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CONCRETE STRUCTURES

It's All in The Details

The Intricacies of Roof Installation and Design

The Steps for Prefabricated EIFS Wall Panels

The Functionality of Rainscreen Systems

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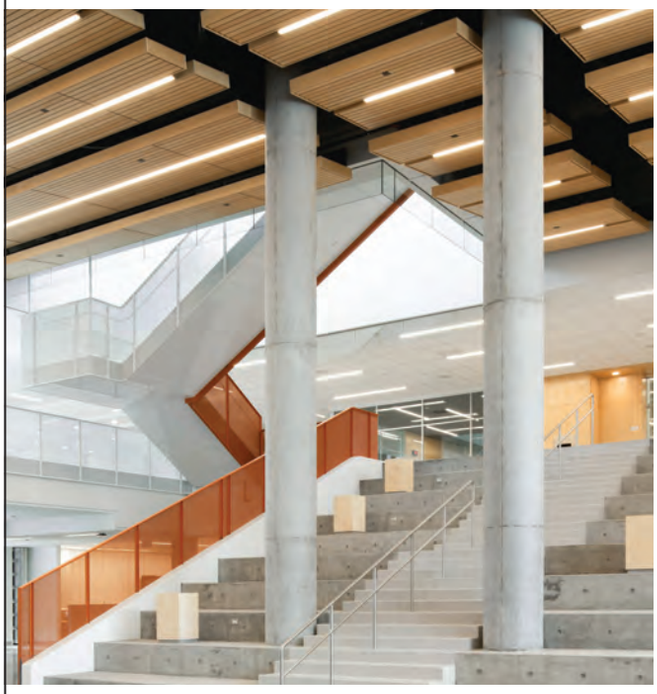

Aux Mille-Voix High School in Montreal blends sustainable materials and innovative design: recycled concrete pavements, wood columns, and cladding paired with green-and-white roofs and geothermal energy to reduce environmental impact. Designed by TLA Architectes, UN architecture, and NEUF architect(e)s, this structure is LEED Silver certified and fosters natural light, community, and sustainability for generations to come.

PHOTO BY RAPHAËL THIBODEAU/COURTESY V2COM

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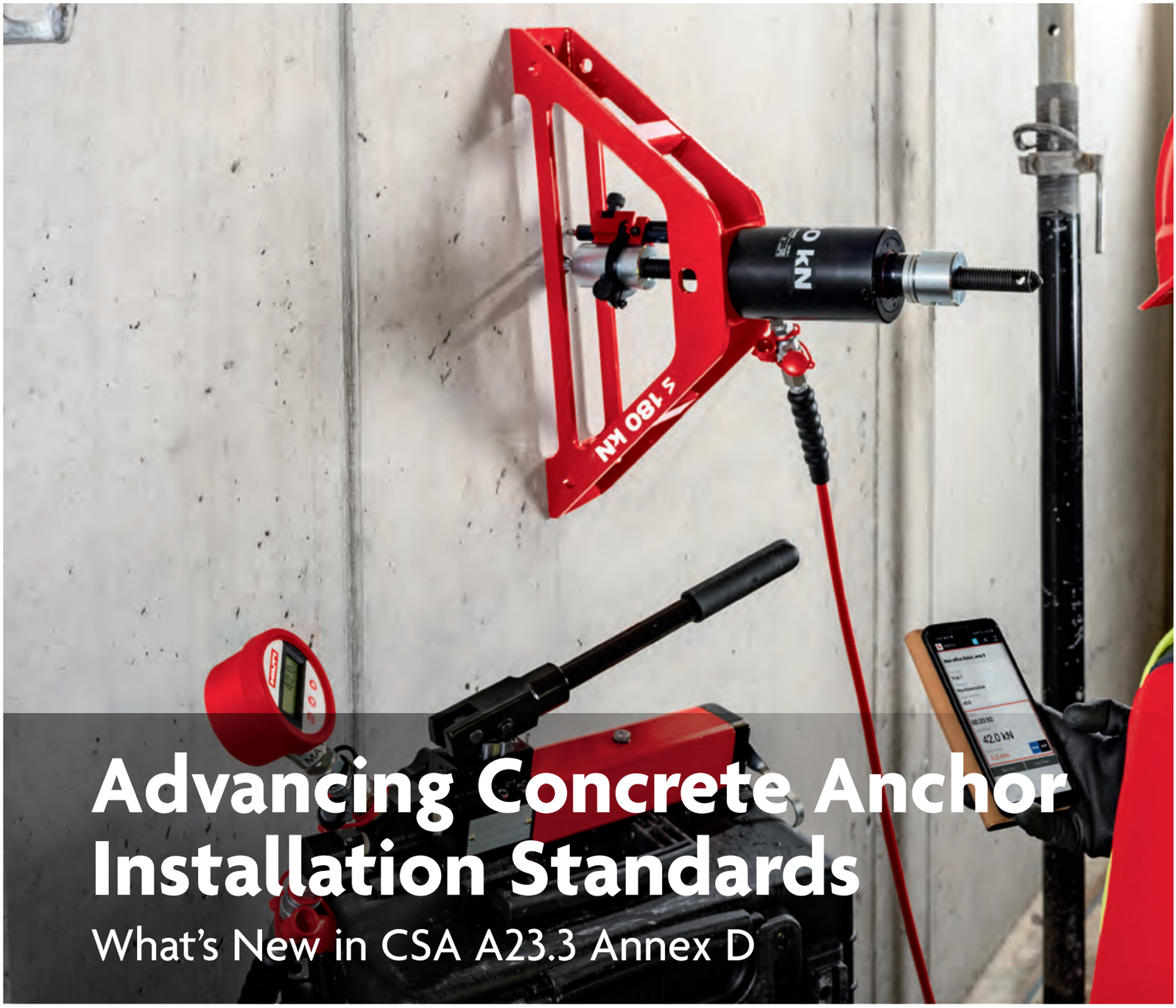


Advancing Concrete Anchor Installation Standards

What's New in CSA A23.3 Annex D

By Ali Ahrabi
PHOTOS COURTESY HILTI

The Canadian Standards Association's (CSA Group's) CSA A23.3 standard governs the design of concrete buildings in Canada. It is referenced by both the *National Building Code* (*NBC*) and provincial or territorial building codes. *NBC* 2020 refers to the 2019 edition of CSA A23.3 (CSA A23.3-19) for designing concrete structures.

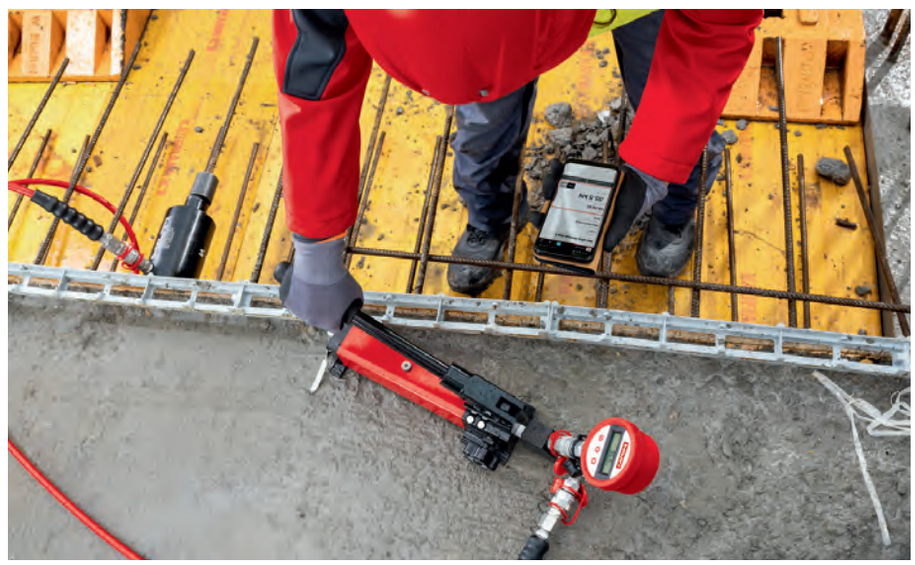
Annex D of CSA A23.3 is dedicated to the design, installation, and quality assurance requirements for cast-in and post-installed mechanical and adhesive anchors in concrete. This annex became "normative" (*i.e.* mandatory) in the 2019 edition of CSA A23.3, whereas it was "informative" (nonmandatory) in the 2014 edition. As a result, the requirements outlined in Annex D are now enforceable under *NBC* 2020 and any provincial or territorial codes that have adopted CSA A23.3-19.

This article will focus on the installation and quality assurance requirements of anchors as detailed in Clause D.10 of Annex D. It will explore the provisions outlined in the 2019 edition of CSA A23.3, discuss the updates introduced in the newly published 2024 edition, and highlight key changes between the two editions.

Clause D.10 in CSA A23.3-19

The 2019 edition of CSA A23.3, Clause D.10, is dedicated to anchor installation and inspection.

Standard drilling into concrete (using hammer drill bit) to install anchors.



On-site rebar pull test on concrete.

All anchors must be installed by qualified personnel (Clause D.10.1) following the manufacturer's printed installation instructions (MPII). For adhesive anchors, this requirement further specifies that only personnel trained in adhesive anchor installation could perform this work (Clause D.10.1).

The required level of inspection for both mechanical and adhesive anchors varies depending on the anchor category specified in the manufacturer's evaluation report. Adhesive anchors are subject to specific inspection requirements, as outlined in Clauses D.10.2.2 to D.10.2.4, which call for periodic or continuous special inspections. In certain cases, such as adhesive anchors being installed horizontally or upwardly inclined to support sustained tension loads, continuous special inspection is mandatory by a special inspector. D.10.2.4 requires that a special inspector provide a report confirming that continuous inspections have been conducted during the installation of adhesive anchors in these orientations. Such reports verify that all anchor work complied with the approved contract documents and the MPII, ensuring proper installation.

Personnel installing adhesive anchors horizontally or upwardly inclined to support sustained tension loads are required to hold a certification from recognized programs

Type	Continuous special inspection and proof loading	Periodic special inspection
a) Adhesive anchors and post-installed reinforcing bars installed in horizontally or upwardly inclined orientations to resist sustained tensile loads	X	–
b) Adhesive anchors and post-installed reinforcing bars not defined in)	—	X
c) Mechanical anchors	–	X
Note: Descriptions of typical inspection procedures can be found in the explanatory notes of the Cement Association of Canada's (CAC) "Concrete Design Handbook."		

Drilling into concrete (using self-cleaning hollow drill bit) to install anchors.

Adhesive injection into the drilled hole to install anchor rods.

in accordance with the American Concrete Institute (ACI) and Concrete Reinforcing Steel Institute (CRSI) Adhesive Anchor Installer Certification Program or an equivalent certification (Clause D.10.2.3).

The 2019 edition of CSA A23.3 references ACI 355.4 for proof loading requirements where specified by contract documents (Clause D.10.2.2) without providing further clarity for how to accomplish this.

