shortening the service life of materials and leading to costly repairs.

Another challenge created by thermal bridging is the increased strain it places on heating and cooling equipment. When walls and ceilings allow uncontrolled heat flow, mechanical systems must work harder and run longer to maintain set temperatures, leading to reduced equipment life and higher operational costs over time.

In addition, thermal bridging poses significant challenges for code compliance. With energy codes such as the *International Energy Conservation Code* (*IECC*), ASHRAE 90.1, and Canada's *National Energy Code of Canada for Buildings* (*NECB*) pushing for improved envelope performance, leaving bridging unaddressed can make it difficult, or even impossible, to meet required performance targets. Ultimately, managing thermal bridging is not just about saving energy; it is also critical for occupant comfort, building durability, and regulatory compliance.

Why sprayfoam insulation is an effective solution

Sprayfoam insulation is a highly effective choice for high-performance building envelope design because, when properly designed, it addresses thermal bridging. By minimizing conductive pathways and providing both thermal and structural benefits, sprayfoam offers a comprehensive solution for energy efficiency and durability. This becomes especially important in high-performance wall and ceiling assemblies, where even small gaps or inconsistencies in insulation layers can significantly affect energy modelling results and real-world performance.

There are two main types of SPF: open-cell and closed-cell. Both share the same core advantages: continuous thermal coverage, strong adhesion to irregular substrates, and the ability to seal around penetrations. However, they differ in density, rigidity, and moisture behaviour.

Open-cell SPF is lighter and more flexible, allowing it to expand and fill cavities effectively while providing good acoustic absorption. Its higher vapour permeability makes it appropriate for interior applications, where wall thickness limitations are less stringent. In such cases, a separate vapour retarder can be incorporated if necessary.

Closed-cell SPF, by contrast, is denser and more rigid. It provides a higher R-value per inch, adds structural strength to assemblies, and has low water permeability, allowing it to act as a vapour retarder in many applications.

Whether used in exterior walls, interior partition walls, cathedral ceilings, or flat roof-ceiling assemblies, SPF creates a continuous insulation (c.i.) layer that significantly reduces the impact of framing-related bridges.

Since both open- and closed-cell SPF can form effective air barriers when installed to the tested minimum thickness, each can help stabilize indoor temperatures and reduce heat loss. However, in thin-profile assemblies or cold-climate construction, closed-cell SPF is often favoured. Its high R-value per inch allows designers to meet energy targets without increasing wall thickness, while its built-in moisture resistance helps prevent condensation at thermal bridges.

Moisture resistance adds another layer of protection. Closed-cell spray foam has low water permeability and, in many assemblies, can serve as a vapour barrier. By controlling moisture migration, it minimizes the risk of condensation at thermal bridges and helps protect the building's structure from potential damage.

Beyond its insulating and sealing capabilities, closed-cell spray foam also enhances structural integrity. When applied, it adds rigidity to walls, roofs, and other assemblies, increasing their resistance to deformation over time. This combination of thermal efficiency, moisture control, and added strength makes spray foam insulation an appealing option for builders and designers who prioritize both performance and resilience in their projects.

Assembly methods to meet new energy efficiency requirements

There are some assembly methods available to the building community that offer innovative solutions to both thermal bridging and the increasingly stringent energy-efficiency standards. By installing very specific sprayfoam products from the interior, this type of system seamlessly fills the gaps between the exterior sheathing and the wall studs, bridging what would traditionally be cold paths through the structure. What makes this approach especially effective is its integrated functionality: only a single application of sprayfoam from the interior provides insulation, air barrier, and vapour barrier simultaneously, eliminating the need for three separate layers applied both from exterior and interior.

When applied from the interior, sprayfoam integrates easily into stud walls, rim joists, and roof/ceiling cavities, allowing contractors to enhance performance without altering standard wall or ceiling designs. This not only bolsters thermal resistance and airtightness but also enables a much thinner wall profile, helping architects and builders meet new energy-savings mandates without compromising performance or increasing wall thickness.

Operational efficiency and reliability are also key advantages. Since the sprayfoam is applied entirely from inside the building, weather conditions, wind, and extreme

Top: Interior wall assembly insulated to support airtightness and energy performance.

