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STANDING TALL WITH TIMBER

Balancing Acoustics & Esthetics

Explore the Benefits of Clay Brick Masonry

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Quality Facades with IGUs & Sealant Testing

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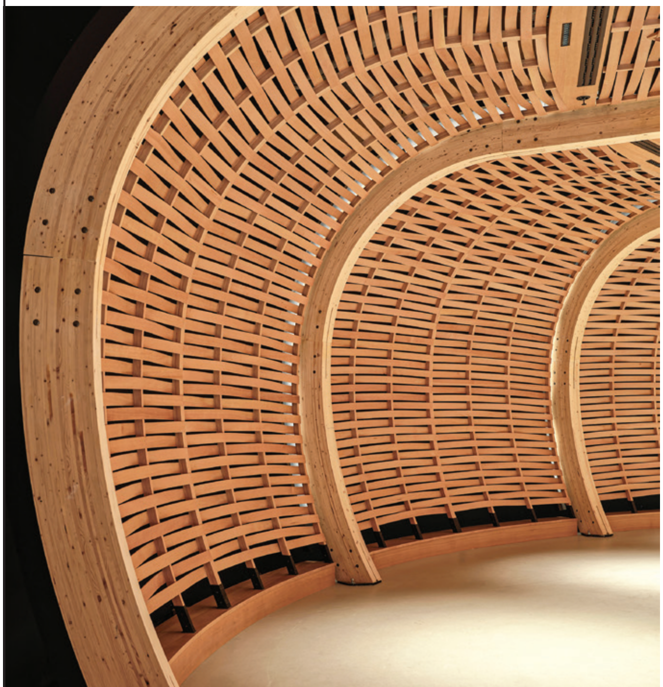

The Centennial College A-Building expansion in Scarborough, Ont., is a LEED Gold-certified, zero-carbon, WELL-certified mass timber education facility. It features sustainably harvested glulam posts, beams, and cross-laminated timber (CLT) floor panels, with exposed CLT in classrooms. The building highlights acoustical design, including the unique domed Indigenous Commons room, where acoustic challenges were met with creative solutions, enhancing both functionality and esthetics.

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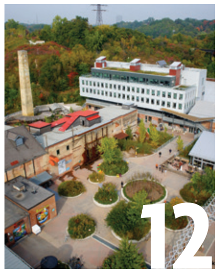

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CSC is a multidisciplinary, non-profit association committed to the ongoing development, and delivery of quality education programs, publications, and services for the betterment of the construction community.

Solving Acoustical Challenges in Mass Timber Construction

By Amanda Robinson

PHOTOS ©RILEY SNELLING/ COURTESY DIALOG

Changes in the *National Building Code* (*NBC*) in 2020 laid the foundation for the rise of taller timber buildings, and the market has responded. According to a Natural Resources Canada (NRC) 2021 report,1 there were more than 750 completed or under-construction mass timber projects from 2007 to 2022, with a gross area of 2.9 million m^2 (31 million sf). B.C., Ontario, and Quebec are the leaders, hosting 87 per cent of Canada's mass timber projects.

Sustainability is the primary driver of the shift to mass timber, since it is a low-carbon construction solution. The building sector is Canada's third most carbon-intensive industry,[2] accounting for 22 per cent of emissions in 2022. Adopting more mass timber could cut embodied emissions in buildings by as much as 25 per cent. More progressive building codes, new products, and more innovative design possibilities are also driving the interest in wood.

Leading the way in B.C.

When it comes to mass timber, B.C. has always been leading, and it will continue to with updates to its building code in 2024 that enable new types of wood construction.[3] B.C. owners and developers can build almost any type of building using mass timber, up to 18 storeys, and include restaurants, shops, care facilities, and warehouses. Ontario followed suit in January 2025 to also allow construction up to 18 storeys.

The code includes new encapsulation requirements tailored to the scale of the building. Encapsulated mass timber construction refers to buildings where the mass timber components must be surrounded by fire-resistive material. Encapsulation delays the exposure of the wood structure to a fire, but the recent B.C. code changes include some zero-minute fire encapsulation requirements for lower-rise buildings, except in critical areas such as exits, vertical shafts, and public corridors. This allows architects to expose the timber without violating fire codes.

Traditionally, mass timber projects have concrete in sections of the floor. The concrete serves multiple purposes: it helps acoustically by adding mass to improve sound reduction performance, helps structurally provide a diaphragm, and creates fire separation. However, the changes in the *BC Building Code* (*BCBC*) will allow for concrete-free mass timber buildings. Not pouring concrete on-site offers multiple benefits, including less carbon output, reduced project construction time and labour, and, as a result, lower costs.

While the "no concrete" option is more environmentally friendly, B.C. is in a more active seismic zone than other parts of the country, so reducing the mass of the building increases the stability if the ground shifts. Between the three aspects of acoustics, structure, and fire, the new *BCBC* has removed barriers to explore the benefits of adopting a "no poured concrete" design ethos.

Moving to dry construction

Architects and designers are focused on net-carbon-zero buildings. Concrete provides mass that makes it easier to reduce sound transmission in mass timber buildings, but it is also one of the most carbon-intensive materials, contributing an estimated eight per cent of global carbon emissions.

In traditional mass timber builds, the structural floor would include concrete thick enough to prevent a certain amount of sound from getting into the floor and travelling to other spaces. Developers can use thinner concrete toppings; however, less concrete can create its own challenges. For example, a thin concrete topping going across three or four walls means sound flanking can occur. To keep the acoustics from being compromised, builders today would pour the concrete floors in a mass timber building in each section and then build a wall between them. This kind of jigsaw puzzle construction is more labour-intensive and more challenging to schedule.

The new B.C. code finally broke the barrier of not requiring poured concrete in mid-rise buildings. However, as soon as the concrete is removed, a building needs workable acoustical considerations. A standard cross-laminated timber (CLT) alone will not provide sufficient sound reduction for residential construction that needs ASTC–47 or above. Even in the greenest building, tenants or owners do not want to hear what their neighbours are doing. To manage this, different build-ups can be used, and construction can incorporate more isolated layers and air gaps. Dry construction allows a floor build-up with plywood or precast, with the pieces laid on cementitious boards or other similar materials for greener solutions.

It is a common misconception that timber buildings require concrete floors for acoustics. Concrete is also not always required to meet fire code or structural needs. The move away from this common material means projects can re-examine how buildings are constructed.

Circular rooms are a challenge acoustically but an important aspect of Indigenous architecture. The Indigenous Commons room at Centennial College's A-Building incorporated absorption materials into its basket weave effect to help manage sound.

Exposed timber, acoustically sound

Architects and designers want to showcase the beauty of mass timber, but it creates challenges acoustically. Builders and designers have to work really hard on all the junctions. And this is not the only consideration—sound isolation is one part of the acoustic puzzle with mass timber.

For Centennial College in Scarborough, Ont., the expansion of its A-Building achieved zero-carbon certification due largely to a highly efficient building envelope. It is now the first LEED Gold-certified zero-carbon, WELL-certified mass timber education facility.

The building incorporates sustainably harvested mass timber glulam posts and beams

The ceiling treatment in Wisdom Hall at Centennial College's A-Building included custom wood baffles acting as absorptive panels to control acoustics. The acoustical baffles were incorporated into the story being told, so they did not interfere with the design.

Wisdom Hall is a cascade of terraces and stairs over multiple storeys. It is a tall space that needed to be acoustically comfortable for all users—any acoustical treatments needed to complement the beautiful interior.

that support CLT floor panels. The CLT was exposed in the classroom areas, and a high level of sound reduction was achieved in the adjoining space through careful attention to the details and the damping provided by the concrete topping above. If the concrete toppings were removed in this instance, other design solutions would have been required for the same outcome.

The mass timber used throughout the project was designed to represent the spirit of the region's woodlands, reflecting the natural setting of Highland Creek. However, achieving a nature-inspired interior involved a number of acoustical challenges. Within the building, Wisdom Hall is a cascade of terraces and stairs over multiple storeys, providing a bright and dynamic setting for students and visitors to gather and interact. The ceiling treatment included wood panels in different shapes and artwork to represent the flow of a river. It is a tall space with old wood that needed to be acoustically comfortable for all users.

In addition to looking at the sound reduction performance, the acoustically pleasing interior is esthetically pleasing. Custom wood baffles were used to create absorptive panels in the space. Working with the designers, acoustical engineers determined how many baffles were needed to incorporate absorption, while honouring the design and not interfering with the tale being told. This used a combination of custom acoustics baffles and acoustic wall panels, with the designers providing the shapes and spacing.

Acoustics baffles were evenly distributed across the impacted areas, with some baffles left untouched. For example, every other baffle on the second floor needed to be micro-perforated with tiny holes to improve acoustics. Since the baffles were integrated into the design, Indigenous artwork was also included as a feature piece of the building.

The domed room in Centennial's Indigenous Commons room presented multiple acoustical challenges. Circular rooms are an important aspect of Indigenous architecture because they are inclusive. However, round rooms with curved walls cause challenges from an acoustical perspective. If the sound is not treated correctly, all of it comes back to the centre of the room. If people are within the focal point, they receive all the sound in the room but will not necessarily be able to understand it.

In addition, the designers wanted to acknowledge the arts of traditional indigenous people with the basket weave effect in the room. The spacing of the wood slots and the thickness were set to ensure the acoustics of the room worked with absorption materials incorporated behind the weave. The room also has a skylight box where much of the noise can be trapped. Creative acoustic design ensured that all aspects of the room could perform as intended.

Holistic approach

Detailing is very important with a mass timber structure to achieve the ultimate design goals. Contract administration is a key component, since the pre-planning for mass timber buildings can include decisions that may be made for the sake of simplicity but add to acoustical challenges.

Selecting the supplier of the timber material early in the process is critical. This decision should be made as early as the acoustician and architect's choices because engaging a team that can quantify the constraints from the beginning can save a lot of rework and wastage.

For example, at Centennial College, the CLT beams were designed and created very early in the process, and notches were added to provide a channel for items such as wires or plumbing. The notches were sized to accommodate a certain amount of penetrations, whether or not the entire notch size was to be used, so the design was flexible.

From an acoustical point-of-view, the holes provided challenges, and just putting sealant in them was not sufficient since some of the holes were fairly large. The solution was to cover both sides of the penetration with wood, drywall, or metal, and a closure plate with an oversized hole that could be sealed. In addition, insulation was added to the entire cavity to ensure that sound isolation through the larger opening was maintained. This was not an issue for beams in the middle of the room, but the penetrations in room boundaries needed to be covered.

With more push toward dry construction, more opportunities exist to explore how to expose timber; sometimes, creating a particular look will not be acoustically sound. Some cases may require finding the middle ground between design and acoustics. For example, trying to achieve STC–60 in a mass timber building with exposed beams is not yet possible. However, collaborating with all the project partners can help identify potential solutions early in the process to avoid fixing costly issues once the building is finished.