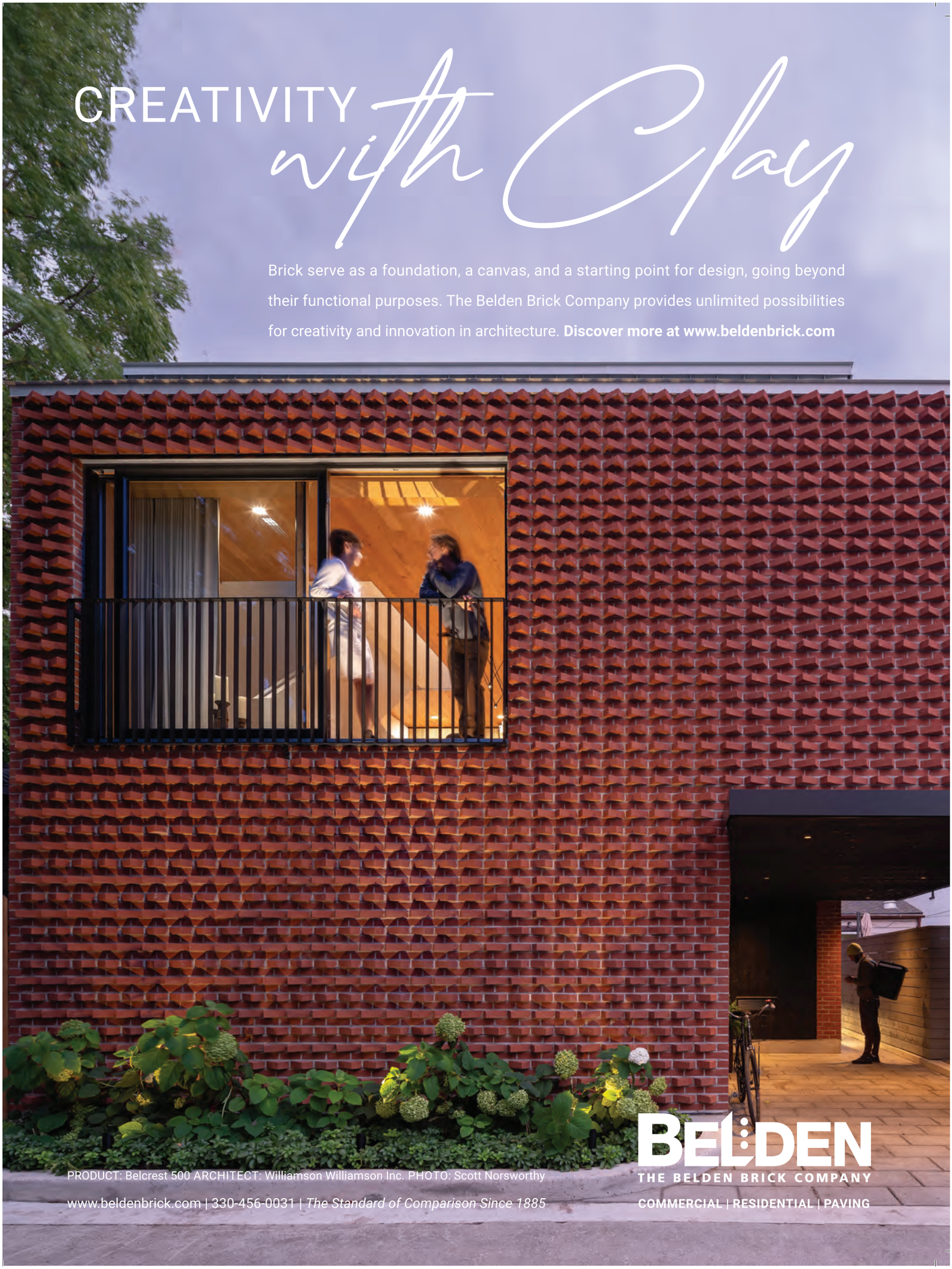
Updates in Clause D.10 of CSA A23.3-24

The 2024 edition to CSA A23.3 introduces several important changes in Clause D.10, broadening its scope and enhancing provisions on quality assurance. The title has been revised to include post-installed reinforcing bars, expanding the range of applications that require inspection.

A significant update is the introduction of D.10.2 Quality Assurance, which provides a structured framework for special inspection requirements. Table D.3 (on page 325 of CSA A23.3-24), a new addition, outlines the minimum levels of special inspection for anchors (adhesive and mechanical) and post-installed reinforcing bars.

The definitions of "special inspection" and its different levels (periodic and continuous) have been added to Clause D.2. Adhesive anchors and post-installed reinforcing bars now have more defined inspection requirements, including clear stipulations for continuous special inspection in cases where they are installed horizontally or upwardly inclined to resist sustained tensile loads. Continuous special inspection and proof loading are also mandated when the manufacturer's data specifies these conditions.

Another key update includes detailed requirements for proof load testing, as outlined in D.10.2.2.2. This clause specifies the threshold loads to be applied during proof load testing for adhesive anchors and post-installed reinforcing bars. The load, held for at least 10 seconds, must be the lesser of two values: 67 per cent of the published characteristic bond stress capacity (for uncracked concrete, with adjustments for edge distance and concrete strength) or 80 per cent of the minimum specified steel yield strength of the anchor.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Post-installed rebar installation using an adhesive anchor.

Baseplate installation using anchors.

The 2024 edition also introduces ASTM E3121/E3121M-17 as the standard for conducting confined proof load tests in situ. A footnote in this section emphasizes that proof load testing is not a substitute for special inspection. These updates clarify the process for performing proof loads, ensuring that anchors are installed properly and consistently.

Additionally, the 2024 edition introduces the defined term "third-party inspector," emphasizing their role as independent inspectors of anchors. According to the newly added definition of "third-party inspector" in Clause D.2, these inspectors must be hired by the owner or the owner's representative. They must furnish detailed reports to the licensed design professional and building officials.

Comparison between 2019 and 2024 editions

The 2024 edition of Clause D.10 presents a more comprehensive and clearly defined set of requirements compared to its 2019 counterpart. Expanding the clause to include post-installed reinforcing bars demonstrates a broader recognition of applications requiring quality assurance. Further, introducing specific standards, such as those based on ASTM E3121/E3121M-17, reflects the further clarity required in conducting anchor testing.

While the 2019 edition focused heavily on the proper installation and inspection of adhesive anchors, the 2024 edition provides more details on third-party inspection, continuous special inspection, and the required load level for proof loads.

It is important to note that CSA A23.3-19 is enforceable under the 2020 *NBC*, setting the regulatory requirements for anchor installation and inspection. However, CSA A23.3-24 is expected to be referenced in the upcoming *NBC* 2025 and can be considered state-of-the-art in anchor installation and quality assurance requirements.

Conclusion

Whether installing mechanical anchors, adhesive anchors, or post-installed reinforcing bars, the 2024 updates clarify the need for thorough inspections and third-party verification to ensure that installations meet safety and performance standards.

Ali Ahrabi graduated with a bachelor's degree in civil engineering in 2006 and obtained his master of science in civil engineering from Concordia University in 2012. He has been a professional engineer in the province of Quebec (Ing.) since 2013 and has experience in various engineering settings. Ahrabi currently serves as the manager of codes and approvals at Hilti Canada. He contributes to developing fastening-related provisions within the National Building Code (NBC) and Canadian Standards Association (CSA) with heavy emphasis on anchors, including contributions to CSA technical committees A23.3, S6, S16, and S304. He can be reached at Ali.ahrabi@hilti.com.

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The Three Ps of Prefabricated EIFS

Preparation, Production, Placement

By Alex Ardelean, Elizabeth V. Rodenkirch, and Peter M. Babaian

PHOTOS COURTESY SIMPSON GUMPERTZ & HEGER (SGH)

In its most general form, exterior insulation and finish systems (EIFS) consist of expanded polystyrene (EPS) insulation board coated with a reinforced polymer-modified cementitious base coat and a polymer-based finish coat. Other less commonly used types of rigid insulation boards in EIFS include extruded polystyrene (XPS), polyisocyanurate (polyiso), and mineral wool. Drainage EIFS, unlike barrier EIFS, includes a dedicated water-resistive air barrier (WRAB) and drainage plane.

EIFS is lightweight and uses relatively few materials. It is typically adhered in place, eliminating cladding anchorage penetrations through the WRAB. EIFS-clad wall panels can be fully prefabricated, from the structural backup to the finish coat. EIFS adhesives, typically polymer-modified cementitious materials, are compatible with many WRAB chemistries. EIFS provides continuous insulation (c.i.) on the exterior of the building, which increases the effective thermal resistance of the assembly. EIFS can be readily sourced from several manufacturers, many of which have already performed numerous assembly tests, including fire performance, bond strength, impact resistance, and drainage efficiency, among others, and obtained assembly approvals in major jurisdictions. EIFS is also a cost-competitive cladding in many markets. As a result, EIFS has become an attractive cladding option for use in prefabricated wall panels, in which EIFS materials are shop-applied to sheathing and metal stud backup wall construction under controlled conditions. Prefabricated panels may also include fenestration and other elements of the exterior wall.

Despite its potential benefits, EIFS has limitations that must be considered when used as a prefabricated wall panel cladding. By having continuous and often flammable insulation on the exterior side of the wall, EIFS is susceptible to melting, ignition, and fire propagation. It is prone to impact damage during transportation, installation, and service, particularly at panel edges. Where field repairs or modifications are necessary, it can be challenging to repair the prefabricated panel in the field in a way that restores WRAB continuity and provides a matching finish texture. While fully adhered systems offer certain advantages, their water management performance depends entirely on the quality of the installation, specifically, the quality of the drainage plane, which is rarely verified. As with any prefabricated panel cladding, joints and transitions to adjacent enclosure systems require significant forethought and planning while considering constructability in the shop and the field.

One can realize the schedule and quality benefits of prefabricated EIFS-clad wall panel construction by following the three "Ps": ensuring appropriate scope and detailed design during "Preparation," implementing robust quality assurance and control processes during "Production," and executing effectively during "Placement."

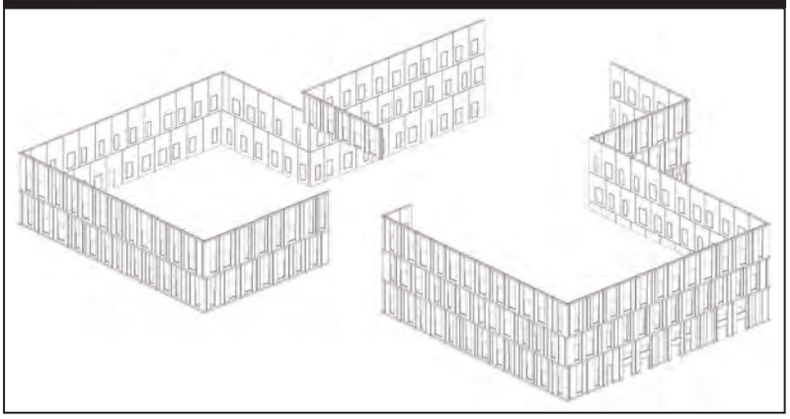
Preparation

Scope

A portion of most prefabricated cladding construction projects will inevitably require field installation. Successful prefabricated cladding projects delineate the prefabricated and field-installed portions of the work. Prefabricated construction is usually conducted through delegated design and affects many project stakeholders, so it is important to have all parties aligned as early as possible during design. Engaging a contractor, a delegated designer, and a fabricator early in design to provide insights on scope, construction sequencing, and cost can help streamline the design and construction process.

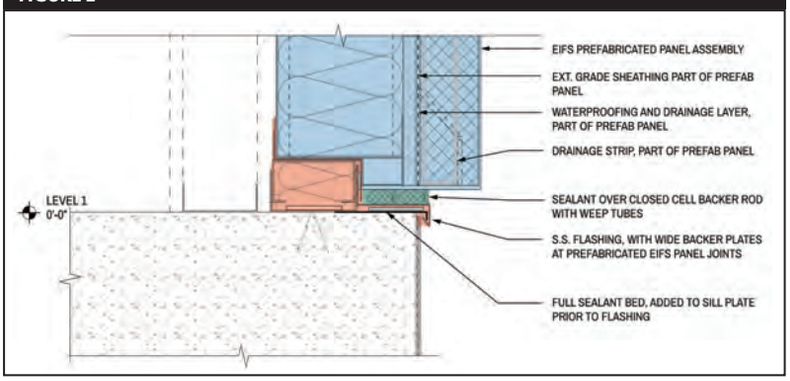
Establishing the prefabricated construction scope depends on the project's type, location, and frequency of unique details. Ideally, prefabricated cladding is installed continuously and uninterruptedly by a single subcontractor with minimal mobilizations. Unique details require coordination and sequencing with other trades, interrupting the prefabricated cladding installation and increasing the risk of mistakes and re-work. These details can negate the schedule and/or cost savings that prefabrication can offer. The contractor should create a register of all unique details associated with the prefabricated construction scope. The register can be used to identify the trades and sequencing required with each detail and to keep track of changes in detail over time due to changes in design. Three-dimensional models help identify unique prefabricated construction details to populate the detail register (Figure 1). Models need not be extensively developed for this purpose; this work can be done early in the prefabrication subcontractor's design and shop drawing process.

FIGURE 1



A 3D model of the prefabricated exterior insulation and finish systems (EIFS) clad wall panel scope of work for a commercial project with a modest Level of Development (LOD300 or less). A 3D model helps identify unique prefabricated construction details and potential conflicts even at this stage.

FIGURE 2



Detail of prefabricated exterior insulation and finish systems (EIFS)-clad wall panel at grade using a shiplap style joint. The blue area represents the prefabricated portion of the joint. The red and green areas represent the field-installed portions of the joint before and after the panel is installed, respectively.

In tandem with determining the prefabricated scope of work, the project team, in consultation with the delegated designer, fabricator, and manufacturer, must determine which parts of the wall panels are prefabricated and installed in the field. Wall panels may be fabricated as full assemblies (from the structural backup out to and including the EIFS cladding and fenestrations), bare assemblies (only the structural backup and sheathing), and other partial assembly configurations in between. Generally, full assemblies yield the most schedule savings and take advantage of prefabrication's enhanced quality assurance and control. Cost, sequencing, and transportation logistics are reasons a project team may elect to fabricate a partial assembly.

Joint type

One of the most critical and challenging aspects of designing prefabricated wall panels, EIFS-clad or otherwise, is providing continuity of the four barriers, thermal, water, air, and vapour, across joints between prefabricated panels and transitions to adjacent enclosure systems.

Joints between prefabricated panels and adjacent enclosure systems that must be given special consideration include:

- Panels to below-grade waterproofing.
- Panels to grade (landscaping and hardscaping).
- Panels to exterior doors.
- Panels to field-installed exterior wall systems.
- Panels to through-wall movement joints (*e.g.* expansion joints).
- Panels to roofing systems:
- Where the roofing transition is at the base of the panel in a rising wall condition.
- Where the roofing transition is at the top of the panel in a parapet condition.