Bottom: Sprayfoam insulation creates a continuous thermal barrier within the wall assembly.

cold (down to -20 C [-4 F]) no longer impede progress. There is no need for scaffolding, hydraulic lifts, or exterior staging for the installation of insulation. The result is significantly accelerated construction timelines, enhanced jobsite safety, and reduced labour and equipment costs.

Further, avoiding exterior compartmentalization per Article 3.1.11.2 of the *National Building Code of Canada* (*NBC*) or the *Commission de la construction du Québec* (*CCQ*) and meeting the required fire tests simplifies code compliance while improving heating performance during cold-weather construction. All these facets make some of these modern-day assemblies not only a high-performance but also a cost-effective solution, particularly in meeting evolving energy codes and efficiency expectations.

Important construction and life-cycle considerations

In all wall and ceiling assemblies, structural elements and buildings within walls—including mechanical, electrical, and plumbing systems—must be fully completed, inspected, and signed off. Sprayfoam, specifically, bonds tightly to substrates and can fully fill cavities, making changes afterward potentially costlier, more complex, and more time-consuming.

That said, while this is an important consideration, the extent of this constraint can vary depending on the assembly design and construction sequencing. There are cases where systems do not need to be fully embedded within the foam, and extensive rework can be avoided when addressed early in the design and planning stages.

For example, electrical wiring can often be installed before or after insulation, depending on the assembly. In exterior-insulated systems, building services remain accessible from the interior by design. Meanwhile, in interior applications, the higher R-value per inch of sprayfoam can allow for partial cavity insulation, leaving sufficient space within the stud cavity to accommodate wiring runs.

As with any assembly, early consideration of construction sequencing is essential. For instance, in a 152 mm (6 in.) stud cavity insulated within 89 mm (3.5 in.) of sprayfoam, the remaining space can be intentionally allocated for electrical routing. When planned, this supports both constructability and future accessibility. It is also worth noting that electrical retrofit practices typically do not involve removing and rerouting existing wiring, but rather installing new wiring while existing conductors are abandoned in place.

Similar considerations apply to ventilation and plumbing systems. Ventilation ducts are ideally installed prior to sprayfoam application, but they can also be installed afterward, with perimeter sealing used to maintain continuity of the air barrier. Plumbing, which is typically located on the warm side of insulation to reduce the risk of freezing, is therefore often kept accessible rather than embedded within the insulated layer. In cases where plumbing must be located near or within insulated assemblies, simple measures—such as isolating components with a protective layer—can prevent adhesion and maintain serviceability.

Ultimately, these considerations highlight the importance of early co-ordination among design teams and trades. Regardless of insulation type, poorly sequenced construction or lack of trade co-ordination can lead to complications. When assemblies are thoughtfully planned, sprayfoam insulation can be integrated without compromising long-term maintenance, while still delivering its performance benefits.

Design strategies for reducing thermal bridging

While sprayfoam can dramatically reduce bridging, best results come from combining it with other smart design choices such as:

- Using exterior insulation to move the primary thermal layer outside structural framing
- Eliminating or redesigning envelope penetrations such as continuous steel structures and balcony slabs
- Incorporating thermally broken connections for fasteners, cladding systems, and structural supports
- Sealing mechanical and electrical penetrations with SPF to prevent both air leakage and conductive heat loss

In hybrid assemblies, sprayfoam can work in tandem with other types of insulation or other materials to deliver code-compliant performance and optimized cost-efficiency. This versatility is especially valuable in wall and ceiling assemblies, where hybrid insulation systems are increasingly used to balance cost, performance, and code requirements.

Steel framing and sprayfoam combine to support long-term thermal performance.

Meeting the demands of modern codes and clients

Building owners, architects, and builders increasingly recognize that investing in a high-performance envelope delivers long-term value. Reduced operational costs, greater occupant comfort, and increased durability are compelling benefits, and, in many cases, meeting today's codes is only possible when thermal bridging is addressed head-on.

By providing continuous thermal coverage, airtightness, and moisture control in a single step, sprayfoam insulation offers a practical, proven approach to this challenge. Whether used as part of a fully exterior-insulated wall assembly or as a targeted solution in framing cavities and connection points, SPF helps ensure buildings perform as designed for decades to come.