At Centennial College, the cross-laminated timber (CLT) beams had notches to accommodate a certain number of penetrations, even if some notches were not used. The room boundaries needed to be covered with wood, drywall, or metal and a closure plate included with an oversized hole that could be sealed to control noise.

PHOTO COURTESY DIALOG

The Catalyst Building sets a new standard for sustainability while showcasing the natural acoustic benefits of cross-laminated timber (CLT), creating a workspace that balances innovative design with a warm, sound-conscious environment.

Photo ©2020 Benjamin Benschneider/courtesy Aercoustics Engineering

Finding new solutions

Alternative dry construction toppings, such as fibre cement or heavy board materials on resilient underlays, have successfully been used on projects to achieve the required sound reduction without concrete. In addition, using rubber gaskets at construction joints helps reduce flanking paths.

Ceilings in commercial (non-residential) mass timber buildings can often be challenging since the architect often wants exposed wood. In these cases, dowel-laminated timber (DLT) can provide support. Created by stacking dimension lumber together on its edge or cross-laminating, each DLT plank is embedded with a cut-out that allows a dowel to connect them. There are versions of DLT that incorporate acoustic absorption into the DLT panel. However, other aspects of DLT need to be considered, and this solution may not be the ideal direction in many cases. With multiple considerations, a holistic approach to design is crucial.

What is next for mass timber?

In the early days of mass timber, it was a structural element covered with gypsum layers for fire safety and acoustical performance. This risk-averse approach is still the case, but as more people see the beauty in wood, there is an increased push for exposed timber because the industry has the solutions to make it work.

The code changes include hotels, dormitories, and apartment buildings, so mass timber could be important in expanding Canada's housing supply. For example, HAVEN is a pre-fabricated, 12-storey mass timber overbuild solution for existing commercial buildings that is being considered by the Canada Mortgage and Housing Corporation (CMHC).[4] It leverages the high strength-to-weight ratio of mass timber and is a purpose-built rental solution that could add up to 250 units per site.

The guidelines also include assisted living, care facilities, and hospices. The next wave of mass timber will likely include hospitals, but it will need to consider the high standard of infection control requirements and vibration mitigation. For example, medical imaging equipment is vibration-sensitive, so it will be very challenging to build it with mass timber, but it is coming.

Acoustics must be part of the holistic design of any mass timber building. In the case of Centennial's A Building, including baffles as part of the design is a creative way to address acoustics without just adding acoustical add-ons (also known as 'acousticons') everywhere.

The Trinity College Lawson Centre for Sustainability and Acoustic Performance at the University of Toronto is dedicated to advancing sustainable design and optimizing acoustic excellence in a new mass timber, zero carbon, and LEED platinum multi-use building.

PHOTO COURTESY DIALOG

A more collaborative and holistic process can find solutions. It is important to understand mass timber and how a space can sound great within the constraints of the materials.

The possibilities for mass timber are limitless. As the industry innovates, so do the design and construction. B.C. is the first province to adopt dry constructions; based on history, other provinces will follow suit. The key is finding the balance between showcasing the beauty of mass timber and ensuring the buildings are acoustically sound.

Notes

[1] Read more on mass timber construction in Canada, Natural Resources Canada (NRC), Government of Canada, natural-resources.canada.ca/our-natural-resources/forests/industry-and-trade/forest-products-applications/mass-timber-construction-canada/23428

[2] See "Timber Rising: How Wood Can Spur Canada's Green Building Drive," Myha Truong-Regan, Royal Bank of Canada Thought Leadership, October 2023, thoughtleadership.rbc.com/timber-rising-how-wood-can-spur-canadas-green-building-drive/

[3] Refer to "Advancing Mass Timber in BC Codes," Office of Mass Timber Implementation, Province of British Columbia, gov.bc.ca/assets/gov/business/construction-industry/advancing_mass_timber_in_bc_codes_web.pdf

[4] Review HAVEN: A 12-storey pre-engineered, prefabricated mass timber overbuild solution for existing buildings, Final FundingRecipientsforRound4oftheHousingSupplyChallenge, Canada Mortgage and Housing Corporation (CMHC), cmhc-schl.gc.ca/professionals/project-funding-and-mortgage-financing/funding-programs/all-funding-programs/housing-supply-challenge/round-4-housing-supply-challenge/round-4-funding-recipients

Amanda Robinson, vice president of architecture at Aercoustics Engineering, follows her passion for architectural acoustics—seeing designs transform from concept to reality and listening to completed projects. Her 25 years of experience across three continents allow her to understand acoustic designs from many perspectives.

A New Era for Adaptive Reuse

Empty Office Spaces Bring Opportunities for More Sustainable Construction

By Onah Jung, OAA, AIA, LEED AP, NCARB

PHOTOS COURTESY STUDIO JUNG

As the pandemic fades into the past, it has become clear that the relationship with workspaces has been permanently altered.

The ongoing debate over remote work, hybrid models, and a return to traditional offices has revealed an undeniable truth—future work environments will never look the same.

This shift has left a significant mark on cities. According to the Avison Young First Quarter 2022 Office Market Report, the downtown office vacancy rate in the Greater Toronto Area (GTA) surged to eight per cent, up from just 2.1 per cent the previous year.

Even long-standing tenants are rethinking the future of their buildings, exploring new possibilities for under-utilized office spaces. With an increasing number of vacant office spaces and the demand for housing intensifying, the question arises: What should be done with these empty spaces?

Adaptive reuse, the process of transforming existing buildings for new purposes, presents a compelling solution. However, whether it can effectively address the housing crisis and environmental challenges remains to be seen.

The potential for adaptive reuse is immense, yet the path forward is anything but simple. As this evolving landscape is navigated, its significance and complexities require full attention and innovative thinking.

Renewed emphasis on adaptive reuse

Adaptive reuse has long been a familiar concept in the construction industry but has not always been at the forefront of design strategies.

The practice of transforming old, often neglected buildings into new spaces with entirely different purposes has existed for decades, yet it has only recently gained the spotlight it deserves.

The pandemic, coupled with the urgent call to combat climate change, has renewed emphasis

associated with new construction. This is especially crucial in light of the 2021 Intergovernmental Panel on Climate Change (IPCC) report, which described climate change as "widespread, rapid, and intensifying."

The urgency of the situation cannot be overstated, and adaptive reuse offers a practical solution to minimize environmental impact by converting old buildings into sustainable, energy-efficient spaces.

Architect Carl Elefante's assertion that "the greenest building is the one that already exists" holds renewed significance in the current context. What was once merely a nod to sustainability now stands as a guiding principle for shaping urban development in the era of climate change.

Adaptive reuse preserves the past while aligning with the environmental goals of the future, positioning it as an essential strategy in the pursuit of more sustainable cities.

Adaptive reuse example: Office to housing building

In the wake of the pandemic, transforming vacant office buildings into housing seems like a logical solution to the ongoing housing crisis. With affordable housing in short supply, repurposing office spaces could offer a quick fix. However, as straightforward as this idea may sound, the reality of adaptive reuse is far more complex.

The concept of using existing buildings as a cornerstone of sustainability is not new. The assertion "the greenest building is the one that's already standing," and reusing structures can significantly reduce carbon emissions—up to 40 per cent, according to British Land's Sustainable Development report.

So, why not start by converting those empty office buildings? This approach seems like a win-win: addressing the housing shortage while reducing the environmental footprint.

However, the journey from office space to livable housing is fraught with challenges. Scale is a crucial factor in adaptive reuse. While reusing a building shell can have positive environmental impacts, other elements, such as outdated interior materials, may not meet modern standards and could hinder the project.

Adaptive reuse is not just about repurposing a single building; it is about considering a range of

on adaptive reuse as a critical approach in urban development.

In Toronto, several adaptive reuse projects illustrate the potential of this practice. The Evergreen Brickworks, once an abandoned industrial site, has been transformed into a vibrant community hub focused on sustainability and urban ecology.

Similarly, the Toy Factory Lofts repurposed a former factory into modern residential spaces, preserving the building's industrial character while meeting contemporary living needs.

The 401 Richmond Building is another prime example of an old factory converted into a dynamic arts and cultural centre, retaining its historical charm while serving new functions.

These examples highlight adaptive reuse's esthetic and functional benefits and environmental significance. Repurposing existing structures allows for a substantial reduction in the carbon footprint typically

An example of adaptive reuse in action, the Evergreen Brick Works transforms a former industrial site into a vibrant community hub, featuring a seasonal skating rink that blends history with sustainability.

The Toy Factory Lofts repurpose a historic industrial building into modern residential spaces, seamlessly blending urban character with contemporary living.

scales—from furniture and equipment (product level) to entire cities. At its best, this approach is comprehensive, meeting environmental and community needs.

However, the "best" scenario is rare. Office buildings and residential spaces are fundamentally different. Many older office buildings lack the necessary infrastructure for living spaces: insufficient bathrooms, inadequate natural light, windows that do not open, and ceiling heights that complicate retrofitting HVAC and electrical systems.

According to a *CNN* article,[2] only three per cent of New York City's office buildings and two per cent in downtown Denver are suitable for residential conversion. The statistics are similar to those of other U.S. and Canadian cities like Toronto.

The evolution of building design also plays a role. In the mid-20^{th} century, before air conditioning became widespread, office buildings were designed with numerous windows to allow for natural ventilation. These buildings typically had smaller floor plates, ranging from 465 to 1,394 m^2 (5,000 to 15,000 sf), making them more adaptable for residential use.

In contrast, modern office buildings have larger floor plates—sometimes up to 3,716 m^2 (40,000 sf)—making it difficult to convert them into apartments with sufficient natural light and ventilation.

Despite these hurdles, turning empty office spaces into housing remains an optimistic and necessary venture. This effort demands creativity, innovative design solutions, and, above all, a willingness to rethink the use of the built environment.

The challenges are significant, but with the right strategies, this approach could be a key to solving both the housing and environmental crises.

Financial challenges of adaptive reuse

Adaptive reuse sounds like an ideal solution for developers looking to go green—taking an old building and giving it new life demonstrates sustainability. However, once the financial realities hit, the dream often starts to unravel.

Old buildings come with baggage: asbestos, outdated plumbing, creaky structures, and defunct electrical systems. The cost to bring these elements up to code can quickly overwhelm even the most optimistic developer.

Despite these challenges, the appeal of adaptive reuse is undeniable. The buildings are already integrated into their neighbourhoods, offering a blend of character and context that new constructions often lack. Moreover, the environmental benefits are significant—reusing structures minimizes waste, conserves resources, and supports global sustainability objectives.

However, does it make financial sense? The short answer is not immediate. One of the toughest parts of tackling adaptive reuse projects is the uncertainty of when—or even if—these investments will pay off.