There are two common joint types in prefabricated construction: butt joints and shiplap joints. Butt joints provide a basic level of weather protection and require less work than shiplap joints during prefabrication and installation but rely heavily on the proper application of joint sealants.

Shiplap joints offer redundancy in weather protection due to their inherent layering that sheds water, but they require additional work in fabrication and field installation. During fabrication, panels are fitted with one-half of the shiplap joint, and in the field, adjoining construction, such as concrete curbs at grade, is prepared with the receiving end of the shiplap joint (Figure 2). Preparing the receiving end of the shiplap joint in the field generally involves one subcontractor installing the joint framing and another flashing the framing to integrate it with the adjacent enclosure. This additional work may require multiple subcontractors to make several passes at a detail during construction, depending on how it is bought out and coordinated by the contractor.

The receiving end of the shiplap joint (the red area in Figure 2) is usually constructed by multiple subcontractors, as described here. The blue and green areas in Figure 2 may be in the scope of two other separate contractors. If that is the case, there is relatively more coordination and sequencing required by the contractor of the four various subcontractors that could be engaged to

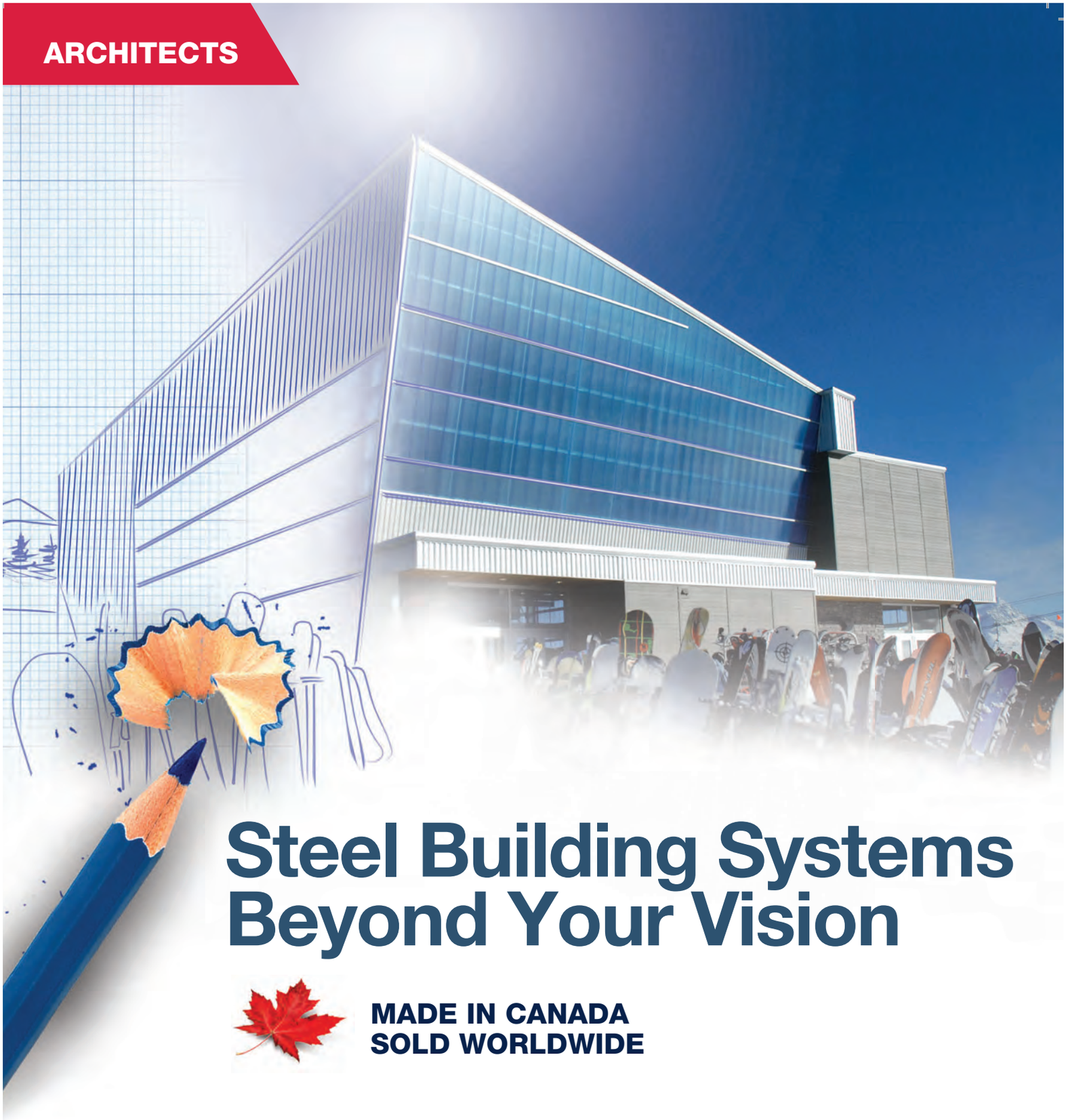


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FIGURE 3

The vertical gap between wall panels is irregular at the four-way panel intersection due to excessive material buildup at adjacent panel corners.

construct this detail (cold-formed framing and insulation, metal flashing and sealant bed, prefabricated panel, and joint sealant).

To reduce the coordination required, the contractor may "buy out" or group some of the scope under fewer separate subcontractors, *e.g.* one subcontractor does all the cold-formed framing, insulation, sealant bed, and metal flashing instead of two separate subcontractors. This requires forethought by the contractor and project team in the bidding process.

Wall panels with shiplap joints may also require installation in a particular order on the building. The prefabricated wall panel shiplap joint installation sequence should be established early and fully coordinated to schedule other subcontractors' work accordingly.

Joints can occur more frequently in prefabricated EIFS-clad wall panel construction than in traditional field-installed EIFS construction. Trucking limitations and crane capacities often limit prefabricated panel joint frequency/spacing. Panels must fit on the trucks transporting them to the site and in the trucks' lanes. They must also be safely handled during installation and hoisted onto the building.

Joint width

The type and magnitude of the anticipated wall panel movement and joint sealant limitations govern wall panel joint widths. Code-based structural requirements determine the minimum joint width; simply put, panels must not collide during service-level movement. Service-level movement includes building movements (inter-story drift, floor deflections, and thermal stresses) and panel movements (thermal stresses). Owners can further enhance the structural performance of the wall panels beyond the code-based requirements by using prescriptive criteria based on the owner's tolerance to risk.

Seismic areas, high-importance structures, and especially the combination thereof generally have the most demanding structural requirements. These requirements are typically met by designing larger joints between wall panels, specifying joint sealants with high movement capabilities, locating panel collision points away from higher-risk areas of the building (*i.e.* emergency egress and assembly areas), or providing crumple zones in the cladding (areas where it is deemed acceptable for the cladding to crush during movement that exceeds service levels).

On the other end of the spectrum, the maximum joint width is determined by the movement capacity of the sealant material. Gun-grade silicone sealant can be installed into a maximum joint width of 102 mm (4 in.).[1] Some manufacturers suggest even stricter joint width limits when using silicone sealants and even stricter still with other sealant chemistries. As the sealant joint width increases, the sealant's movement capability suffers, and it becomes increasingly difficult to install the sealant reliably, especially on vertical surfaces.

Designers and specifiers must also carefully consider panel fabrication and installation tolerances because they directly affect panel joint widths. Irregular joint widths can occur due to various fabrication-related issues, including a buildup of material at panel edges and imprecise panel size and squareness (Figure 3). Installation issues generally include wall panels not being installed plumb; sometimes, this can be caused by superstructure installation tolerances that cannot be accounted for by the panel anchorage.

Designers should consider the appropriate combination of tolerances and anticipated movements when determining panel joint widths. As a result, typical joint widths between prefabricated wall panels and adjacent wall

systems can differ from those between prefabricated wall panels.

Repairs

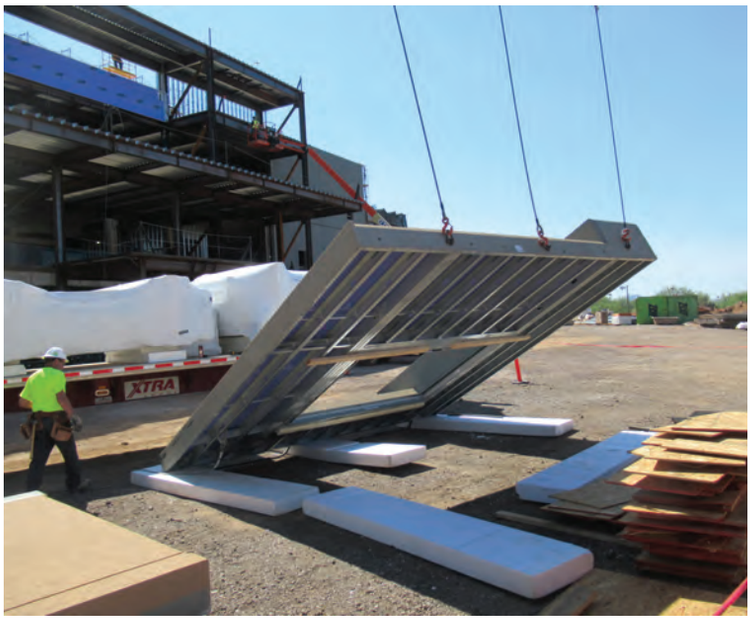
Often overlooked, planning for wall panel repairs early in the design process is critical. In the authors' experience with prefabricated EIFS-clad wall panel construction, some panels will likely require field repairs or replacement after installation due to construction damage, field modifications, or other unforeseen conditions. Mockups of field repairs should occur before the construction phase to establish standards of what constitutes repairable damage or modification (versus damage or modification that requires full panel replacement) and specify field repair and finish requirements that result in a product acceptable to the owner. It is helpful to include these requirements and procedures in an operation and maintenance manual for the owner/operator at project turnover to address in-service damage.

FIGURE 4

Damage along the inner edge of the exterior insulation and finish systems (EIFS)-clad wall panel from strapping.

Due to wear and age, panel components will require repair or replacement. Joint sealants and fenestrations, among other components, are expected to deteriorate and should have an

FIGURE 5



Designated lifting points are provided along the top track of the wall panel's cold-formed metal framing structure.

associated inspection, maintenance, and replacement schedule. Give special consideration to means of access for inspection and maintenance activities. It is also important to consider how noise, vibration, and particulate emissions will be controlled during field repairs and replacement work.

Production

Quality assurance/quality control (QA/QC)

Prefabricated construction lends itself well to robust QA/QC programs. The project team should establish and vet QA/QC processes well before fabrication and ensure they align with the owner's project requirements and contract documents.

QA documentation should include information regarding product batch numbers, material manufacture and expiration dates, material installation dates, environmental conditions at installation, as well as installation procedures.

QC documentation should include testing procedures, environmental conditions during testing, testing apparatus information and calibration dates, testing results, and a description of where the testing occurred on the panels and panels tested. It should also include the sizes of the panels, including squareness at corners and flatness along edges, as well as cladding thickness measurements.

Prefabrication allows the panels to be staged so all panel components and surfaces are easily accessible for inspection and testing. Prefabricated panels are typically constructed on horizontal surfaces, eliminating the need to work at heights and preventing hazards such as falls.