As the performance expectations for modern wall and ceiling assemblies continue to rise, SPF provides a practical path to meeting—and exceeding—those demands.

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Kelly Sawatzky, CSP, RSW

Looking Back, Moving Forward

Someone once said, "You can't prophesize the future." That is likely true for anyone who has served as president, and this past year has reinforced that idea.

While the year brought some unpredictability, it has been a privilege to work with such a dedicated group sharing the same goal: building a stronger association for the future. Sincere thanks go to those who offered their support and guidance—Russ Snow, Abigail MacEachern, Yvon Lachance, Jonathon Greenland, Jeff Halashewski, and Don Shortreed. Their ideas, perspectives, and commitment helped shape a rewarding year, and there is great confidence in their leadership as the transition to the immediate past president begins and the association looks ahead.

Special appreciation is also extended to Nick Franjic and Clafton Fiola for their kindness, encouragement, knowledge, and tireless work on behalf of the association.

Equally important are the volunteers who keep the organization running. Their passion and dedication make CSC a strong and vibrant community that benefits members across the country.

Gratitude goes to family and friends for their support, especially to Ross, whose encouragement has been constant through both challenges and successes.

One of the most meaningful parts of serving the association has been connecting with members across CSC and within CSI. It is the sense of family so many people describe when they become involved. Service to the association shapes and strengthens those who participate, and it is inspiring to see that transformation across the membership.

Although the board remains focused on the future, this year required particular attention as CSC navigates significant changes in both the industry and the organization. One of the biggest challenges has been filling Nick's shoes, who is retiring after 33 years of service. His guidance and institutional knowledge will be missed more than he realizes. His character and leadership are truly irreplaceable.

There are a few projects I plan to continue over the next year or two. It will be exciting to see how they grow and evolve. The commitment to CSC's mission and vision remains strong. It's been an honour to serve you. I am CSC, and you are too.

Regarder en arrière, aller de l'avant

Quelqu'un a dit une fois : « Vous ne pouvez pas prophétiser l'avenir ». Cela est probablement vrai pour tous ceux qui ont servi en tant que président, et l'année dernière a renforcé cette idée.

Bien que l'année ait apporté une certaine imprévisibilité, cela a été un privilège de travailler avec un groupe aussi dévoué partageant le même objectif : construire une association plus forte pour l'avenir. Sincères remerciements à ceux qui ont offert leur soutien et leurs conseils — Russ Snow, Abigail MacEachern, Yvon Lachance, Jonathon Greenland, Jeff Halashewski et Don Shortreed. Leurs idées, leurs perspectives et leur engagement ont contribué à façonner une année enrichissante, et il y a une grande confiance dans leur leadership alors que la transition vers le président sortant commence et que l'association se tourne vers l'avenir.

Une reconnaissance spéciale est également accordée à Nick Franjic et Clafton Fiola pour leur gentillesse, leurs encouragements, leurs connaissances et leur travail inlassable au nom de l'association.

Les bénévoles qui assurent le fonctionnement de l'organisation sont tout aussi importants. Leur passion et leur dévouement font de DCC une communauté forte et dynamique qui profite à ses membres partout au pays.

La gratitude va à la famille et aux amis pour leur soutien, en particulier à Ross, dont l'encouragement a été constant à travers les défis et les succès.

L'une des parties les plus significatives de servir l'association a été de se connecter avec les membres à travers DCC et au sein de CSI. C'est le sens de la famille que tant de gens décrivent lorsqu'ils s'impliquent. Le service à l'association façonne et renforce ceux qui y participent et il est inspirant de voir cette transformation à travers les membres.

Bien que le conseil reste concentré sur l'avenir, cette année a nécessité une attention particulière alors que DCC traverse des changements importants dans l'industrie et l'organisation. L'un des plus grands défis a été de remplacer Nick, qui prend sa retraite après 33 ans de service. Son orientation et ses connaissances institutionnelles nous manqueront plus qu'il ne le réalise. Son caractère et son leadership sont vraiment irremplaçables.