Converting under-utilized office spaces into residential units, for instance, presents a major financial challenge. The cost of conversion, paired with the need for competitive pricing in a tight rental market, means developers could be looking at a long wait before seeing any return on their investment.

The median asking rent for apartments is significantly lower than the office rent. The significant price drop in converting office space into residential units makes the math tricky. High vacancy rates further complicate matters, as developers are unlikely to convert a building still performing well as an office.

However, change is on the horizon. Government-backed incentives have been introduced to ease the financial burden of these conversions. Tax policies are evolving, making it more feasible for developers to consider adaptive reuse a viable option.

Adaptive reuse remains a financially challenging project, but with the right incentives and a long-term view, it could become an increasingly attractive option for developers looking to balance sustainability with profitability.

The greenest building practice in the face of climate change

When it comes to combating climate change, the greenest buildings already exist. In Canada, many existing buildings have reached the 50-year mark, presenting a unique opportunity for adaptive reuse.

By preserving, retrofitting, and reusing older structures, significant reductions in the nation's annual emissions from building operations can be achieved. This approach is not only environmentally responsible but also economically sound.

One of the most compelling reasons to prioritize adaptive reuse is its impact on embodied carbon emissions. Embodied carbon refers to the carbon released during manufacturing, transporting, and assembly of building materials.

Constructing new buildings from scratch releases vast emissions while reusing existing structures avoids 50 to 75 per cent of the embodied carbon a new building would generate. It has to do with renovations typically retaining the most carbon-intensive parts of the building—such as the foundation, structure, and envelope—thereby reducing the overall carbon footprint.

The benefits of reducing embodied carbon through adaptive reuse are immense. Not only does it help achieve emission reduction goals, but it also offers an innovative strategy that can be replicated globally. Shifting the focus from new construction to preserving and retrofitting existing buildings represents a meaningful step toward a more sustainable future.

An outstanding example of adaptive reuse, the 401 Richmond Building integrates sustainability with urban revitalization, featuring a lush rooftop garden that enhances biodiversity while preserving the site's historic character.

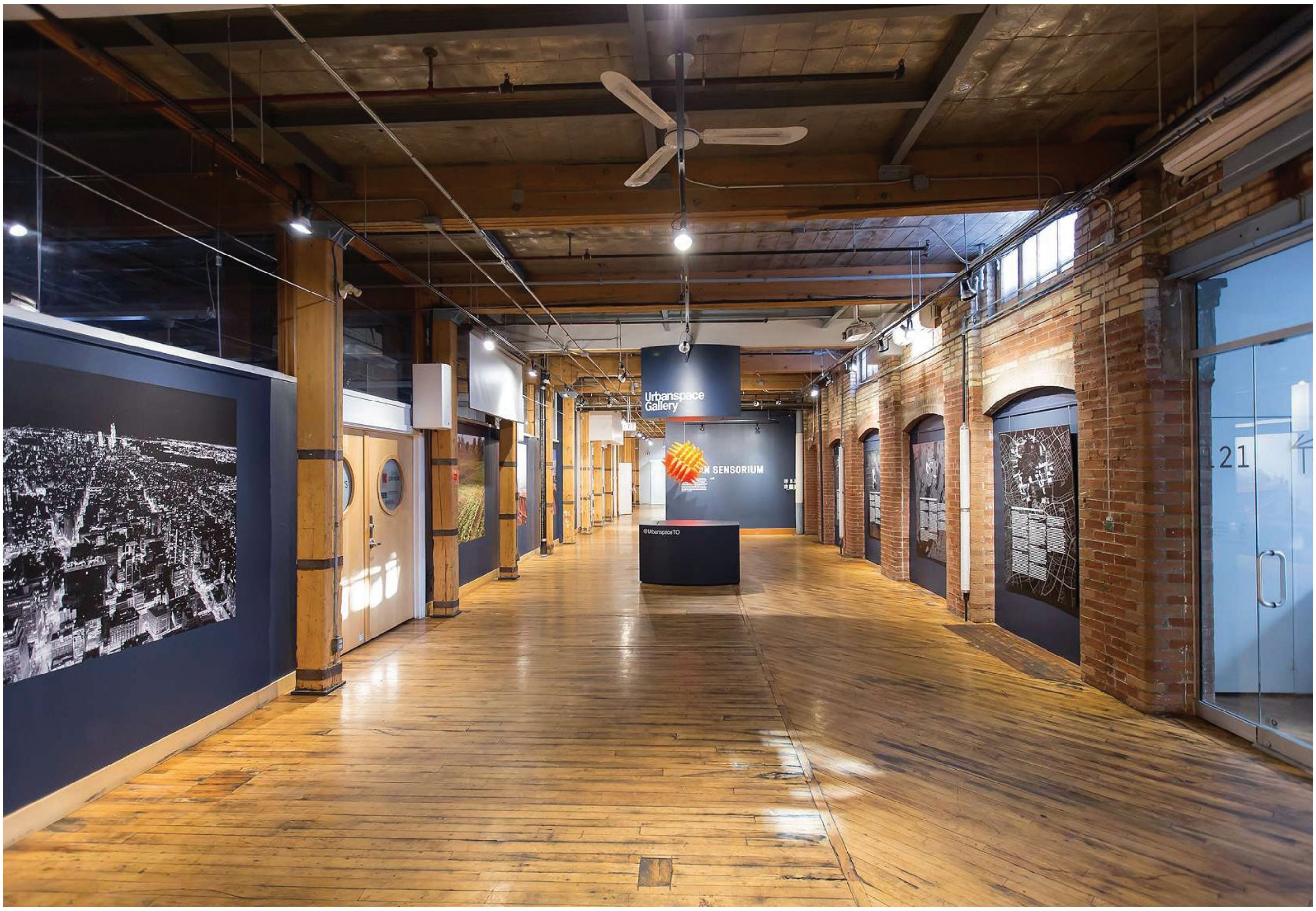
However, the current rate of building demolition poses a significant challenge to this strategy. According to an article by the American Institute of Architects (AIA),[1] approximately 92,903,040 m^2 (1 billion sf) of buildings are demolished each year, often for reasons unrelated to the structural integrity of the buildings themselves. In fact, 34 per cent of these demolitions are driven by land-use concepts rather than the physical state of the buildings.

The waste generated from these demolitions is staggering—544.3 million tonnes (600 million tons) of construction and demolition debris were produced in 2018 alone, with demolition waste accounting for more than 90 per cent of this total. Most of this waste ends up in landfills, contributing to air pollution and occupying land that could otherwise be used for farming or forestry.

Adaptive reuse offers a way to mitigate this waste by extending the life of existing buildings. However, it does not stop at embodied carbon. Retrofitting older buildings also dramatically reduces operational carbon emissions—those released during heating, cooling, lighting, and other daily activities within a building.

Improving the energy efficiency of these structures can significantly reduce the operational carbon emitted into the atmosphere.

In urban environments, reusing buildings has the potential to achieve half of the carbon



Blending heritage with innovation, the 401 Richmond Building's interior hallway showcases adaptive reuse at its finest, transforming a former factory into a thriving arts and cultural hub while preserving its industrial charm.

reduction targets necessary to meet global climate goals. Additionally, the economic advantages of retrofitting existing structures are considerable.

Historic rehabilitation projects, for example, have a proven track record of creating jobs and generating private investment. Studies show residential rehabilitation creates more jobs than new construction, making it a win-win for the economy and the environment.

Federal incentives could further bolster the case for adaptive reuse. These credits support rehabilitating historic buildings, making it financially viable for developers to invest in energy-efficient upgrades.

Aligning financial incentives with environmental goals can drive the more widespread adoption of adaptive reuse practices.

Adaptive reuse is more than a viable option—it is necessary to address the challenges of climate change. Prioritizing the preservation and retrofitting of existing building stock enables reducing carbon emissions, conserving resources, and creating a more sustainable built environment. This approach not only aligns with environmental responsibilities but also supports economic interests, presenting a path forward that is both promising and essential.

Key takeaways for architects, developers, and engineers

By focusing on following specific strategies, architects, developers, and engineers can effectively turn adaptive reuse challenges into opportunities for sustainable and successful projects.

- Long-term financial planning: Adaptive reuse requires a long-term perspective. While upgrading old buildings has high initial costs, government incentives and future returns make it a financially viable strategy.
- Maximize sustainability by reusing existing structures: Reusing buildings significantly reduces embodied carbon emissions. Architects should focus on maintaining key structural elements to maximize environmental benefits.
- Address conversion challenges with innovation: Converting office spaces into residential or other uses presents challenges like insufficient natural light and outdated

systems. Architects and engineers must develop creative solutions to adapt these spaces effectively.

- Consider the scale of reuse: Adaptive reuse can be applied at different scales, from small interior projects to large urban transformations. Understanding the project's scale is crucial for planning and impact.
- Enhance energy efficiency: Retrofitting buildings to improve energy efficiency is essential for reducing operational carbon emissions. Utilizing government incentives(s) can help offset these costs.
- Leverage policy support: Government policies and incentives are key to making adaptive reuse viable. Developers should stay informed and advocate for policies that support sustainable practices.

Bringing nature into the built environment, this lush interior hallway at the 401 Richmond Building blends historic architecture with green design for a vibrant, sustainable workspace.

Conclusion

Adaptive reuse has transitioned from being seen as a creative solution to an essential strategy for addressing the critical challenges of the present era.

As cities contend with the dual crises of climate change and post-pandemic reconfiguration, repurposing existing buildings offers a pathway that integrates environmental responsibility with practical urban development.

The transformation of vacant office spaces into housing or other functional uses is not solely a response to economic shifts—it is a crucial measure for reducing the carbon footprint within urban environments.

Reusing structures preserves the embodied carbon invested in these buildings while reducing operational carbon emissions, aligning with broader sustainability objectives.

However, the journey is not without its hurdles. Financial challenges, structural limitations, and regulatory barriers complicate the process, making it clear that adaptive reuse requires long-term planning, innovative design, and strong policy support.

Yet, as seen in projects like Toronto's Evergreen Brickworks and the 401 Richmond Building, the potential rewards for cities' environments and vibrancy are immense.

Ultimately, the wisdom that "the greenest building is the one that already exists" rings more accurate than ever. Adaptive reuse offers a way to honour the past while planning a more sustainable future.

It is about reimagining buildings that have served in one capacity to meet the needs of today and tomorrow. Creativity, commitment, and collaboration across the construction industry can turn these challenges into opportunities, building a resilient and sustainable world from existing structures.