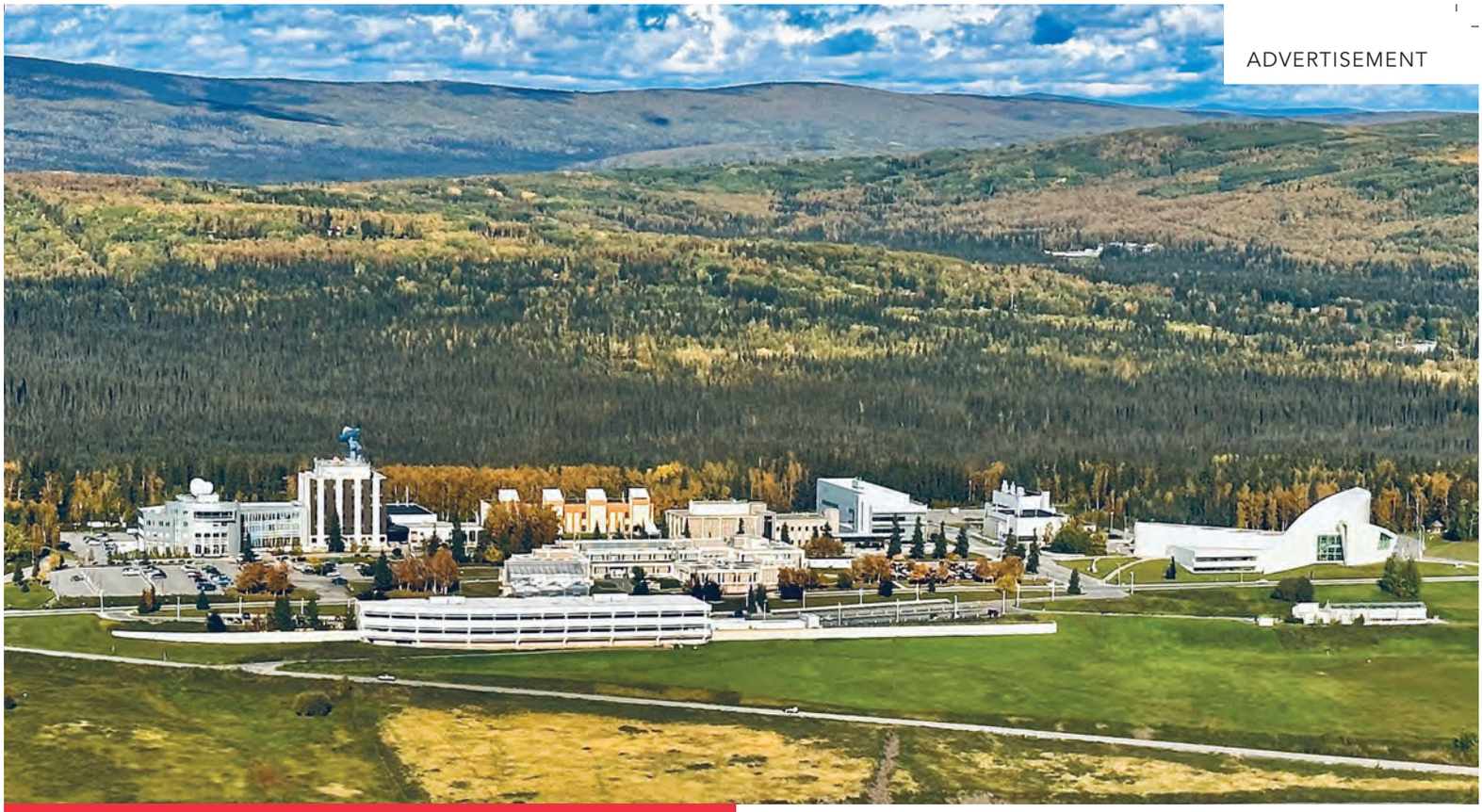
Prefabricated EIFS panel testing should include wet and dry film thickness testing for fluid-applied WRAB, adhesion testing for fluid-applied and self-adhered WRAB, transition materials, and flashings to the panel sheathing, adhesion testing for the EIFS insulation to membranes and flashings, and adhesion testing for joint sealants at all sealant-substrate combinations planned for use in the field; this includes sealant-substrate combinations to adjacent construction by others. Special inspections of the WRAB must be performed where required by the applicable building code. Metal flashings and diverter tracks can be examined to ensure a positive and outward slope. Under controlled conditions in a factory setting, metal flashings and diverter tracks should be continuous and installed without joints; however, if they occur, they should be examined to ensure they are watertight.

Logistics

The fabricator must consider logistics, including transportation and packaging when determining which panel components are installed at the shop. Some panel components are at higher risk of damage during handling and transportation. EIFS is especially sensitive to transportation-related damage from lifting and strapping, particularly at panel edges (Figure 4, page 17).

Designated lifting locations (Figure 5) and touch points for strapping panels to the trucks should be marked on each panel and reinforced in the panel packaging, on the panels themselves, or both. Panels with protruding elements, such as EIFS features, penetration sleeves, or other appurtenances, should also be packaged and oriented thoughtfully during transport to avoid damage.

Modern glazing systems offer solutions that can be fully shop-installed (Figure 6, page 20), fully field-installed, or partially installed in both. An example of a partially pre-installed window is a flanged, receiver-set system. The flanged receiver framing is fully set in the rough opening, treated at joints and corners, and integrated with the panel WRAB in the shop. The glazing and glazing seals are packaged separately and set



University of Alaksa Fairbanks, Theater Renovation

Since the construction of the Salisbury Theatre in 1968 at the University of Alaska Fairbanks, many fire protection codes have changed. An inspection at the school by the local fire marshal showed the building was no longer in compliance.

The renovation addressed deficiencies in fire rated assemblies throughout the project footprint. Fire suppression coverage was improved, fire alarms were tied into theater lighting controls and detection for fire door activation was expanded. Adjustments were also made to smoke vents sizing, and improvements to maintainability were also made.

The project took about four months to complete, and most of the renovation took place while students were on campus.

"The BILCO vents were selected during bid time as these were the only vents that provided the highly desired motorized operation within the project timeline."

– Rachel Bruesch, *GHEMM Company*

Project Snapshot

- The University completed the first phase of a multi-year renovation to complete code corrections.
- The project covered nearly 11,560 square feet in the 450-seat theater and cost $962,000.

BILCO Products

- The project included nine motorized double leaf smoke vents manufactured by BILCO. The vents include two inches of polyisocyanurate insulation in the cover and curb to help reduce energy costs.
- Smoke vents assist firefighters by removing smoke, heat and gases from a burning building.

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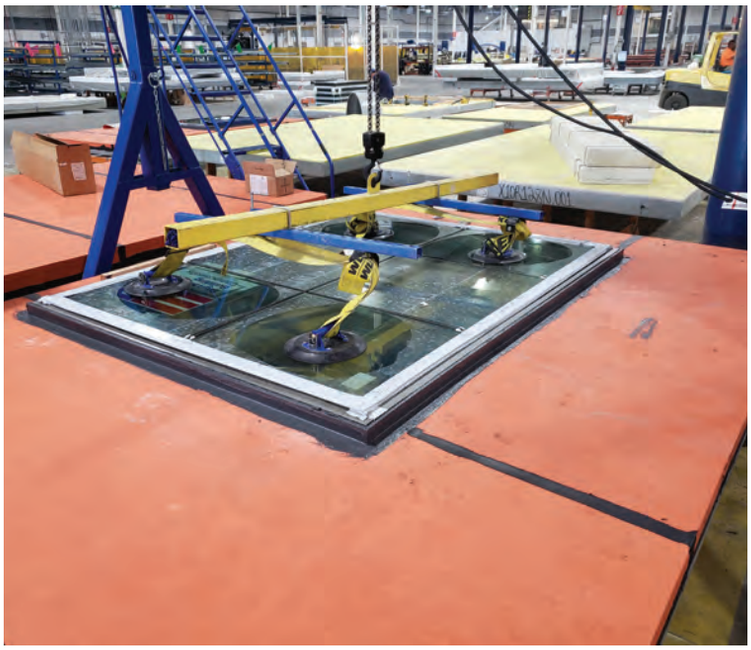
FIGURE 6



The punched window system is installed onto pre-treated wood bucks in the panel opening. This process is done entirely in the shop. The panel is shipped to the site with the cladding and fenestrations pre-installed.

FIGURE 7

Mockup that includes several typical panel details and esthetic components for review.

into the pre-installed receivers in the field. This is an effective way to provide a robust window installation that takes advantage of the enhanced QC in the shop when integrating the window flanges and minimizes risk during transportation by leaving the glazing out of the prefabrication portion of the work. As part of selecting the panel scope during "Preparation," the project team should consider the logistics to handle transport panels with pre-installed windows safely.

When incorporating air-sealed systems like insulated glass units (IGUs) into prefabricated wall panels, consider whether pressure equalizing is necessary. Over a sustained period, a large change in elevation between where the IGUs are sealed and the project site causes stresses in the IGU seals due to the difference in air pressure inside and outside of the IGU. This can lead to early deterioration of the IGU. The pressure difference can also lead to the bowing of the glass panes and visual distortions.

Mockups

Construct mockups that maximize the project-specific prefabricated wall panel conditions. Mockups are beneficial for the design team to evaluate the esthetics of the construction and for the fabricator to train installers in specific installation roles and techniques, especially for unique details. Approved mockups should be protected and used to establish the technical and esthetic requirements of the completed work. Consider assigning shop staff exclusively to install shop-fabricated components of the mockups and, conversely, field staff exclusively to install field-installed components of the mockups as a training and teaching exercise; this applies to visual and performance mockups if there are multiple.

Mockups should contain all typical conditions, including the field of wall finishes and textures, fenestrations, appurtenances, typical penetrations, and panel joints, including back-wrapped and edge-wrapped panel edges (Figure 7). The authors also recommend including field repairs in the mockup.

It can be advantageous to construct and display mockups off-site, but consider that the esthetic evaluation of some components is better suited for the project site, with site-specific exposures, adjacent cladding systems, nearby buildings, landscaping, and hardscaping, among other conditions.

Performance mockup testing can be very valuable when specified appropriately. Certain tests can occur on individual panels at the shop,


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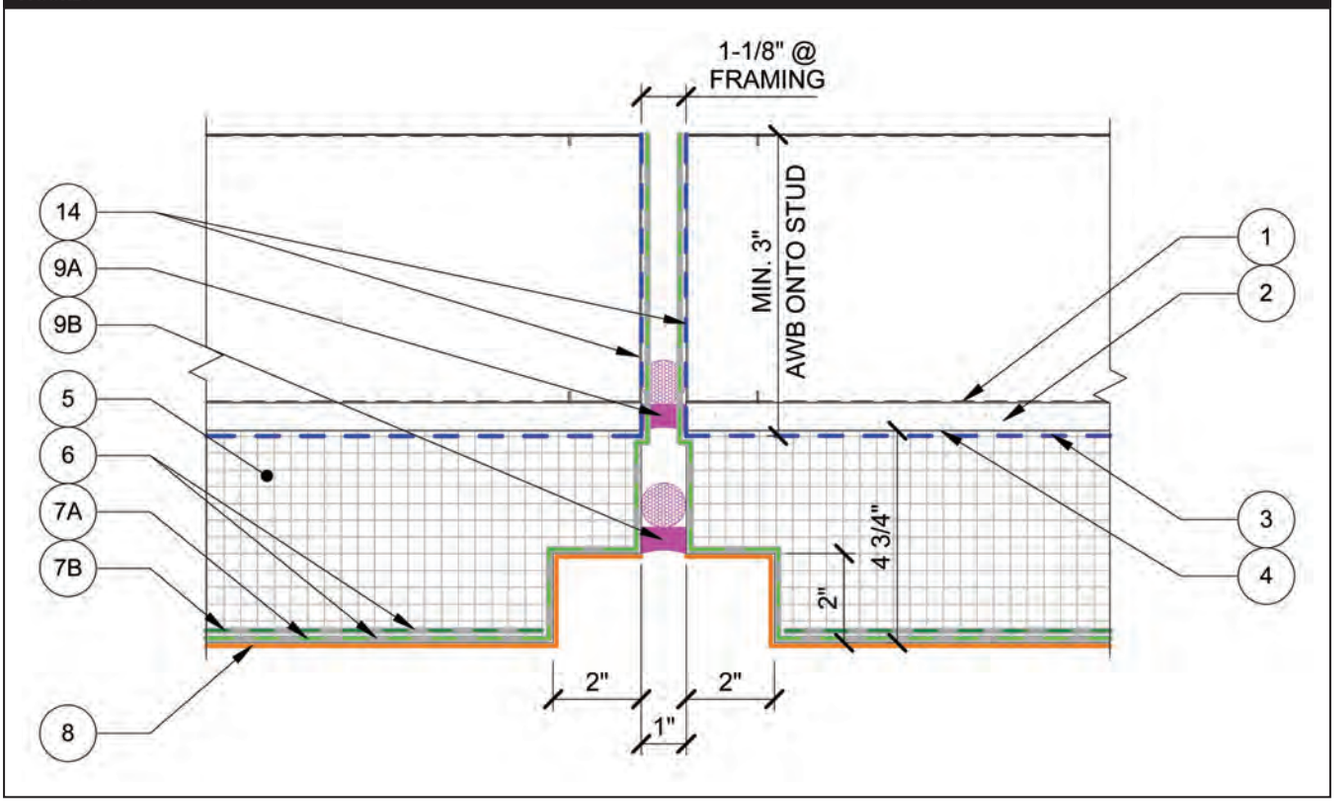
FIGURE 8



Typical vertical joint between exterior insulation and finish systems (EIFS) clad wall panels, with a centred reveal and dimensions providing clearance to install and inspect both primary and secondary joint sealants.

FIGURE 9

In-progress repair of a field-installed penetration. The size of the repair area is considerably larger than the size of the penetration itself.

and others must occur on the building as part of the permanent construction. Testing that can be performed at the shop is generally more cost-effective for the testing itself and subsequent diagnostic and repair efforts. Testing should be performed as early as possible to identify and repair systemic issues before the issues are replicated.

Placement

Joints

Joint sealant performance depends on the quality of the sealant installation. To ensure consistent results, limit joint sealant installers where possible. Consider employing a project-specific certification system for the installers using the visual and performance mockups (*i.e.* installers that produce joints acceptable to the design team on the mockups are approved to install joint sealants on site for the project).