Il y a quelques projets que je prévois de poursuivre au cours des deux prochaines années. Ce sera passionnant de voir comment ils grandissent et évoluent. L'engagement envers la mission et la vision de DCC reste fort. Ce fut un honneur de vous servir. Je suis DCC et vous aussi.


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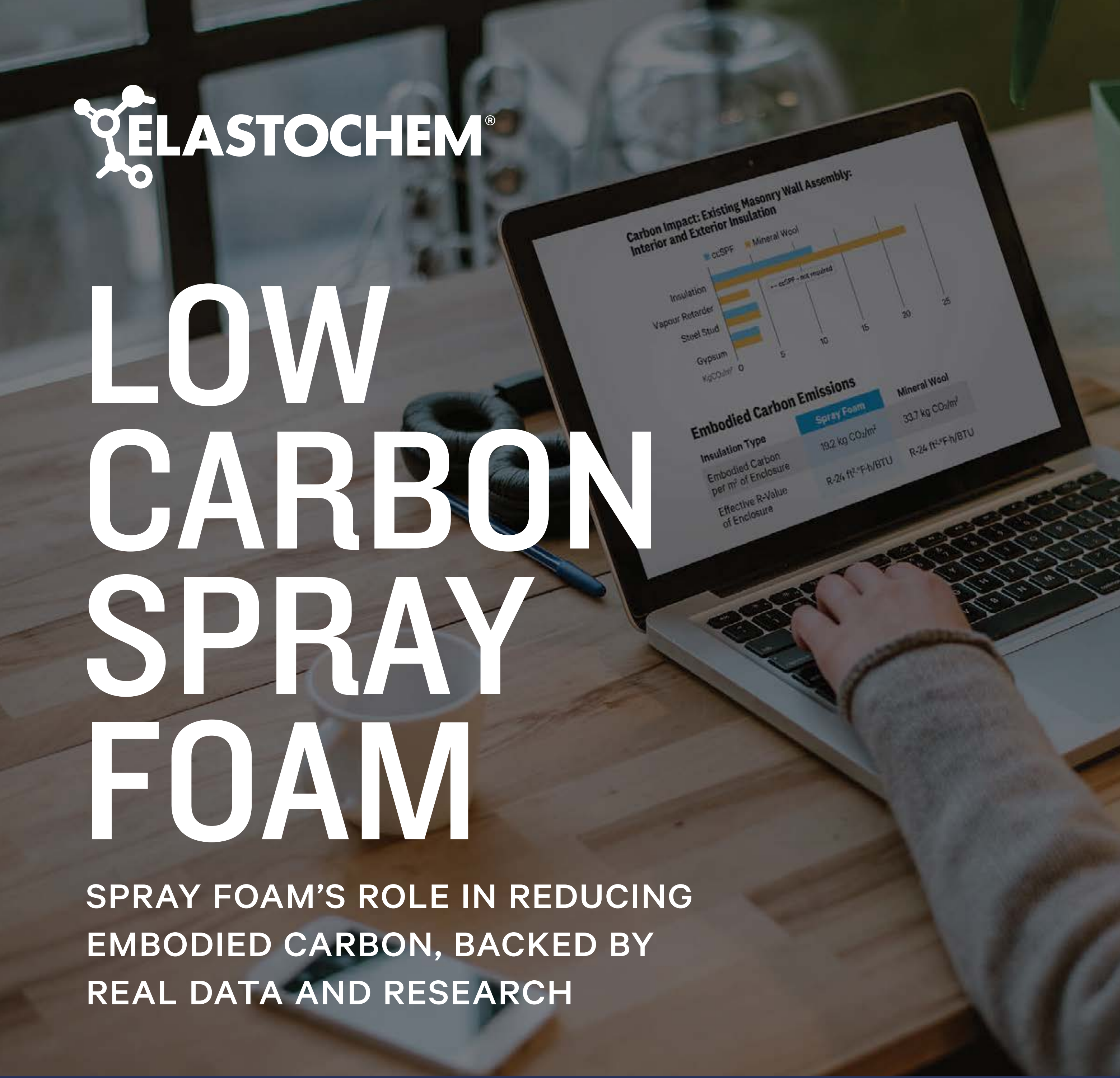

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