Notes

[1] Learn more by visiting cnn.com/2024/01/13/business/can-we-turn-empty-office-building-into-housing/index.html

[2] Read the article here aia.org/design-excellence/aia-framework-for-design-excellence/resources

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Supporting Sealants

Ensuring Quality and Consistency in Insulated Glazing Unit Seals

By Amy Roberts

PHOTOS COURTESY FENESTRATION AND GLAZING INDUSTRY ALLIANCE (FGIA)

Sealants, the glue that keeps everything together, play a critical role in the performance and longevity of glazed fenestration systems.

The Fenestration and Glazing Industry Alliance (FGIA) is revamping IGMA TM-2400, *Test Methods of Insulating Glass Sealants*, to offer specifiers, manufacturers, and fabricators the most up-to-date information and best practices.

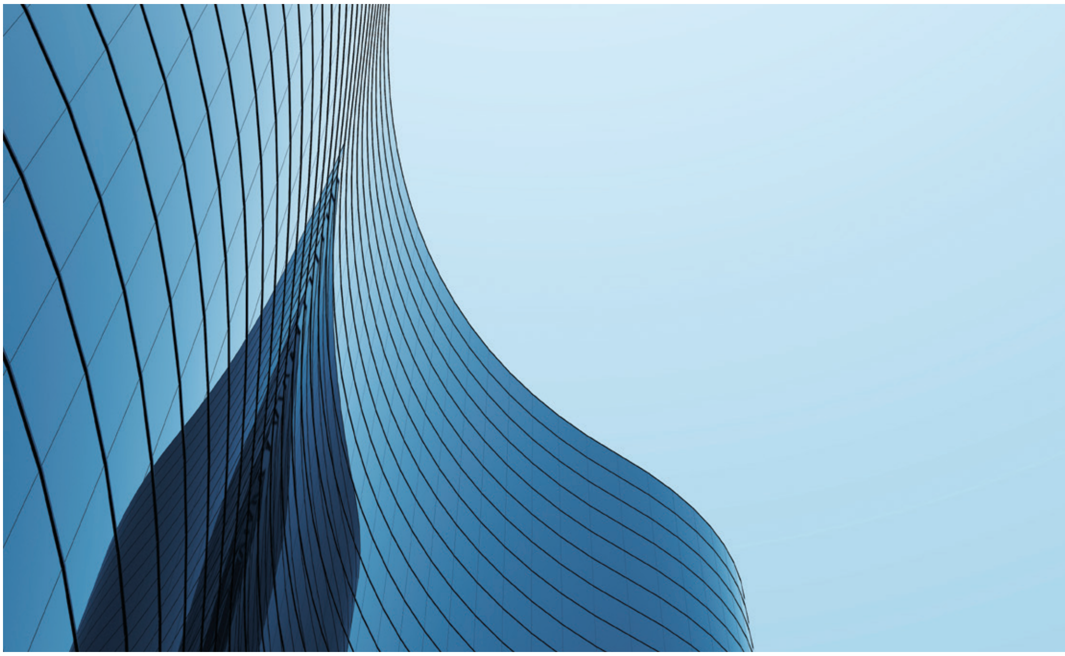
Together with several other FGIA documents, IGMA TM-2400 helps support quality assurance and product performance, mitigates risk, and ensures compatibility between sealants and glazing system components.

The role of sealants

A properly sealed insulating glass unit (IGU) ensures the vapour barrier and structural support are dialled in, allowing the IGU to deliver daylighting and thermal comfort in buildings.

On the other hand, seal failure can occur with poor or inadequate waterproofing, weeping, or vent holes in the glazing cavity. Failure can also happen because of faulty glazing techniques or selecting glazing materials that are incompatible with the insulating glass sealant system.

Considering the many different aspects of glazing systems—*i.e.* glass types, framing, gaskets, spacers, drainage, setting blocks, spacers, and shims—to design and install a high-performance facade, these components must be carefully specified, tested, and installed as a compatible and cohesive system. While each part of the system must be high-quality and suitable for installation, the sealant is key to a successful system.



A properly sealed insulating glass unit (IGU) ensures the vapour barrier and structural support are dialled in, allowing the unit to deliver daylighting and thermal comfort in buildings.

Before discussing the details and testing methods of the new IGMA TM-2400 standard, the reader may wish to familiarize themselves with IGMA TM-3000*, North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use*, an informative resource on achieving the long-term performance of IGU systems.

In addition, IGMA TM-4000, *Insulating Glass Manufacturing Quality Procedures,* offers detailed guides and work instructions for the individual tasks necessary for assembling IGUs in a production setting.

The latter provides detailed guides and step-by-step instructions for IGU production in a factory setting. The former guide seeks to help standardize the manufacturing process to ensure quality and consistency.

The first section of IGMA TM-4000 is an overall checklist for unit fabrication, and the second offers detailed instructions for the different functions in the assembly process to support consistency.

By better understanding the inner mechanics of a glazing system and how everything works together, industry professionals will be better equipped to identify where failures can occur.

IGMA TM-3000

Unpacking some relevant information covered in IGMA TM-3000, the document contains advisory guidelines to assist in achieving the long-term performance of IGUs. It delves into different aspects of the glazing system and gives instructions for achieving adequate sealing and common pitfalls to avoid.

For example, to achieve a proper edge seal for dry-glazed systems, the minimum applied pressure is 0.70 N/mm (4 lb/in.) to create an adequate seal. At the same time, excessive or uneven pressure can increase mechanical stresses and contribute to glass breakage. Therefore, while edge-clamping pressure is usually sufficient to achieve an air and watertight seal, pressure should not exceed 1.75 N/mm (10 lb/in.).

Another example is the importance of a framing system providing firm, four-sided perimeter support for an IGU. If this is improperly done, undue stresses are placed on the seals, which could lead to premature IGU seal failure.

IGMA TM-3000 also emphasizes the importance of ensuring proper drainage in the glazing channel because prolonged exposure to water or moisture vapour in the glazing channel is the number one cause of seal failure.

On the issue of compatibility, the document instructs that any materials that might come into contact with the components of the glazing system or IGU sealant(s) or be enclosed together under expected environmental conditions must be compatible with the sealant in all of those conditions.

Another issue to watch out for is sealants that contain linseed, mineral, vegetable oil, or certain excess plasticizers. When curing, these can release significant amounts of solvents or

This project shows the importance of a properly sealed insulating glass unit (IGU). In this instance, it would be difficult to go back and re-glaze.

acids, thereby leading to IGU seal failure and surface contamination.

IGMA TM-3000 guidelines instruct that sealants used as heel beads or air and weather seals in contact with the IGU remain pliable under all expected temperatures, UV exposure, and environmental conditions to not interfere with the IGU's movement capability. If this is impeded, it could lead to glass breakage or seal failure.

Sealants must also be designed to withstand very hot temperatures, as IGUs with heat-absorbing or reflective glasses can heat up to as high as 60 C (140 F) when exposed to sunlight and still air and, in spandrel areas, as hot as 90 C (194 F). Also, the IGU assembly sealant must accommodate all structural frame and glass movements caused by wind, live and dead load deflection, and thermal expansion from those high temperatures.

Overall, it is highly recommended that one consult the glazing sealant manufacturer about their products' performance, adhesion, movement capability, compatibility, and life expectancy.

Latest version: IGMA TM-2400-24

This *Test Methods for Insulating Glass Sealants* was originally published back in 1976. It was reviewed in 1990, but no changes were made. While the vast majority of the information and test methods still apply, the document has been restructured and edited to incorporate the application of new technology.

The new version contains a revamped chart presenting the test methods with links in an easy-to-read manner. As a result, readers will be able to navigate the 69-page document more easily to find the most suitable test for analyzing the sealant in their application. This, in turn, lends greater quality assurance for the IGUs.

Delving into some more of the background in the newly revised IGMA TM-2400, FGIA points out the test methods were developed as advisory information and are meant to be guidelines. Consequently, they are intended to be voluntary, not requirements, as every application and installation differs.

FGIA test methods can be adapted into a plant's quality control program, used to perform incoming materials checks, or employed to determine physical properties useful for engineering calculations supporting end-use. Essentially, the content is available as a tool for sealant manufacturers in their quality assurance programs and sealed insulating glass fabricators to assist in determining the quality of

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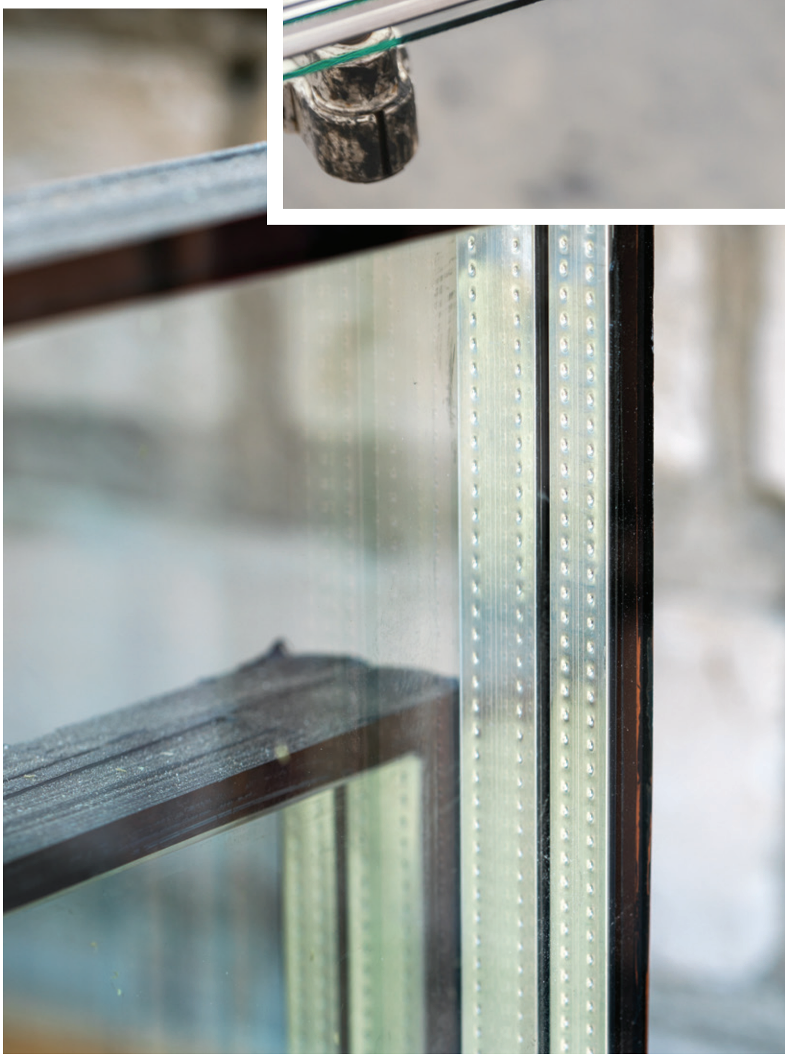
Sealants are literally the glue that keeps everything together, and they play a critical role in the performance and longevity of glazed fenestration systems.