Designers can also significantly impact joint sealant installation success in providing clearance for joint sealant installation. Consider the space provided between prefabricated panels that include the cladding and finishes; the thicker the cladding, the less access installers have to the joint where they need to install sealant, and the more unreliable the joint sealant installation is. Inspection and maintenance of the joint sealants would be equally as unreliable. Since prefabricated panels are generally installed 12.7 to 25 mm (0.5 to 1 in.) apart, the authors suggest the cladding thickness is limited to 76 mm (3 in.) immediately adjacent to panel joints. Stepping

the cladding thickness down at panel joints using reveals or chamfered edges can provide reasonable clearance to panel joints while maintaining thicker cladding in the field of the panel (Figure 8, page 22).

Field penetrations

Penetration locations should be coordinated so that flashed openings can be prefabricated; however, some field penetrations during construction are inevitable. The repair area for field penetrations is always larger than the penetration area itself. It includes the penetration, the gap between the penetration and the panel, and the space required to adequately integrate the penetration flashing to the panel WRAB (Figure 9, page 22). Subcontractors can perform field repairs without delay for design approval using the pre-approved repair criteria and procedures established during "Preparation."

The contractor should engage subcontractors that require exterior wall penetrations, such as mechanical, electrical, plumbing, security, and signage, as early as possible during subcontractor procurement to finalize penetration requirements and locations. These requirements should be monitored as part of the detail register and closely coordinated between the contractor, relevant subcontractors, the delegated panel designer, and the panel fabricator.

Conclusion

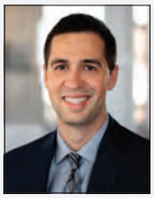
With appropriate coordination during "preparation," "production," and "placement," one can successfully use EIFS in their next prefabricated wall panel project:

- Preparation: Determine an appropriate prefabrication scope of work; be proactive in design detailing by considering construction and maintenance constraints.
- Production: Make the most of shop fabrication by implementing the right quality assurance and control processes; full advantage of mockups; package wall panels thoughtfully and strategically, not only for installation but for all steps in between, including careful handling and transportation.
- Placement: Execute within the project tolerances; manage field issues using established project procedures.

The items presented here are based on the authors' experience, are focused on prefabricated EIFS-clad wall panels, and are by no means an exhaustive study of the benefits and challenges of prefabricated construction. They convey the importance of appropriately planning for prefabricated EIFS-clad wall panel use on buildings and provide a road map to identify potential issues affecting the project.

Notes

[1] Refer to Dow Building Science's Dow Construction Sealants Technical Manual (Americas); The Dow Chemical Company, Midland, MI, 2024.



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Roof Replacements

By Michael Hensen

PHOTOS BY CHRIS DAWSON

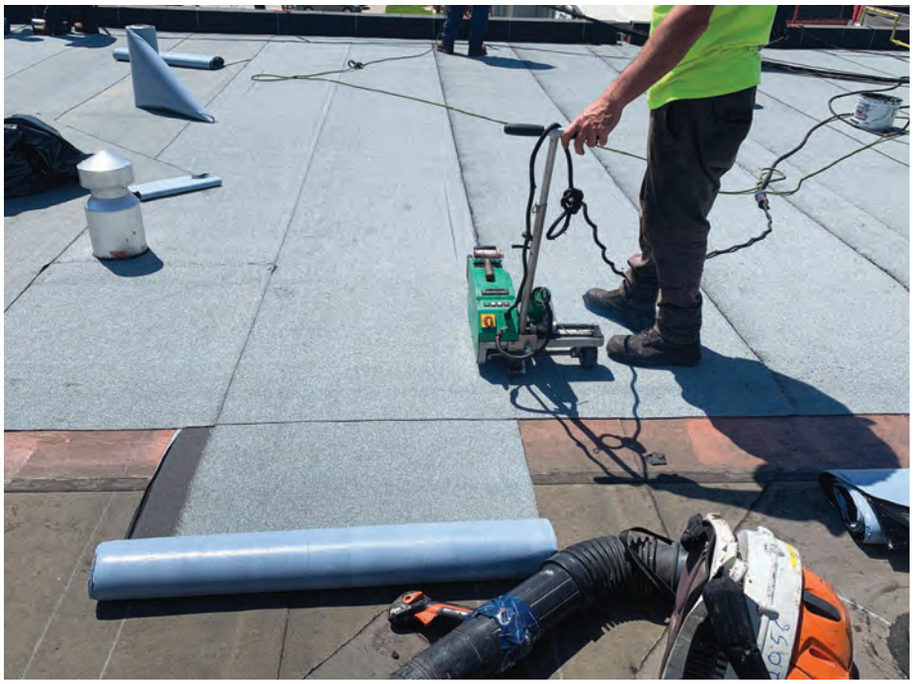
As many building restoration consultants and contractors will attest, roof replacement design and construction have evolved substantially in the last 20 years. Contractors or roof designers can no longer rely on habitually selecting favourite roof solutions, and one roof system or assembly can no longer be considered suitable for all buildings. There is no longer one material manufacturer that can supply all the solutions. New roof designs have increased demands from building owners to provide roofs that offer complete sustainable solutions and not just waterproof protection.

Evolution of roof construction practices

Roof construction up to the mid-1980s was traditionally a predictable practice. Roofing crews would leave their place of business to work on projects where the only installation instruction required was how much roof work was expected to be completed that day. There was no question of what type of roof system was to be installed, no concern about how much or what kind of insulation was required, and no consideration of how to ensure continuity of the air barrier, vapour retarder tie-ins, adhesive rates, mechanical fastening patterns, material lists, and shop drawings. The practice

worked well, with roofing contractors installing watertight solutions that would typically provide long-lasting, effective results. Roofing technicians were craftsmen often trained through apprenticeship and generational-type training. They were successful in their trade primarily due to the predictable and repetitive nature of working with built-up roof assemblies with few variables and the sole objective of keeping precipitation out. There was very little thought of using roof assemblies for anything but waterproofing.

Modern construction practices and increased building code demands have transformed substantially since the 1980s, primarily to provide a better environmental separation between the interior and exterior climates, improve interior comfort, and reduce energy costs. There are no longer umbrella-type covers on buildings; instead, impermeable solutions that attempt to control or eliminate thermal, moisture, and airflow migration. Early attempts with what seemed to be revolutionary materials, including new membranes and insulations designed to provide improved roof performance, brought mixed results. As an industry, roofers and designers alike



Cold process modified bitumen membrane built-up roof installation.

Thermo-fused modified bitumen membrane built-up roof replacement.

Completed modified bitumen membrane built-up roof replacement at a municipal fire hall.

experienced roof system failures, often due to a lack of understanding regarding how to install the roof with the new products and not knowing how to apply building science principles to roofing design and installations.

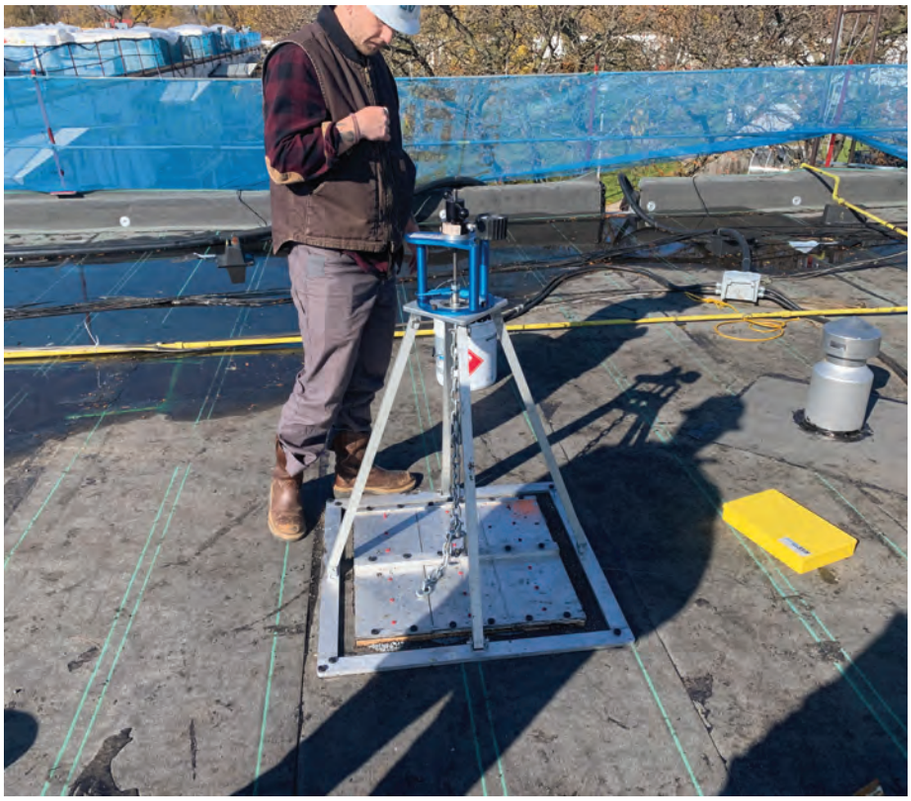
Challenges with early insulated roof systems

The early versions of insulated roof systems brought new issues, including vapour drive and thermal bridging, which resulted in uncontrolled deterioration and premature failures of roofs to provide the desired improved protection. The moisture-related deterioration included reduction in anticipated thermal resistance values, mystery leaks, emulsifying adhesives, corrosion of metals, and mould issues. Membrane technology also changed as new membrane types were developed to improve performance and (hopefully) provide reliability in an insulated roof system. Roof membrane system types included single- and multi-ply

Cold process roof replacement on an industrial building. Replacing a wind-damaged roof.

assemblies incorporated in built-up (membrane over insulation) or inverted (membrane under insulation) formats. The unfortunate part of the new membrane and insulation trend was that the roofing industry was unsure about how to install and detail the new roof assemblies. Roofing contractors would rely on their workers with their traditional built-up roof training, habits, and equipment to install new single- or multi-ply systems by trial and error. As time progressed, some membrane manufacturers worked with contractors and industry organizations to determine best practice methodology and attain reasonable confidence in providing long-term solutions.

There is no denying that historically, owner roof replacement decisions were swayed by selecting roof membrane systems from persuasive material sales staff offering extraordinary solutions and services, the attempt for the economy by choosing an inexpensive solution and price, or even chasing what appears to be a too-good-to-be-true warranty. The bottom line is that no sales pitch can guarantee success, the best price does not ensure a successful solution, and no warranty



Bonded up-lift test to confirm roof application and performance to resist code-prescribed wind loading.

has ever improved the performance of a roof assembly. A well-designed and installed roof system deserves warranties issued by the contractor and membrane manufacturer as a gesture of quality, not as a guarantee that a roof system is a suitable solution to waterproofing and energy management or that the roof system meets the building code.

Modern designs account for the difficulty of installing roofs (the art) to meet raised expectations of building performance (the science) and, of course, all within governing building code requirements. The practicality of installing membrane and insulation continuity can sometimes resemble a game of "Twister" that requires coordination between the roofing contractor and representatives of other trades, including mechanical, electrical, plumbing, fenestration, cladding, and insulation contractors, during new build construction projects. Roofing contractors are often hired as general contractors, subcontracting other trades within a roof replacement project contract as the only way to complete a roof replacement without risking water infiltration.

Prior to designing a roof replacement, it is important to understand how the existing building has been constructed, including the type of structure and roof deck, existing mechanical and plumbing systems, parapet and adjacent wall construction, rooftop equipment, and penetrations. It is counterproductive to design a roof incompatible with existing materials or building detailing as the connections could fail, allowing for air and moisture infiltration (resulting in energy loss and leaks). Removing wall parapet claddings to ensure continuous barrier membrane and insulation transitions, lifting mechanical units to complete curb detailing, and ensuring sufficient drainage capacity and strategy are all steps that must be intentionally and carefully detailed and performed to ensure successful roof replacement.

Relying on the roofing contractor's technician to bridge the transition between adjacent wall and parapet detailing, building materials, and roof accessories without professional direction opens the possibility that the technician's installation does not meet building code and building science best practices. This is not a slight towards a roofing technician's ability but is an emphasis on the co-operative approach between the roofing contractor and design professional that roof replacement work should follow. In turn, the designer must be mindful of the difficulties, limitations, and obstacles of roof construction and the notion that what may look good on paper may not be possible or practical to install. Weather conditions, safety, accessibility, and material limitations could all turn what looked like a good design idea into an impossible or costly endeavour.