This shows a good representation of an edge seal in a finished unit.

their incoming sealant. The information is also beneficial for specifiers and consultants to know what to look for when selecting products for their applications.

Key testing parameters

It is particularly important to call out a few key performance factors to test for, such as tack-free time, the sealant mix ratio and quality, moisture vapour transmission and permeability, shear testing, and sealant adhesion.

For the majority of these methods, the testing materials and apparatus must be equilibrated at 23 ± 1 C (73 ± 2 F) before starting the test.

Tack-free time is very important as the sealant must be fully bonded before the glass is moved.

Defined as the time interval after the sealant is mixed at standard conditions and without direct sunlight, it is determined to be fully cured when a polyethylene strip is pulled away from a sealant specimen and no sealant adheres to it.

The test method uses a 30 g (1.2 oz) brass weight, polyethylene strips, polytetrafluoroethylene (PTFE) moulds, a metal or PTFE straight edge, and a balance sensitive to 0.1 g (0.005 oz) to test tack-free time. The exact measurements are in the document.

To begin, 300 g (10.6 oz) of sealant base is thoroughly mixed with the appropriate curing agent for two or three minutes. Then, the mould is filled and struck off flat with a straight edge and cured for the specified tack-free time. Next, a polyethylene film with a brass weight is placed on the top surface for about 20 seconds. The film is peeled at right angles to the compound. If no sealant adheres to the strips, the unit passes the test.

IGMA TM-2400 delineates a couple of ways to check the sealant mix ratio, defined as the ratio part A holds to part B after mixing based on their proportionate weights.

The gravity cup method is a primary method performed with a specific gravity cup, a bottle used to determine the weight per litre (or gallon) and the specific gravity of paints or other liquids. The test weighs the Part A base material and the Part B accelerator material. Then, the actual mixed sample weight is compared to the theoretical mixed weight.

It should be noted the method requires a very high degree of accuracy when the two components have nearly the same specific gravity.

Another approach is the machine mix ratio check, a secondary test method that determines the base compound's ratio to the curing agent created by a meter/mix machine.

To evaluate the uniformity of the mix, a small amount of mixed sealant is extruded onto a glass plate, and then a second glass plate is placed on top. The sealant on both sides is pressed down and examined under strong light. If striations or streaks appear, the test should be repeated with additional extruded material.

Three tests are provided for the moisture vapour transmission (MVT) and permeability of a sealant. The MVT is defined as the rate of MVT through a barrier in g/24h*m.[2] The water vapour permeability is the MVT multiplied by the thickness of the sample divided by the vapour pressure difference between the two sides in g*cm/24hr*m^{2}*mmHg.

The simplified cup primary test method involves slowly and thoroughly mixing 100 g (3.5 oz) of sealant base with a curing agent for two to three minutes in a PTFE ring on a PTFE sheet. A second PTFE sheet is placed on the sealant, and pressure is placed on one of the lites of glass. Excess material is forced out, and the assembly is fastened with clamps.

After initial curing, the clamps, glass, and PTFE sheets are removed, and then the specimen is forced out of the PTFE ring and checked for the absence of bubbles.

Curing continues for another seven days. The specimen is then placed in a 50 mm (2 in.) diameter petri dish filled halfway with distilled water. The specimen is sealed on the dish and cured for another day.

Next, the assembly is placed in a desiccator where zero per cent relative humidity (RH) is maintained by a molecular sieve replaced every week. The petri dish with the sealant is weighed twice a week on an analytical balance, and the weight is plotted against elapsed time.

After three and four weeks, weight loss should become linear, indicating a steady state of MVT exists. Calculations are then applied to determine both MVT and permeability.

IGMA TM-2400 also provides instructions for an automated method and an alternate automated method for testing these values but notes that a third-party laboratory usually performs these tests.

Shear testing is performed in a number of different ways. The dead load method for shear testing is a primary and secondary test method, which is a laboratory procedure for determining the ability of a sealant to resist shear forces exerted by dead loading after the tack-free condition has been achieved. Dead load is defined as the condition which occurs when one or more panes of glass in a multiple pane IGU are in an unsupported condition relative to the other pane of panes of glass in the same unit, except for the support supplied by the strength of the sealant(s).

This is an important test because some sealants do not gain full adhesive properties until some time after the tack-free condition has been achieved. This method provides a basis for judging when it may be safe to handle, pack, store, or ship the IGUs without experiencing adverse stresses and loss of adhesion of the sealant to the glass and metal components.

For this test, a cured specimen is placed in a deal load tester. Immediately afterward, a 10 kg (22 lb) weight is placed on the platform and the plunger assembly and left for 10 minutes. Any movement of the unsupported light is noted in millimetres. In addition, the adhesion characteristics of the sealant to the spacer and the glass should be observed.

Another primary test method for creep determines the ability of a hot-applied sealant to resist shear forces exerted by dead loading.

An overlap shear test measures sealant adhesion to glass, aluminum, and galvanized steel spacers and the shear strength.

To perform the primary test method, 300 g (10.6 oz) of sealant base is mixed with the appropriate curing agent for two or three minutes. Two glass specimens are bonded with the sealant to produce a 25.4 mm (1 in.) overlap. Separately, the aluminum and galvanized steel spacers are bonded similarly. After curing, each specimen is mounted to a tensile tester and

This cross section shows, in better detail, an example of a desiccant, spacer, and the sealant system.

pulled in opposite directions at 50 mm (2 in.) per minute. The PSI is then calculated per IGMA TM-2400 instructions.

An alternate method to test overlap shear involves heating the second substrate in a forced draft oven prior to bonding it to the first substrate, which has had 25.4 x 25.4 x 3.2 mm (1 x 1 x 0.125 in.) of sealant applied to it.

Another very important value to test is the sealant adhesion, which is critical to ensure the units do not slide or shift.

The primary test method for tensile peel strength is used to evaluate adhesion. Like previous tests, 100 g (3.5 oz) of sealant base with the appropriate curing agent is mixed for two to three minutes. The sealant is then buttered over half the length of the glass strips. Additional sealant is then applied to the glass, and aluminum strips are placed over it. The bars are set on either side of the prepared panel.

The panels are placed in a 49 C (120 F) oven for two to three hours, then removed and left at ambient conditions for 24 hours. They are then put in the tensile testing machine and pulled at a rate of 50.8 mm (2 in.) per minute, and the level of adhesion loss is recorded. The method also offers a long-term exposure testing option.

A hand peel secondary method involves applying a patty of sealant to a glass panel and embedding a 50.8 mm (2 in.) section of the spacer stock in the patty with the balance of the spacer section protruding beyond the edge of the patty to serve as a handle. The same applies to the metal specimens.

After curing for 24 hours, adhesion to the metal is tested by lifting or twisting the spacer section to apply tension to the band area and noting any adhesion failure and the effort used to affect the movement of the spacer.

Using a razor knife, parallel cuts are made through the patty. The razor blade is run under the patty at one end of the section to produce a tab of sealant free from the panel. The tab is used as a grip, and tensile peel is applied to the sealant. Adhesion loss and effort used to affect movement are noted.

The document also gives instructions for a 180-degree peel adhesion test.

Sealing the deal

Since the sealant is such a critical aspect of IGU performance, the above-delineated tests and more have been developed to help ensure the consistency of fabrication and installation characteristics of high-performing IGUs.

By better understanding the important role of high-quality sealants in glazing assemblies, professionals will be better equipped to ensure their ultimate success.

Amy Roberts oversees the Fenestration and Glazing Industry Alliance FGIA Canadian standards and regulatory building and energy codes, as well as the Insulating Glass Manufacturers Association of Canada (IGMAC) Certification Program for Insulating Glass Units (IGUs). She has more than 20 years of industry experience in glass and IG manufacturing, including residential and commercial window manufacturing. She can be reached at aroberts@fgiaonline.org.

Guarding Foundations

Waterproofing with Polyurethane Sprayfoam

By Jean-François Lupien

PHOTOS COURTESY HUNTSMAN BUILDING SOLUTIONS AND GROUPE VALCO

In any construction project, the integrity of a building's foundation is paramount. Ensuring the longevity and structural soundness of a foundation requires effective waterproofing. If the water infiltrates, it can cause severe damage, including cracks, mould growth, and erosion of building materials. Fortunately, innovations in waterproofing technology—such as polyurethane sprayfoam and polyurea coatings—are revolutionizing the industry and transforming foundation waterproofing, focusing on the technical, economic, and environmental benefits. These advanced materials provide superior protection, enhance energy efficiency, and contribute to the sustainability of commercial buildings.

How to effectively waterproof commercial foundations

Waterproofing is essential for the long-term durability and stability of any building. Foundations, especially in large structures, are subject to various stresses—from environmental factors such as temperature changes and moisture to the sheer weight of the building itself. Water can infiltrate the foundation without proper waterproofing, leading to cracks, corrosion, and even complete structural failure in severe cases.

Traditional waterproofing methods, such as tacked membranes and bitumen coatings, have been used for decades. However, these systems have limitations, including potential seams and weak points where water can penetrate. Polyurethane sprayfoam and polyurea coatings provide a clear advantage, offering seamless, durable, and flexible protection.

Polyurethane sprayfoam and polyurea coatings are ideal for commercial waterproofing because they can handle large areas, withstand higher stresses, and resist environmental factors such as moisture and temperature changes. Their flexibility allows customization to meet challenges such as vibrations or chemical exposure. Additionally, these high-performance solutions help commercial buildings meet strict regulatory standards.

For a dry and durable exterior foundation

A stable and watertight building envelope is difficult to achieve when weather such as rain, snow, and ice affects the foundation. Issues such as cracks, water infiltration, and wood rot undermine the best building structure. The ideal time to insulate and waterproof a foundation is during the external excavation of an existing foundation or before backfilling a new one, ensuring a seamless seal between the footing and the wall.

Using sprayfoam insulation with a protective coating offers numerous benefits, simplifying the waterproofing process and enhancing overall efficiency. The foam expands to fill every crack, gap, or hole in the foundation, creating a continuous, seamless barrier that eliminates weak points common in traditional waterproofing methods, such as membranes, which require seams or adhesives. This comprehensive coverage strengthens the system's integrity, effectively preventing water infiltration. Also, sprayfoam is more adaptable to various application conditions and less sensitive to temperature fluctuations than traditional materials. This flexibility allows for installation across broader environmental conditions, minimizing weather-related delays. Moreover, sprayfoam insulates and seals simultaneously, reducing multiple steps into one. This streamlines the process, cutting installation time and labour costs and accelerating project completion.

In addition to weather conditions, the condition of the concrete is critical. New foundations require sufficient curing time, typically at least 28 days, to ensure optimal strength before waterproofing. This minimizes the risk of cracks and moisture infiltration. For existing foundations, the surface must be clean, dry, and free of loose debris for proper adhesion of the waterproofing materials. Following these guidelines ensures a durable, long-lasting seal and protection for the foundation.

In specific design applications, closed-cell sprayfoam insulation with an R-value of six per inch and an RSI of 2.06 for 50 millimetres can be used to meet and surpass energy code requirements while safeguarding the foundation.[1] This insulation is applied from the exterior, forming a continuous, bonded, seamless barrier without needing surface prep, sealing seams, filling gaps, or gluing boards. In specific design applications, protection boards are necessary per building codes when using closed-cell sprayfoam insulation to safeguard it from external forces or environmental damage.

Liquid blowing agent technology and a waterproofing foundation coating.

For example, a closed-cell polyurethane sprayfoam expands 30 times its original volume in just five seconds, thoroughly sealing the entire foundation. Typically, this sprayfoam is evaluated below grade by the National Research Council (NRC),[2] and findings show it maintains its integrity and is not prone to water absorption over time. It is resistant to flood damage because it expands rapidly, filling cracks, gaps, and voids within the foundation, forming a seamless, airtight seal. [3,4] The closed-cell structure of sprayfoam is inherently water-resistant, preventing moisture infiltration and absorption, making it ideal for below-grade waterproofing. Evaluations by the NRC show it maintains integrity even in prolonged water exposure or flood conditions. Its expanding nature ensures complete coverage of foundation contours, eliminating weak points common with traditional methods such as tacked membranes.

While sprayfoam resists moisture well, polyurea coatings are required for first-rate durability. Polyurea provides superior resistance to water, chemicals, and abrasion, making it essential for foundations exposed to harsh conditions, continuous water pressure, or heavy foot traffic. The combination of sprayfoam for sealing and polyurea for waterproofing and added protection offers the best defence against

Grid of steel rebar over the waterproof coating and closed-cell sprayfoam insulation to enhance durability and resistance to environmental factors.

long-term water damage, especially in flood-prone areas.

For new construction, the foundation is accessible from the exterior and can be insulated on its cold side, below grade, or before backfilling; this is the preferred approach for insulating below-grade foundations. Insulating the foundation from the exterior enhances energy efficiency, eliminates thermal bridges, stabilizes interior temperatures, and reduces the likelihood of condensation. In existing buildings, excavation may be necessary for waterproofing due to inadequate initial design or poor construction. A closed-cell polyurethane can be applied across the foundation surface, including over the footing, to direct water toward drainage systems. Applying polyurethane directly onto concrete, block, or stone foundations is advisable depending on the foundation type. Some sprayfoam options are classified as damp-proof materials. Still, when waterproofing is critical, additional layers such as polyurea coatings, bituminous coatings, or drainage membranes may be installed directly on the foam where high water levels or accumulation risks exist.

Maintaining the above-grade esthetic during excavation

What should be considered for the above-ground portion of the foundation? There are several viable solutions, but one efficient method involves installing a galvanized Z-bar structure along the above-ground sections. This setup allows for the continuity of the exterior finish that extends both below and above ground. Installation of this structure is essential before any polyurethane product is applied. After insulating, it is advisable to mount a lightweight cement board onto the Z-bars. Following backfilling, a finishing layer can be applied to the cement board to achieve the desired esthetic.

Polyurethane sprayfoam

Polyurethane sprayfoam is a high-performance material that provides insulation and waterproofing when combined with polyurea. Its ability to expand and conform to any surface makes it an ideal solution for complex foundation geometries. Some of its key advantages include:

- Seamless coverage—Unlike traditional waterproofing systems that involve seams or joints, sprayfoam and polyurea create a continuous, monolithic barrier. This eliminates weak points where water infiltration typically occurs.
- Adhesion—Polyurethane sprayfoam adheres to various substrates, including concrete, metal, and wood, making it versatile for construction materials. It also creates a clean substrate for the polyurea application, ensuring the adhesion of the sprayfoam to the substrate and the polyurea to the sprayfoam.
- High insulation value: Sprayfoam also provides excellent thermal insulation, helping regulate the internal temperature of the building and reduce energy costs.
- Polyurethane sprayfoam is an impermeable moisture and vapour barrier, preventing moisture from penetrating the foundation and effectively reducing condensation. In compliance with CAN/ULC S705.1, this standard ensures the performance of polyurethane sprayfoam in

Contractor spraying the waterproofing coating over closed-cell sprayfoam.

managing air infiltration and moisture control within building envelopes, providing robust protection and long-term durability.

Polyurea coatings

Polyurea coatings are essential for modern waterproofing systems, offering durability, flexibility, and fast-curing properties, making them ideal for commercial foundation protection. Application requires attention to temperature, surface conditions, and moisture content. Ideal ambient temperatures range from 10 C to 35 C (50 to 95 F), with substrate temperatures above 5 C (41 F). Surfaces must be clean, dry, and prepared adequately through methods such as sandblasting or grinding, with concrete surfaces needing a pH between seven and 10 and moisture content below four per cent.

Moisture and humidity are also crucial. The substrate should be at least 3 C (37 F) above the dew point to prevent condensation, and relative humidity (RH) should be under 85 per cent. When applied correctly, polyurea coatings use high-pressure spray equipment to cure quickly, ensuring long-term durability and resistance to moisture, chemicals, and abrasion.

The key advantages of these coatings consist of:

- Rapid curing time—Polyurea coatings can cure in minutes, allowing for fast application and minimal downtime. This is especially beneficial for commercial projects where speed is crucial.
- Flexibility—Polyurea maintains its elasticity even in extreme weather conditions, allowing it to expand and contract with the foundation as the temperature changes.
- Chemical and abrasion resistance—Polyurea is highly resistant to chemicals, UV rays, and mechanical wear, making it ideal for foundations exposed to harsh environmental conditions.
- Seamless barrier—Like sprayfoam, polyurea coatings form a continuous layer that provides seamless protection against water infiltration.

For reliable and durable waterproofing, polyurea is the ideal product to install directly on top of a high-performance sprayfoam. Polyurea coatings are non-toxic, quick-curing products compatible with almost any shape, forming a solid, 100 per cent waterproof barrier. This solution is ideal for various surfaces, including wood, concrete, metal, geotextiles, and sprayfoam. Together, these products deliver top-tier insulation and waterproofing, ensuring complete protection against water intrusion. Available in multiple colours, they can be applied in various levels of thickness and are resistant to both alkaline and mildly acidic conditions.

Case study: The Groupe Valco

To illustrate the effectiveness of polyurethane sprayfoam and polyurea coatings, consider Groupe Valco's project on a commercial construction site in Montreal. Groupe Valco, a leading insulation and waterproofing company, was tasked with addressing the foundation waterproofing needs of a commercial building.

The foundation waterproofing project during polyurea coating application over closed-cell sprayfoam.

During the assessment and planning stage, they evaluated the steps needed to perform the work with the highest quality and on time. The project, conducted in cold weather conditions, involved a building with a blindside wall constructed directly adjacent to an existing structure or retention system. With the project being in downtown Montreal and the limited space, it was challenging to waterproof the foundation to be poured. Traditional excavation methods were impractical due to the building's proximity to other structures, sidewalks, and towers.

Using traditional materials, the new foundations would need to be poured and excavated on its exterior, and then the insulation and waterproofing would be applied on the exterior of the new foundation. All this was not entirely possible. To overcome this challenge, the project team decided to insulate the retaining wall instead, apply the sprayfoam first, the waterproofing on top, and then pour the concrete—inverting the process. The team used a crane to gain a clear vantage point, enabling them to apply the waterproofing system effectively. From this elevated position, they applied a 76-mm (3-in.) layer of high-performance sprayfoam followed by a polyurea coating to the surface of the adjacent structure or retention system. Once the membrane was installed, the concrete foundation was poured directly on top, reaching a depth of 9 m (30 ft). This approach allowed for precise application of the waterproofing membrane and ensured project completion within the confined space. In contrast to traditional methods requiring extensive excavation, polyurethane sprayfoam eliminates the need for significant digging, reducing costs and installation time.

Combining polyurethane sprayfoam and polyurea coating proved the optimal solution for durable, long-lasting waterproofing. This system involves a two-component assembly, with a polyurea membrane applied directly over the hydroflouroolefin (HFO) sprayfoam. This waterproofing solution meets AC29 standards for below-grade applications. It complies with the *International Building Code* (*IBC*) and *National Building Code of Canada* (*NBC*), as confirmed by a UL report.

The results of the project demonstrated several key benefits. The combination of polyurethane foam and polyurea coating improved the foundation's structural integrity by creating a monolithic barrier that prevented water infiltration and protected against structural movement and freeze-thaw cycles. Additionally, the high R-value of sprayfoam enhanced the building's thermal efficiency, reducing heating and cooling costs while improving occupant comfort. The project was completed efficiently, even with space limitations, resulting in significant cost savings compared to traditional methods, with reduced site preparation, maintenance and energy costs, providing a rapid return on investment (ROI).

The polyurea coating's flexibility and elongation allowed it to adapt to the foundation's movement, preventing cracks and leaks even in extreme temperatures. Its resistance to chemicals and mechanical wear further contributed to the foundation's long-term durability.

Economic and environmental benefits

In combination, polyurethane sprayfoam insulation and polyurea coatings offer significant economic and environmental benefits. Some of the key advantages include:

- Long-term cost savings—Although the initial investment in polyurethane and polyurea systems may be higher than traditional materials, they offer significant advantages, including quicker installation times and substantial long-term energy savings, making them a cost-effective solution over time.
- Energy efficiency—Polyurethane sprayfoam provides excellent insulation, which helps regulate the building's temperature and reduces energy consumption. This lowers heating and cooling costs, making the building more energy efficient.
- Environmental footprint—Many polyurethanes and polyurea products are crafted with environmentally responsible ingredients, such as low levels of volatile organic compounds (VOCs) and sustainable blowing agents. For instance, some formulations feature an Ozone Depleting Potential (ODP) of 0.0, meaning they do not harm the ozone layer, and a Global Warming Potential (GWP) of less than one, indicating minimal impact on global warming compared to CO2. These formulations promote healthier indoor air quality (IAQ) by reducing VOC emissions and limiting exposure to harmful chemicals. At the same time, their low ODP and GWP contribute to more sustainable construction practices, as supported by their environmental product declaration (EPD). This combination helps create safer indoor environments and lessens the overall ecological footprint.
- Sustainability—Polyurethane sprayfoam insulation helps reduce the building's overall carbon footprint by improving energy efficiency. The long-lasting protection these materials provide also ensures the building remains in good condition for decades, minimizing the need for reconstruction or extensive repairs.
- Waste reduction—The seamless application of sprayfoam and polyurea coatings reduces material waste compared to traditional waterproofing methods, aligning with sustainability goals.