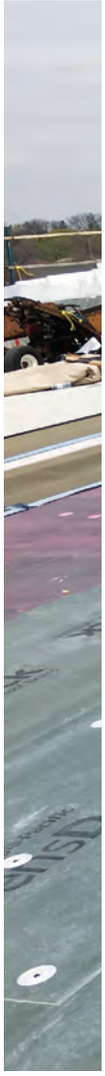
Modern roofing practices and responsibilities

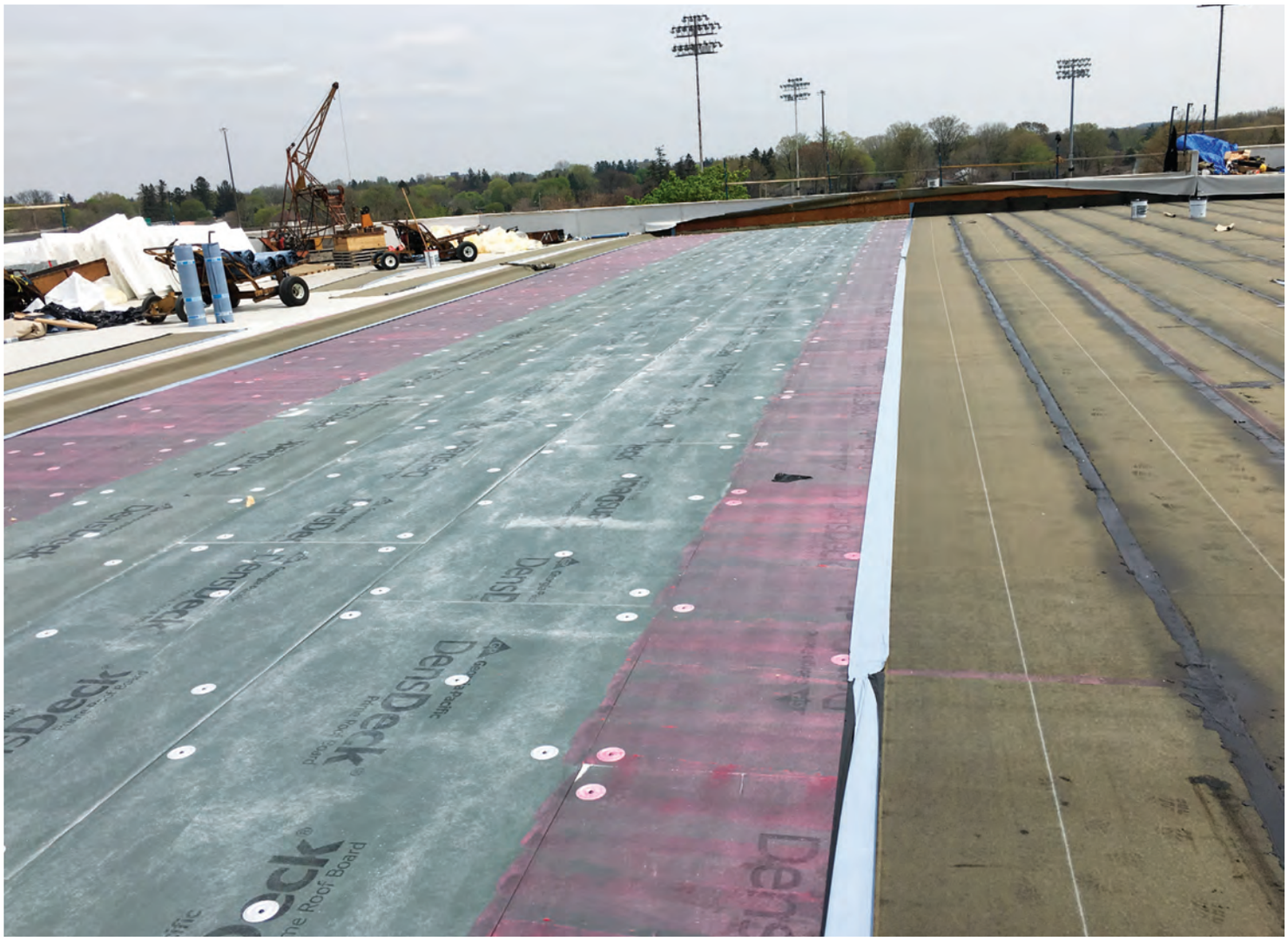
Today's roofing contractors have, for the most part, adapted to the modern ways of roofing. They send their crews to project sites with material safety data sheets, life safety and rescue equipment and plans, engineered shop drawings for scaffolding and hoarding, building and road closure permits, and tapered insulation drawings. Today's roofing technicians are trained to install multiple types of roof membranes and incorporate them with insulation in various configurations of roof systems. How they incorporate their ability to work with roofing materials into the entire building envelope is where accurate contract documentation and site review of work in progress by a design professional lead to successful roof installations.

With the trend toward municipalities requiring building permits for roof replacement work in many jurisdictions, designers are reminded of their obligation to implement current building codes and municipal by-law requirements in the design. Considerations for structural loading, wind uplift resistance, roof drainage, insulation values, and building occupancy have always been required; however, they are not often accurately analyzed or calculated.

Balancing design and practicality

In recent years, increased demands have also come from how roofs are used. Some view roofs as prime opportunities





Mechanical fastener securement of metal deck overlay board, primer application, and self-adhered vapour barrier installation at a municipal arena.

to implement landscaping, additional building mechanical and operational equipment, stormwater retention systems, and energy production equipment (solar and wind). Some of these have become requirements and are included in municipal by-laws to "green" the roof surfaces and reduce the negative aspects of large, low-slope roof spaces. How roof design and construction are to cope with these new demands on roof space is a challenge from a roofing design and engineering perspective. Providing viable solutions to roofing contractors to overcome these innovations to the roof space must be the objective of the roof design professional.

Looking at the future of roof construction practice, designers must be able to continuously identify solutions to meet the demands of balancing roof installation with sound building science and engineering principles. With the most recent demands by governments of decarbonization, CO2 reductions, energy consumption reductions, and sustainable land and building stewardship, owners are more motivated than ever to engage professionals with proven experience in balancing the arts and sciences of roof design and installations.

Michael Hensen is a professional engineer and a registered roof consultant (IIBEC). His technical duties for Rimkus include engineering and leadership of the building enclosure consulting practice.

Modern Rainscreens

The Ultimate Upgrade for Retrofits

By David Hohenstern

PHOTO BY DEAN RIGGOTT/ COURTESY STO CORP

A renovation can be triggered by various factors, including water intrusion issues, delaminating exterior finishes, cold walls, and new fire and energy performance regulations. Often, a range of issues happening with increasing frequency indicate it is time for an update. Regardless of what prompts a renovation, it is an opportunity to build back better, enhance the building's performance, and ensure good building science is followed.

Give that building a jacket

Exterior wall assemblies are like multitasking performance jackets—they withstand longer lifespans while protecting against changing weather conditions, safeguarding interior environments, and promoting occupant health and well-being.

However, sometimes, a building needs a new jacket, and retrofitting for an esthetic refresh also provides an opportunity to enhance the wall assembly's performance. Key components

Installing a complete rainscreen over the existing corduroy-finished concrete facade showcases the system's ability to modernize and insulate without requiring extensive structural changes.

PHOTOS COURTESY STO CORP

The addition of a rainscreen system then protects inner walls from weather exposure and prevents water and moisture from penetrating the building envelope. The benefits of a modern rainscreen system include:

- Energy efficiency—Rainscreen cladding improves thermal performance, reducing heating and air conditioning costs by up to 40 per cent annually.
- Insulation—When done correctly, an added insulation layer enhances thermal efficiency and limits condensation. If done and installed incorrectly, condensation can occur in areas where it should not, leading to moisture buildup and potential damage. There must not be a gap or pockets between the sheathing and exterior insulation.

required include proper continuous air sealing and water-resistive barriers, thermal insulation, and a rainscreen ventilation cavity. These elements collectively form a high-performance exterior wall assembly.

The perfect jacket: A modern rainscreen system

When retrofitting an old building with a new jacket, air sealing is critical. A continuous air seal is best achieved with careful air barrier detailing, particularly at openings and corners, and transitions to the roof and foundation.

This complete rainscreen system combines sleep, an opaque glass panel with durable thermal insulation and an advanced air and water-resistive barrier (AWRB).

The sub-construction system supports the glass panels, providing a thermally efficient, back-ventilated facade that enhances the museum's energy performance.

PHOTOS BY DEAN RIGGOTT/COURTESY STO CORP

- Protection—The cladding protects the building's exterior from wind, rain, and snow, extending its lifespan and reducing maintenance costs.
- Structural stability—The air cavity in the rainscreen mitigates temperature variations, reducing structural movements and the risk of cracks.
- Acoustic insulation—An additional insulation layer helps block outside noise, which is beneficial in urban environments.
- Design freedom—With rainscreen systems, an exoskeletal system will support a variety of architectural finishes, such as glass, stone, wood, and brick, as well as finishes that use a variety of colours, textures, and shapes.

Components of a modern rainscreen system

A rainscreen is made up of several key structural components that work together to manage airflow and moisture effectively; these components usually include:

- Outer cladding material—The cladding is a building's first line of defence. Depending on the climate zone and local environment, choose the cladding type (*e.g.* fibre cement, metal panel, HPL, specialized render systems, etc.) based on the hazards present and the level of protection needed in a building.
- Air gap or cavity—A ventilated space behind the cladding that helps manage moisture. A modern rainscreen system incorporates a larger air gap of 20 mm (0.78 in.) or more, compared to traditional rainscreens used in wall assemblies, to promote drainage and drying.
- Air and water-resistive barrier (AWRB)—This is attached directly to the building's frame

and is the last defence against air leakage and moisture intrusion. The AWRB may be permeable or impermeable to water vapour, depending on the climate. A good rule of thumb is that a permeable AWRB should be used in humid climates to allow moisture to escape from the building envelope. An impermeable barrier is better suited to keep moisture out in dry, cold climates. Always factor in local climate conditions when selecting an AWRB.

- Exterior insulation (a building's overcoat)—This outer insulation layer can handle moisture and drying without degrading or reducing RSI value. Depending on the building owner's thermal requirements and targets, this layer may be supplemented. Also, energy codes require different degrees of exterior wall thermal performance.
- Venting profiles—Several ventilation options, including venting flashings, perforated profiles, and weep holes, help direct moisture away from wall surfaces and keep out pests.

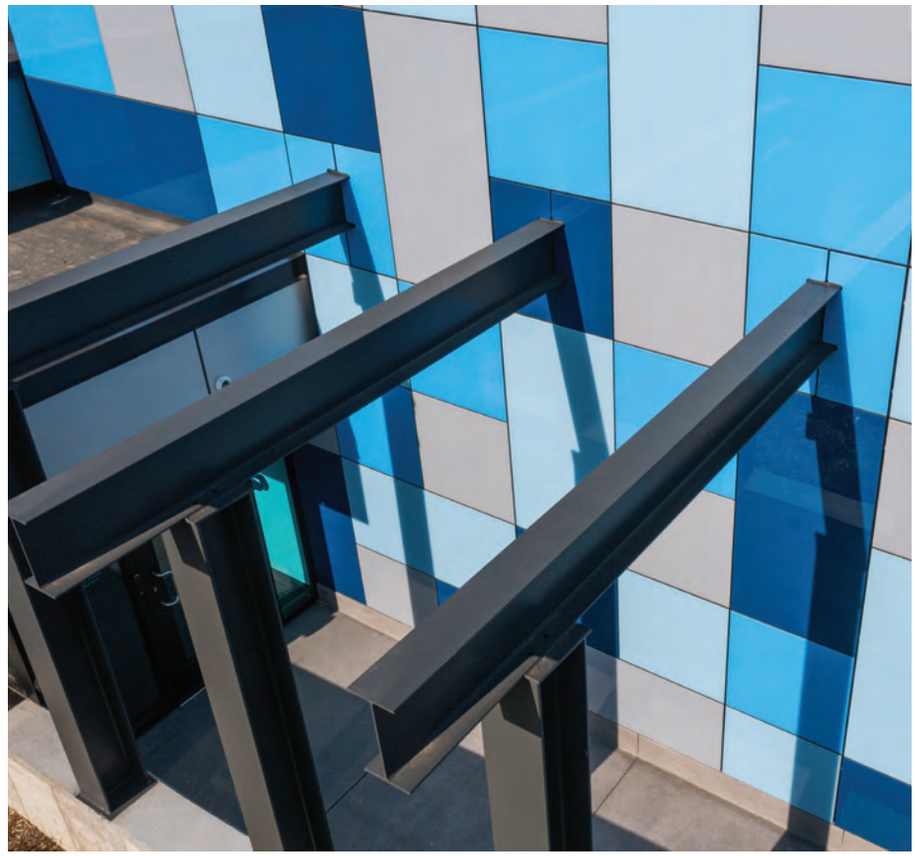
Straighten walls without moving them

When most buildings are built, neither the building owner, architect, or applicator worries about straight exterior walls. Their primary focus is on everything from the cladding inward. Therefore, the exterior surface inherited from the initial construction is the wall to work within a retrofit. There is a chance it may be straight, but more than likely, it will not be. One of the benefits of a rainscreen system is adding an exoskeleton to the exterior wall, allowing teams to adjust and square up the wall before adding the new cladding.