Best practices for application and maintenance

Following best practices for application and maintenance is essential to fully capitalize on the advantages of polyurethane sprayfoam and polyurea coatings.

During application, it is critical to properly prepare the surface by ensuring the foundation is clean, dry, and free of contaminants, as this promotes optimal adhesion. It is also important to follow the manufacturer's recommendations for the appropriate thickness of the polyurethane foam and polyurea coatings. Applying too thin a layer may reduce waterproofing effectiveness, while an overly thick layer can lead to material waste.

Additionally, applying these materials under suitable environmental conditions is crucial. Extreme temperatures or high humidity can affect curing times and adhesion, so scheduling the application during optimal weather conditions ensures the best results.

What is the future of commercial foundation waterproofing?

Polyurethane sprayfoam and polyurea coatings represent the future of commercial foundation waterproofing. As demonstrated by Groupe Valco's project, the combination of sprayfoam and polyurea coatings enhances the structural integrity of a foundation alongside further benefits.

Investing in polyurethane and polyurea systems is a smart choice for builders, architects, and engineers looking to future-proof their commercial projects. These materials offer superior protection, contribute to sustainability goals, and provide a return on investment that traditional waterproofing methods cannot match.

By adopting these cutting-edge solutions, construction professionals can ensure that commercial foundations remain strong, secure, and impervious to the elements for decades.

Jean-François Lupien is the global director of product management at Huntsman Building Solutions.

Brick by Brick

The Enduring Value of Clay Masonry

By Aarish Khan

PHOTO ©TONNY ANWAR/ COURTESY DREAMSTIME.COM

Imagine walking through a historic Canadian neighbourhood surrounded by century-old buildings with facades as solid and vibrant as the day they were constructed. What is the secret behind their resilience? The answer lies in a centuries-old material: clay masonry. This material has been the backbone of architecture across civilizations and continues to prove its value in modern Canadian design. For homeowners, architects, and designers today, clay masonry represents more than just a traditional building material; it offers an ideal combination of sustainability, timeless esthetics, and superior technical performance, making it the premier choice for facades in challenging climates.

From ancient mansions to the enduring appeal of historic townhouses, clay masonry has been a fundamental building material for centuries. The resilience of these structures, many of which stand tall to this day, speaks to the inherent durability of clay. In the Canadian architectural landscape, where climate and environment demand high-performance materials, clay masonry remains a go-to choice. For designers and architects, selecting the right facade material is about more than appearance; it is about technical details that ensure longevity, resilience, and sustainability. Clay masonry has earned its place as a leading choice for facades in Canada, offering a unique blend of practicality and enduring beauty.

The technical superiority of clay brick

One of the key advantages of clay masonry is its impressive compressive strength. Most Canadian masonry manufacturers produce clay bricks with an average compressive strength of 60 MPa (8.7 ksi) or higher, making them exceptionally strong and durable. This compressive strength is significantly higher than the average block on the market, surprising many who discover this fact. This strength is crucial in a country where buildings must withstand various environmental challenges, from heavy snowfall to high winds. The robust nature of clay bricks allows them to support significant loads while maintaining structural integrity over time.

Further, facades with clay bricks exhibit excellent durability, have great sound insulation, facilitate moisture management, and show remarkable thermal lag. Their high thermal mass enables buildings to absorb, store, and gradually release heat, contributing to energy efficiency. In the winter, homes stay warmer longer without excessive heating, and clay masonry helps keep interiors cool in the summer. As climate change drives fluctuations in temperature and increases the need for energy-efficient buildings, the thermal properties of clay bricks are invaluable.

Durability

Durability and longevity are crucial considerations when constructing buildings that stand the test of time. The durability of clay bricks is nothing new but not talked about often. For thousands of years, civilizations have used clay bricks to construct monumental structures that still stand today. These historical examples showcase the material's resilience to weathering, environmental factors, and even seismic events:

- The Great Wall of China: Stretching more than 20,921 km (13,000 miles), much of the Great Wall is constructed from clay bricks. It has endured for more than 2,000 years, with sections still standing strong despite natural and man-made wear.
- The Alhambra, Spain: A stunning example of architecture, the Alhambra is made from clay bricks and remains a well-preserved masterpiece more than 600 years after its construction.
- The Sumerian Ziggurats, Iraq: Some of the world's oldest monumental structures, these massive, stepped pyramids were built using mud bricks, a form of clay brick, around 4,000 years ago. Despite their age, many ziggurats are still visible today.
- McMartin House, Canada: Located at 125 Gore Street in Perth, Ont., this is a remarkable example of Loyalist Georgian architecture infused with American Federal style elements. Built in 1830 for Daniel McMartin, a prominent barrister and member of the Tory elite, this brick and stone house reflects the wealth and social ambitions of its era. Distinguished by its intricate detailing, cupola, and lanterns, the house symbolizes the craftsmanship and durability of traditional masonry. Designated a National Historic Site in 1972, it stands as a testament to the enduring legacy of clay brick and stone construction in preserving Canada's architectural heritage.
- The Grange, Canada: Built in 1817, the structure is a testament to the enduring craftsmanship of clay brick masonry. As the oldest remaining brick house and the 12th oldest building in Toronto, it exemplifies clay brick's strength, durability, and timeless esthetic. The house reflects the architectural heritage of the period. It showcases the historical significance of clay brick as a resilient and lasting building material capable of withstanding the test of time while maintaining its charm.

Many of these structures are still intact centuries later, demonstrating the inherent durability of clay bricks. Their ability to resist environmental factors, pests, and physical wear makes them an ideal building material for enduring architecture. Modern structures such as The Grange and McMartin house highlight clay bricks' exceptional resistance to environmental stressors and their low maintenance needs in Canada. This durability factor significantly reduces lifecycle costs, making clay bricks a sustainable and economical choice.

Fire resistance

While visiting a friend's place one weekend, the author noticed something unexpected. Known for his hands-on skills, the friend had built a makeshift barbecue using clay bricks. "I don't have a proper grill," he chuckled, patting the bricks. "But these can take the heat." Curious, the author watched as the bricks withstood the intense flames without cracking or crumbling. This simple observation sparked a question: Are clay bricks actually fireproof?

This moment led to a deeper appreciation of the fire resistance of masonry. For centuries, clay bricks have been relied upon for their ability to endure extreme conditions, providing safety and stability in countless structures. Their enduring role in fire-resistant design continues to inspire architects, engineers, and designers.

Clay bricks' fire resistance lies in their composition and manufacturing process. When fired at temperatures exceeding 1,000 C (1,832 F), they develop a dense and durable structure capable of withstanding extreme heat. They do not burn or release toxic fumes, and their solid form minimizes heat transfer, significantly slowing the spread of fire, even under prolonged exposure to high temperatures.

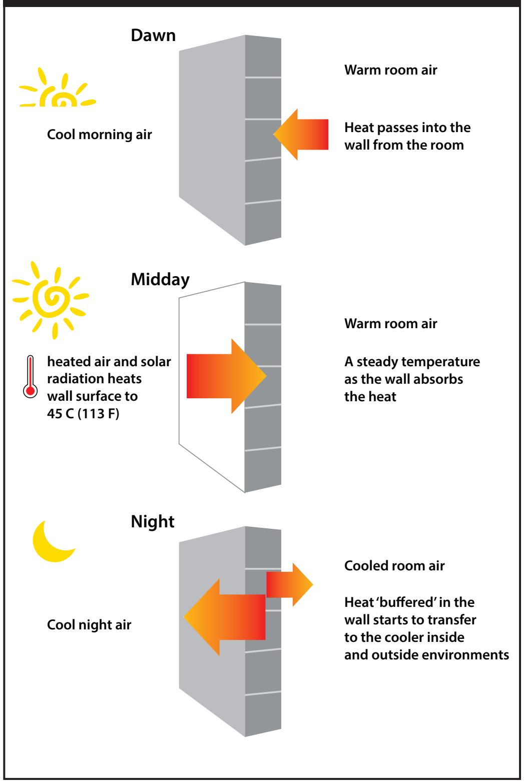
Standards and fire resistance ratings

Fire resistance ratings are determined using rigorous tests mentioned in CAN/ULC S101,

The Alhambra in Spain is made from clay bricks and remains a well-preserved masterpiece more than 600 years after its construction.

PHOTO ©SORIN COLAC/COURTESY DREAMSTIME.COM

FIGURE 1



During the day, bricks absorb heat from sunlight, preventing rapid temperature surges indoors. As temperatures drop at night, they release the stored heat, maintaining a stable indoor environment.

ILLUSTRATIONS COURTESY AARISH KHAN[3]

which measure an assembly's performance under fire conditions. This fire endurance test is the Canadian version of the ASTM E119 fire test used in the United States. In Ontario, designers refer to the Supplementary Standard SB-2 of the building code, which provides guidelines for clay bricks. For example, a 90-mm (3.5-in) standard clay brick unit, which is 80 per cent solid, is rated to resist fire for one hour. With thicker walls or multi-wythe assemblies, these ratings can exceed four hours, offering versatile solutions for fire-safe construction.

Clay bricks are a trusted material in fire-resistant construction. They are frequently used in walls and paired with insulation/fire retarders to limit the spread of flames in buildings and, in some countries, as load-bearing walls that combine structural support with fire containment. Their high thermal stability makes them ideal for industrial furnaces and other high-temperature applications. Similarly, using them as veneers also lowers the risk of fire jumping from one building to another.

Effectiveness during a disaster

Fire generally spreads through four mechanisms: conduction, convection, radiation, and direct flame contact. Clay bricks demonstrate effectiveness in mitigating fire spread against each of these methods:

- Conduction—Clay bricks are highly effective at resisting heat transfer through conduction. Their high density and porous mass absorb heat slowly, making them an excellent barrier to prevent the rapid spread of fire through walls. Unlike metals or combustible materials, clay bricks do not conduct heat efficiently or burn, containing the fire within a limited area for longer durations, providing enough time to take necessary actions. Clay bricks are non-combustible and maintain structural integrity even when exposed to direct flames. Unlike wood or synthetic materials, clay bricks neither ignite nor produce toxic fumes, making them dependable for walls and veneer applications.
- Convection—While clay bricks do not directly stop convection currents, as these involve air movement, they play a crucial role in sealed, fire-rated wall assemblies. By minimizing gaps and voids, clay bricks reduce the pathways for hot air to flow, limiting the spread of fire through air currents to adjacent spaces or buildings.
- Radiation: Clay bricks serve as a protective barrier against heat radiation. Their surface reflects or absorbs radiant heat, preventing nearby combustible materials from reaching their ignition temperature. This makes clay bricks ideal for firewalls or as barriers in high-risk areas.