The cost of a rainscreen system

The budget is always the elephant in the room. A rainscreen system may increase upfront costs, but such investments will benefit building occupants and owners. Among these benefits are:

- Long-term performance—All the components of a rainscreen system work together to ensure optimal performance over the lifespan of a building.
- Durability—These components are also built to last, with an eye toward future adaptability, reducing maintenance and repair costs over the structure's lifetime.
- Enhanced comfort—A sophisticated exterior that delivers thermal efficiency protects the building and the rainscreen from severe weather, making for a more comfortable interior. Improved thermal efficiency offers a payback on the investment via reduced energy costs and consumption, which also benefits the environment.



Custom-shaped glass panels envelop the I-beam at the entrance, demonstrating the system's versatility in conforming to complex architectural features.

There is always a delicate balance between performance and cost; however, it is important to consider the savings year-over-year that will be realized with a rainscreen system. The right one can completely transform an old building, making it more thermally efficient and esthetically pleasing, allowing it to compete with newer construction and design.

According to the National Renewable Energy Laboratory (NREL), deep energy retrofits achieve at least a 50 per cent reduction in energy usage and usually include building envelope upgrades, building electrification, and energy conservation measures that enhance building performance and occupant value.

Is the manufacturer important?

In the 20 years since rainscreen systems were introduced, the number of manufacturers offering rainscreen products has grown.

This mirrored facade is achieved using glass panels with a mirrored finish, offering esthetic appeal and enhanced thermal performance.
PHOTO COURTESY STO CORP

Several excellent solutions are on the market today, but choosing the right manufacturer is essential. When considering which product to invest in, consider these questions:

- Does the manufacturer offer a complete system? The fewer manufacturers to deal with, the easier the project will be. One manufacturer that provides everything from the sheathing out is ideal because one warranty will cover the entire system. The last thing specifiers want is to stitch together a piecemeal system and hope the subcontractors have successfully installed them to create a properly sealed envelope.
- Has the system undergone extensive testing? Specifiers will want a widely used, trusted, and, most importantly, thoroughly tested system. One of the most recognized tests for rainscreen systems is the AAMA 509. It was the first North American testing standard for drained and back-ventilated (DBV) rainscreen cladding. It was developed to benchmark DBV rainscreen performance and provides specific ventilation and moisture control criteria. When selecting, ensure the chosen rainscreen meets this standard.
- Does the manufacturer offer on-the-ground service support? The right company will have project service managers who deeply understand building science and can help dial in the needed systems. They will provide thermal modelling to balance the thermal target with the structural loading and work with the general contractor (GC) to ensure the project progresses smoothly.
- Is there a need for a manufacturer with expertise in a particular area? This depends on the specifics of a project. If there is significant

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water intrusion into the interior of the building, for example, consider a company with expertise in subconstruction. Or, if dealing with extreme weather conditions is taking a toll on the cladding, consider a company with more cladding expertise. However, all larger manufacturers have the knowledge and experience to solve virtually any problem. They have seen it all and have the expertise to design a rainscreen system that meets specific needs and ensures moisture does not end up in areas where it can do more harm than good.

- Does the manufacturer offer a wide variety of design options? This is very important. Here is why. If the rainscreen system has limited design options, the architect will be restricted in meeting the esthetic goals of the project. So, by default, the system's functionality is being prioritized over the appearance of the building. Also, buildings need to be refreshed every so often. By installing a system with endless design possibilities today, updating only the cladding later instead of replacing the entire rainscreen to achieve a specific look is possible. The right product and manufacturer will offer various design options so the client can achieve the look and feel they desire now and in the future.
- Is the system eco-friendly? This is becoming more important with every passing year. Specifiers need a system built for the future that offers lightweight solutions, recycled materials, and sustainable components. Building codes are getting stricter, and the expectation is that building owners will do their part to be mindful of the environment in new construction and retrofits.

The importance of project managers

At the risk of overstating this, project managers are vital with a massive undertaking such as a rainscreen installation. Pertaining to project management from a manufacturer and not a third-party vendor, an experienced project manager will facilitate the project from start to finish—from proper cost estimations at the beginning of the project to determine how many parts and pieces are needed for the system, and along the way, co-ordinating with engineers and other experts in these systems to provide specifications to ensure solutions are tailored to the project needs. They will ensure the project meets energy requirements, address structural requirements, and help stay on schedule and budget.

Beware of the Frankenstein system

As noted above, the fewer manufacturers to deal with, the better. Ideally, one manufacturer will offer all the components required for a rainscreen system. After all, a rainscreen system is a system, not a kit of parts. A Frankenstein system is the total opposite of that. Often, one manufacturer is hired for the esthetics, another for the air moisture barrier, and another for sub-construction. A Frankenstein system is a setup for failure in the long term. If something goes wrong, all the manufacturers will point at each other while the specifier is stuck in the middle. Keep it simple. Find one manufacturer that can provide a total solution from the sheathing out; that way, there is no question about who needs to help address whatever issues arise.

Seeing is believing

When sourced and installed properly, a rainscreen system functions beautifully and saves money from day one. Consider proposing a modern, proven rainscreen system for the next retrofit project. The right one can transform even the oldest building into a modern, thermally efficient work of art—giving the architect freedom to achieve virtually any look.

David Hohenstern is a research and development manager for rainscreen at Sto Corp. He joined Sto in May 2022. He is a voting member of the C17 committee at ASTM, which owns and manages the fibre cement standards used in the Americas; E05, the committee on Fire Standards; and E06, the committee on Performance of Buildings. Hohenstern is a two-time graduate of the Georgia Institute of Technology.

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Saint-Gobain Canada Unveils CarbonLow™, New Gypsum Wallboard line with up to 60% less embodied Carbon

Saint-Gobain, through its building products subsidiary CertainTeed Canada Inc., recently unveiled CarbonLow™, a new line of low-carbon gypsum wallboard to be sold in Canada starting in 2025. With up to 60% less embodied carbon cradle-to-gate than traditional alternatives, CarbonLow™ will allow contractors and homeowners to utilize the quality CertainTeed solutions they trust, while reducing their environmental footprint.

The range of solutions includes Easi-Lite®, Type X, M2Tech®, and GlasRoc® family of products, representing a complete portfolio of high-performance interior and exterior gypsum solutions. The lower embodied carbon wallboard will help architects to achieve building decarbonization in their designs, while requiring no change to standard installation procedures for contractors. To learn more, visit www.carbonlowgypsum.ca.

Announced at CertainTeed Canada's annual Architecture Symposium, the CarbonLow™ product line is set to be manufactured at CertainTeed's facility near Montreal, Quebec, which will soon be North America's first zero-carbon (scopes 1 and 2) gypsum wallboard facility. CertainTeed is working to update equipment and transition the plant away from fossil fuels to being powered completely by hydroelectricity.

"CarbonLow™ represents not only a new, high quality product line for our customers but a fulfillment of our promise to provide solutions for the decarbonization of the built environment," said Julie Bonamy, CEO of Saint-Gobain Canada. "Over the past three years, we have made significant investments to grow our business here in Canada, and this announcement is further evidence of our commitment to offering sustainable solutions for our stakeholders throughout the country."

Saint-Gobain continues its commitment to growth and sustainable construction solutions in Canada:

- In June, Saint-Gobain completed the acquisition of The Bailey Group of Companies, a leading manufacturer of metal framing building solutions in Canada. This acquisition is the company's third in Canada in three years after Kaycan (2022) and Building Products of Canada (2023), tripling its presence in the country. This enables Saint-Gobain to offer a full portfolio of building solutions in Canada.
- In May, Saint-Gobain announced a partnership with TimberHP, offering high-performance wood fiber insulation in North America as the exclusive distribution partner in Canada.
- In February, the company completed the installation of a heat recovery system at its gypsum wallboard plant outside Vancouver, reducing scope 1 carbon emissions by up to 15%.
- In 2023, Saint-Gobain celebrated over 1 million tonnes of gypsum wallboard recycled and returned to production at its facility in Vancouver. The company operates similar recycling operations in Alberta, Manitoba, Ontario and Quebec.

certainteed SAINT-GOBAIN

www.carbonlowgypsum.ca

Experience the difference

Brick has been the choice for architects and builders to create structures that embody style and strength. The Belden Brick Company, the largest family-owned brick manufacturer in North America, has been a trusted source for brick manufacturing with a solid reputation built on years of customer satisfaction. With a foundation over a century in the making, an exciting new era of modernization begins as we pioneer innovation in brickmaking for architects, builders, and homeowners. Offering a unique blend of manufacturing capabilities and bringing modern technology together with our heritage of quality craftsmanship and a gritty, do-it-right attitude.

Commitment to Quality

We've built a reputation for providing the highest-quality building products that contribute to our customers' and communities' structural integrity and outstanding appearance. Understanding that quality raw materials are essential to extraordinary brickmaking, our plants are in a region rich with natural resources. Our mining operations deliver an abundant supply of the finest shales and clays to each manufacturing plant. The superior quality of these raw materials leads to the structural integrity and outstanding appearance of our line of world-class architectural brick.

Continuous Improvement

Expanding brick's creative versatility while maintaining the material's traditional strengths is something we pride ourselves on. We continue to meet the changing needs of the construction market by manufacturing over 20 different face brick and clay paver sizes, more than 500 colors, 13 different textures, and endless designs of special shapes. Over a decade ago at The Belden Brick Company, we began reinvesting in our facilities and keeping up with information technology advances that make our people and machinery more productive. We are maneuvering through and responding to new contexts while maintaining our core values and traditions.

Customer Satisfaction

Our tradition of excellence starts "from the ground up." From selecting the brick to delivering the product, The Belden Brick Company strives to be The Standard of Comparison in the brick industry and maintain a strong commitment towards exceptional quality and premium service. While many other manufacturers will specialize in a limited number of products, we work more on an individual job-by-job basis and establish our production under each job's requirements. We've got an experienced team of production specialists and a team that helps us offer building solutions that many other manufacturers don't provide.

While we have an unparalleled choice of colors, sizes, textures, and shapes at the ready, we also design and produce brick customized to your needs – taking concepts from your mind to the mason's hands.

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The Standard of Comparison Since 1885

Bring your Vision to Life with Morin

Established in the early 1960's in Bristol, Connecticut, Morin Corp is an industry leader in architectural metal wall panels and roof systems. Morin specializes in roll-forming high-quality panels is and is dedicated to transforming architectural possibilities with innovative, sustainable solutions. With an extensive portfolio of products, including aluminum panels, heavy-gauge metals, perforated screens, trimless ends designs, soffit, corners, and customized solutions.

Morin's Matrix, Integrity, and Pulse series provide architects with exceptional design flexibility. Each series is engineered to seamlessly integrate, allowing for sophisticated combinations of profiles that deliver unique and striking architectural facades. The bold box rib configurations of the Matrix Series, the refined elegance of the Integrity Series, and the dynamic contours of the Pulse Series can be mixed and matched to achieve a harmonious balance of form and function. This design versatility ensures that each project reflects a distinct architectural identity while upholding superior quality and performance. Building on this commitment to design versatility, the Matrix line will be expanded next year with the introduction of new multi-depth profiles, offering even greater opportunities for creation of dynamic facade designs. This evolution ensures that Morin continues to set the standard for innovation, quality, and architectural expression.

As part of Kingspan's Group, Morin aligns with the Planet Passionate initiative, a 10-year sustainability strategy tackling climate change, circularity, and biodiversity protection. Our products contribute to environmentally conscious construction, with certifications such as LEED and Environmental Product Declarations (EPDs) ensuring transparency and credibility.

Morin's legacy of innovation, combined with our commitment to customer collaboration and sustainability, makes us the partner of choice for transformative architectural projects. From concept to completion, trust Morin to bring your ideas to life while building a better future for people and the planet.

Morin®
By Kingspan

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BILCO: Your Trusted Commercial Access Partner

The BILCO Company has provided commercial access products and commercial building safety products since 1926. During these years it has built a reputation as the industry leader among architects, engineers, specifiers and the construction trades for dependability and for products that are unequaled in design and workmanship.

BILCO's roof hatches provide safe and convenient access to roof areas through interior ladders, ship stairs or service stairs. Special sizes are available to facilitate installation or removal of large equipment from buildings, with all products featuring engineered lift assistance for effortless one-hand operation.

BILCO automatic smoke vents play a crucial role in property protection and firefighting efforts by removing smoke, heat and gases from burning buildings. Ideally suited for large expanses of unobstructed space such as factories, warehouses, auditoriums and retail facilities, these smoke vents are available in a number of standard UL-listed sizes.

For reliable access to equipment stored underground or between building floors, BILCO floor access doors come in a range of models, including drainage doors, non-drainage doors, those designed for flooring materials, doors for interior building applications, fire-rated floor doors and specialized options for various applications.

Committed to safety, BILCO offers products designed to provide fall protection for roof hatch and floor access door openings.

In order to better serve its customers, BILCO has added manufacturing facilities and strategic distribution throughout the world, along with establishing an extensive international network of factory-trained representatives. These representatives, combined with BILCO's highly skilled and dedicated personnel, ensure a level of customer service that is unequaled in the industry. As the leader in design innovation, many of BILCO's products incorporate features for which numerous U.S. and international patents have been issued. Years of engineering experience, coupled with manufacturing facilities utilizing the most modern equipment available, allows BILCO to design and fabricate access products for virtually every application.

The BILCO Company is committed to producing access products that are unequaled in quality, design and workmanship. BILCO products are fabricated to consistently high-quality standards to ensure complete customer satisfaction. As part of its commitment, BILCO has implemented a LEAN manufacturing quality and continuous improvement system that has achieved ISO 9001 certification.

800.366.6530
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One Vision … One Family … One Philosophy

W. R. MEADOWS delivers one of the broadest lines of premium-grade construction products available to architects, engineers, contractors, and building owners to meet a multitude of construction application needs. Our extensive line of high performance, premium-grade construction products has been developed for use in, on, around, and under concrete.

W. R. MEADOWS was founded in 1926 in Elgin, Illinois, USA, by W.R. "Bob" Meadows and Edna Meadows. In the 95+ years since the founding, the company has grown to include nine branch locations and three warehouses throughout North America. This includes two Canadian locations – Milton, Ontario, and Sherwood Park, Alberta. These two facilities allow W. R. MEADOWS to service the entire Canadian market efficiently and effectively. To this day, W. R. MEADOWS remains family-owned, with several family members involved with the day-to-day operations of the company.

In 1926, W. R. MEADOWS pioneered expansion joint technology, with our ASPHALT EXPANSION JOINT. Since then, the company has moved into several facets of the construction industry, and we are known not only for our breadth of line, but also our high quality and performance.

Our extensive line includes a wide variety of hot and cold-applied joint sealants; each designed to meet specific construction needs. Our concrete products line has a magnitude of products dedicated to every aspect of concrete construction. From curing and sealing compounds, set accelerators, evaporation retardants and bonding agents to form release agents, expansion joints, concrete sealers and an extensive line of restoration mortars, W. R. MEADOWS has all of your concrete construction, restoration and protection needs covered. Our progressive thermal and moisture protection line has a vast selection of products to help protect your construction projects and your properties from water and moisture damage. The product line includes drainage systems, bituminous dampproofing, waterproofing accessories, waterproofing membranes, vapor barriers, vapor retarders, air/vapor barriers and much more. Finally, DECK-O-SEAL®, a division of W. R. MEADOWS, provides a complete line of pool deck construction products, including high performance polysulfide joint sealants and an easy-to-install drainage system.

From highway construction and restoration, to waterproofing, vaporproofing, air barrier products and more, we've been satisfying the needs of the public and private sectors of the building construction industry since 1926. We are very proud of our 95+ years of dedication to providing quality construction materials to the concrete construction community. All of our quality W. R. MEADOWS products are available worldwide through an authorized distributor network.

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Behlen Industries LP
Steel Building Manufacturers

Behlen is Canada's largest manufacturer of steel building systems and the first to manufacture frameless steel buildings in the country. Today, we sell pre-fabricated rigid frame and frameless steel structures including industrial, commercial, recreational, and institutional facilities across Canada and worldwide. Each steel building package is manufactured to the architects needs, all in one place, then shipped directly to construction sites around the world.

At Behlen we are proud of our work, and happy to highlight some of our greatest projects including, but certainly not limited to:

- The PEAK 2 PEAK gondola terminals which are an iconic landmark used in the 2010 Olympic Games in British Columbia.
- The roof for the Gangneung International Ice Rink in South Korea, which housed curling for the 2018 Winter Olympics.
- One of the largest clear-span aircraft hangers in Canada, in Hamilton Ontario.

Behlen offers optional insulated metal panels (IMP's) for projects, which offer a superior thermal performance for both walls and roofs, and are available in a variety of sizes and configurations. One of the greatest advantages of IMP's, is that they're quick and easy to install which allows your building to be completely enclosed in a fraction of the time it would take to install conventional wall assemblies. We encourage you to connect with us to learn more about the advantages of using our IMP's in your project.

Behlen maintains a healthy partnership with Authorized Builders as part of a network that spans across North America and parts of Europe. These builders are supported through a network of qualified sales managers, in-house engineers, and technical customer service representatives that are located in regional offices throughout North America.

Our team is committed to the markets we serve, providing quality products and services, offering cost-effective and innovative building solutions which are on-time and on-budget.

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Innovation in high compression structural foam

Insulthane HC is a groundbreaking structural polyurethane spray foam that offers a faster, more cost-effective, and environmentally friendly solution for projects requiring high compression materials. It is the first and only spray foam with a compressive strength reaching up to 100 PSI, capable of supporting the heaviest loads.

Designed with a holistic approach to sustainability, Insulthane HC not only excels in performance but also minimizes environmental impact. Unlike other high-compression options, it eliminates the use of synthetic blowing agents, opting instead for water as its blowing agent, resulting in a global warming potential (GWP) of just 1.

Spray foam technology, particularly Insulthane HC, is ideal for applications where structural strength is essential. When used under slabs, it enhances strength through adhesion to both the substrate below and the concrete above, creating a continuous, seamless barrier without joints, cracks, or gaps. This makes it perfect for use on substrates like gravel, soil, and sand that are prone to shifting.

Insulthane HC is versatile, suitable for a wide range of applications, including:

- Under slab construction
- Highways
- Airport runways
- Ice hockey rinks
- Parking decks
- Bridge abutments
- Utility lines
- Material retainment
- Geotechnical applications
- Plaza decks

Its value proposition is compelling, offering a custom fit for each project with minimal waste. The rapid and straightforward installation process saves time on job sites, reducing labour costs and maximizing efficiency. The cost-effectiveness of Insulthane HC makes it a preferred choice among builders and designers.

Additionally, its strong sustainability credentials further distinguish it from traditional boards. The on-site manufacturing and reduced need for shipping raw materials significantly lower the carbon footprint. Insulthane HC's ability to expand nearly 50 times its liquid volume allows for efficient shipping of large quantities. Its application in a monolithic system eliminates the need for extra materials to maintain water, vapour, air, and thermal control layers, which are crucial for sustainable enclosure designs.

Plus the product uses recycled bottle content as a key raw material diverting thousands of plastic bottles away from the landfill and oceans.

Available in various compressive strengths from 40 PSI to 100 PSI, Insulthane HC is suitable for a range of commercial and industrial applications requiring high compressive strength. This innovative product represents a significant advancement, combining high performance with sustainability for modern construction projects.

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Signature - Roofing by design

Discover the BP Signature, an extraordinary asphalt shingle designed to redefine modern roof design. Signature combines exceptional wind resistance, a stunning selection of captivating colours created by the BP Chroma Colour Lab and groundbreaking colour-combination designs.

Signature shingles give today's homeowner the ability to express their unique style and personality on their roof without compromising the superior technical performance they expect.

Signature sets a new standard in wind resistance, providing comprehensive protection for structures. It comprises two critical elements:

Advanced Sealant Technology: Powered by Weather-Tite® Plus Technology, Signature's improved sealant technology offers long-term resistance to wind damage. This cutting-edge sealant formulation and design ensures optimum adhesion and protection against the elements, securing your investment for years to come. Featuring both the Hurricane Band® and Weather-Tite® Band, Signature comes with a 220 km/h standard wind warranty.

Improved Nail-Pull-Through Protection: Signature's high nail pull-through resistance ensures superior strength and stability during construction, establishing a solid foundation that safeguards against immediate wind-related damage until the sealant technology is heat activated.

Signature offers a stunning selection of captivating colours meticulously crafted in by the BP Chroma Colour Lab. Drawing inspiration from emerging design trends, the BP Chroma Colour Lab has curated a collection of contemporary takes on traditional shingle colours that seamlessly harmonize with both modern and traditional architectural styles. From elegant neutrals to striking statement hues, each Signature colour adds depth, character, and sophistication to home exteriors.

Signature introduces groundbreaking Profusio colour combinations, a revolutionary feature that empowers homeowners to express their individual style and creativity. Created by the BP Chroma Colour Lab, Profusio harmoniously combines multiple Signature Colours on the same roof. This innovative concept allows homeowners to achieve captivating and unique Colour blends, setting their homes apart with a one-of-a-kind look that reflects their personal aesthetic.

BP Signature shingles are the perfect balance of performance, lifestyle and individuality to satisfy every homeowner's need.

Signature ROOFING BY DESIGN

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Russell Snow, FCSC, CSP, CTR

"The Times They are A-Changin" *–Bob Dylan*

A few months ago, I attended a presentation on multi-generational workforces. I thought the information provided was very enlightening, and I wanted to share some highlights to help all of us, whether young or old, in our daily activities.

My first thought was whether to present this in person, share via email or text, or even post it on social media. I really want every generation to read this and hopefully take a step back and think about your colleagues. Whether you are a Baby Boomer, a Generation X-er (the best generation according to the author), a Millennial, or a Gen Z-er, managing and working with a multigenerational workforce requires understanding, flexibility, and effective communication. Each generation has different expectations, work styles, and values. As a result, it is important to understand this diversity to create a work environment that is both productive and cooperative.

Everyone needs to feel valued regardless of age or experience. Each generation has its strengths and values, all to be shared. Older employees can share their experiences, while younger employees can offer insight into new technologies or trends. This must be embraced in the workforce as anyone can mentor another regardless of age. Remember the famous quote from Ralph Waldo Emerson: "Knowledge is when you learn something new every day." I have learned a few things from others much younger than me, and hopefully, as I get older, I will remember them. Collaboration on projects allows different perspectives to be introduced and considered, enabling creative problem-solving. Can a round peg fit into a square hole? It all depends on what ultimate result needs to be achieved.

Attention should be given to communication styles, flexibility in work arrangements (including work/life balance), leadership and training, and recognition and rewards. For example, one generation may prefer to work more remotely than others, one may want a monetary bonus more than public recognition, and one may prefer informal leadership with feedback instead of a more structured approach.

Being able to take all of these into account is certainly going to be how we can all work together, providing a workforce that works harmoniously and productively. It will contribute to helping manage conflict by understanding the generational differences and, thus, allowing for open communication, along with leveraging the talents and skills of each individual. Everyone will prosper and ultimately contribute to ensure the organization's success.

I am CSC.

"The Times They are A-Changin" (Les choses changent) *– Bob Dylan*

Il y a quelques mois, j'ai assisté à une présentation sur les effectifs multigénérationnels. Je trouve que les renseignements fournis sont très instructifs et j'aimerais vous faire part de quelques faits saillants qui nous aideront tous, jeunes ou vieux, dans nos activités quotidiennes.

Ma première pensée était de présenter cela en personne, de partager par courriel ou par texto, ou même de le poster sur les médias sociaux. Je veux vraiment que chaque génération lise ceci et, espérons-le, prenne du recul et pense à ses collègues. Que vous soyez un baby-boomer, un Gen-X (les meilleurs selon l'auteur), une génération Y ou une génération Z, gérer et travailler avec une main-d'œuvre multigénérationnelle exige de la compréhension, de la flexibilité et une communication efficace. Chaque génération a des attentes, des styles de travail et des valeurs différents. Il est donc important de comprendre cette diversité pour créer un environnement de travail à la fois productif et coopératif.

Chacun doit se sentir valorisé, peu importe son âge ou son expérience. Chaque génération a ses forces et ses valeurs, toutes à partager. Les employés plus âgés peuvent partager leurs expériences, tandis que les employés plus jeunes peuvent offrir un aperçu des nouvelles technologies ou tendances. Il faut que cela soit bien compris par le personnel, car n'importe qui peut être mentor d'un autre, peu importe son âge. Rappelez-vous la célèbre citation de Ralph Waldo Emerson : « Le savoir, c'est quand on apprend quelque chose de nouveau chaque jour. » J'ai appris des choses d'autres beaucoup plus jeunes que moi, et j'espère, comme je deviens plus âgé, que je m'en souviendrai. La collaboration sur des projets permet d'introduire et de considérer différentes perspectives, permettant ainsi de résoudre les problèmes de façon créative. Une cheville ronde peut-elle s'insérer dans un trou carré? Tout dépend du résultat final à atteindre.

Il faut porter attention aux styles de communication, à la souplesse des modalités de travail (y compris l'équilibre entre le travail et la vie personnelle), au leadership et à la formation, ainsi qu'à la reconnaissance et aux récompenses. Par exemple, une génération peut préférer travailler à distance, une autre peut préférer un bonus monétaire plutôt que la reconnaissance publique et une autre peut préférer le leadership informel avec rétroaction plutôt qu'une approche plus structurée.

Pouvoir prendre tout cela en compte sera certainement la façon dont nous pourrons tous travailler ensemble, fournissant une main-d'œuvre qui travaille de manière harmonieuse et productive. Il contribuera à aider à gérer les conflits en comprenant les différences entre les générations et, ainsi, permettre une communication ouverte, tout en tirant parti des talents et des compétences de chaque individu. Tout le monde prospérera et contribuera à assurer la réussite de l'organisation.

Je suis DCC.

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