According to the study by Santarpia *et al.*,[1] temperatures during building fires can vary significantly, often exceeding 500 C (932 F) during the post-flashover phase and reaching up to 1,200 C (2,192 F) in high fire-load conditions with limited ventilation. Fires involving hydrocarbon fuels can generate even higher temperatures, surpassing 1,100 C (2,012 F). Since most clay bricks are fired at temperatures ranging from 1,000 C to 1,200 C (1,832 to 2,192 F), they are well-equipped to withstand such extreme conditions.

Future enhancements in fire resistance through research

A study by Heikal et al. (2023)[2] explored the benefits of polymer-impregnated clay brick composites, highlighting that the inclusion of methyl methacrylate (MMA) polymers significantly enhanced the fire resistance, compressive strength, and durability of these materials. The polymer impregnation process fills the micropores within the clay matrix, making the structure denser and more resistant to heat-induced cracks. The study also suggested the compressive strength of the polymer-treated composites increased after thermal treatment, showcasing their enhanced resilience to fire and heat.

Thermal mass

Energy efficiency in modern buildings begins with the building envelope, which is a critical factor for influencing thermal performance. Often referred to as the structure's "first line of defence," the envelope regulates heat transfer, maintains a comfortable indoor environment, and lowers energy consumption. However, if this first line is weak, other building systems bear additional loads, increasing energy costs and reducing efficiency. A high-performance envelope ensures less energy is required to maintain desired indoor temperatures, reducing greenhouse gas (GHG) emissions and contributing to sustainability goals.

Thermal mass refers to a material's ability to absorb, store, and gradually release heat. This is the property at which high-density materials, such as clay brick, excel. During the day, bricks absorb heat from sunlight, preventing rapid temperature surges indoors. As temperatures drop at night, they release the stored heat, maintaining a stable indoor environment. This phenomenon, known as thermal lag, helps moderate temperature fluctuations, reduces HVAC loads, shifts heating and cooling demands to off-peak hours, and lowers energy costs. Historic masonry buildings exemplify the enduring benefits of thermal mass, often maintaining comfort even without additional insulation. However, modern clay masonry design, paired with insulation, is the best possible assembly that supports thermal lag and maintains a comfortable living space.

The primary reasons for thermal mass here are high density and porosity. These properties allow clay bricks to store significant amounts of thermal energy. Unlike lightweight materials, clay bricks perform well under real-world, dynamic conditions. Their ability to delay heat transfer is particularly beneficial in climates with substantial temperature variations between day and night. In addition to their density and robustness, clay bricks maintain their thermal properties for decades, ensuring consistent performance over a building's lifespan.

Understanding heat transfer in brick masonry

Fire, a function of heat, signifies that heat moves similarly to fire, as discussed earlier, through molecules via conduction, convection, and radiation. In brick masonry, conduction is the dominant mechanism. The effectiveness of bricks in slowing heat transfer depends on material properties such as:

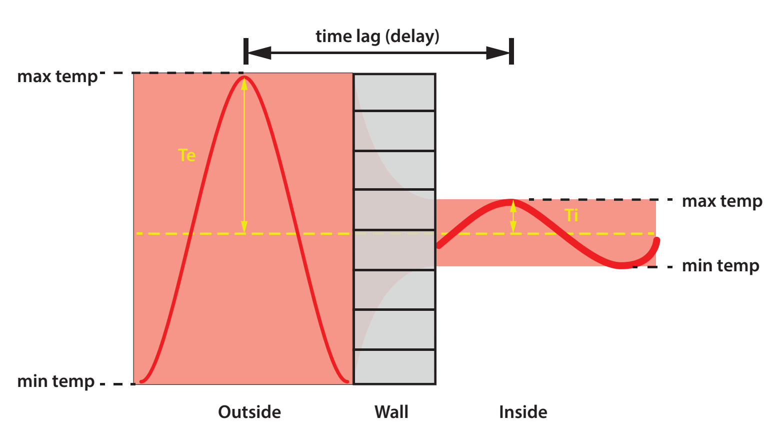
- Thermal conductivity (k)—Measures a material's ability to conduct heat.
- RSI-value (R-value)—Indicates thermal resistance or a material's ability to impede heat flow.
- U-factor—Represents the rate of heat transfer through a material assembly.

Brick masonry, with its naturally high RSI-values (R-values), ensures minimal energy loss when designed and detailed thoughtfully.

Minimizing thermal bridging

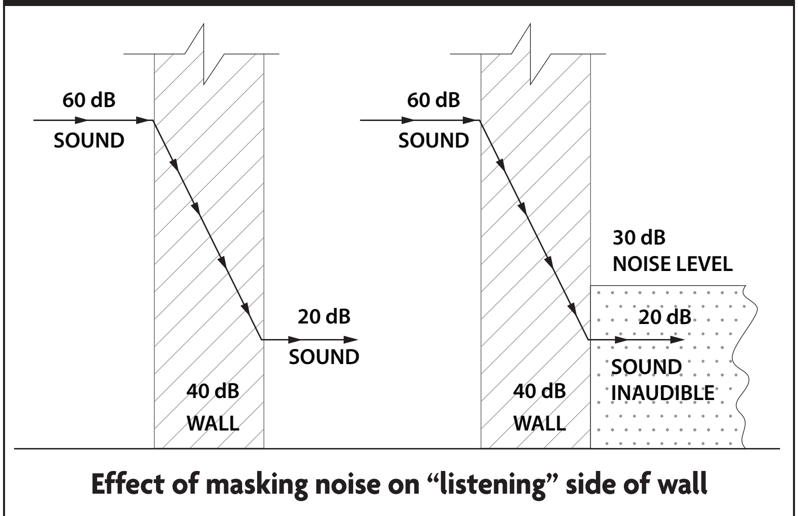
Clay bricks also help in reducing thermal bridges. Thermal bridging occurs when highly conductive materials, such as steel, create pathways for heat loss. Thermal bridging in brick masonry walls is minimal per square metre. The primary areas where thermal bridging may occur in a masonry veneer wall are the brick ties and the shelf angle. Interestingly, these are not specifically masonry issues but design challenges. Several products are available on the market to mitigate steel thermal bridges further. Many designers are also using masonry behind the shelf angle to

FIGURE 2



Thermal lag helps moderate temperature fluctuations, reduces HVAC loads, shifts heating and cooling demands to off-peak hours, and lowers energy costs.

FIGURE 3



Sound insulation is critical for ensuring privacy and minimizing noise pollution when creating comfortable and functional spaces.

ILLUSTRATIONS COURTESYAARISH KHAN[4]

address thermal bridging at the anchorage point, showcasing the efficiency of masonry.

Sound insulation

Sound insulation is critical for ensuring privacy and minimizing noise pollution when creating comfortable and functional spaces. Clay brick has proven to be a great choice for sound insulation, offering numerous benefits for residential and commercial buildings.

Understanding sound insulation

Sound insulation, also known as sound transmission loss, is a material or building assembly's ability to resist sound passage from one side to the other. This property is essential for reducing unwanted noise and ensuring privacy between the enclosed space and surroundings. It is crucial to differentiate sound insulation from sound absorption. Sound absorption refers to the ability of materials to absorb sound waves, reducing reverberation within a room. While both properties are important, sound insulation is the focus here, as it directly impacts how well a wall assembly can block sound from passing through.

Sound Transmission Class (STC) rating

Sound transmission loss is typically measured in decibels (dB) to evaluate a material's effectiveness in blocking sound. The result is often represented by an STC rating, a single-number rating that quantifies how well a building element, such as a wall, reduces sound transmission across a range of frequencies. The higher the STC rating, the better the material's ability to block sound. An STC rating of 50 or higher is considered excellent for sound insulation, as it can reduce most speech or common sounds to an inaudible level. According to a study conducted at Riverbank Acoustical Laboratories, various clay masonry walls demonstrated impressive STC ratings, showcasing the material's effectiveness in soundproofing.

Factors contributing to clay brick's sound insulation

- Mass and density: The weight of clay brick walls, measured in pounds per square foot (psf), contributes to their ability to block sound. Heavier materials tend to prevent sound waves from passing through because they absorb and dissipate the energy of the sound.
- Wall configuration: The thickness and construction of the brick wall also impact its sound insulation performance. Thicker walls or those incorporating multiple layers, such as the composite walls, are even more effective in reducing sound transmission.
- Structural integrity: The solid construction of clay brick walls, including proper mortar joints and well-curated design, enhances their soundproofing performance. Staggered joints and high-quality masonry contribute to the overall effectiveness of the wall in blocking sound.

How clay brick performs in sound insulation

Clay brick walls have consistently demonstrated superior sound insulation qualities. The Riverbank Acoustical Laboratories conducted numerous tests on different types of masonry walls, with clay brick and structural clay tile options performing exceptionally well in sound transmission loss. The results from these tests underscore the effectiveness of clay brick in creating quieter, more private spaces.

These examples demonstrate clay brick's robust sound insulation properties. The STC rating ranges from 45 to 59, depending on the wall configuration. The higher the STC rating, the more effective the material is at reducing sound transmission. This data can be found in *Ontario Building Code* (*OBC*) section 9.11 (note A-9.11).

While many materials are available for soundproofing, clay brick consistently outperforms other common materials, such as gypsum board or lightweight drywall, in terms of sound insulation.

Moisture management

Moisture management is critical in clay brick construction, particularly for facades exposed to weather. Clay brick's natural properties and the design of masonry systems enable effective moisture control, ensuring durability, performance, and longevity.

Moisture can enter a wall through several pathways, which may compromise the structure's integrity. Rainwater penetration occurs during heavy rainfall or wind-driven storms when moisture infiltrates through small gaps or imperfections in the brick veneer or mortar joints due to wind pressure. Additionally, water can be drawn into the brick or mortar via capillary action, especially in prolonged wet conditions, as moisture is absorbed through small pores.

Condensation is another common issue, where warm, moisture-laden air from inside the building migrates into the wall cavity, where it cools and condenses, particularly in poorly insulated or inadequately ventilated walls. Groundwater can also wick upward through the foundation via capillary action if proper damp-proofing is not installed at the base of the wall. Further, improper detailing, such as missing or poorly installed flashing, weep holes, or vents, can lead to moisture infiltration. The vulnerable openings such as windows, doors, and roof-wall intersections are particularly at risk if not properly sealed and flashed. So before discussing how clay brick helps manage moisture, one must understand what happens if it is not managed.

Improper management of moisture in a clay brick wall can turn a sturdy, reliable facade into a crumbling mess faster than one can say "waterproofing fail." Structural damage starts with freeze-thaw damage, where moisture sneaks in, freezes, expands, and turns the sturdy brick into a fragile mess. Further, efflorescence, that unsightly white powdery stuff on the surface, appears when excess moisture dissolves salts in the brick, signalling deeper moisture problems. As moisture continues to penetrate, it causes erosion of mortar joints, weakening the bond between bricks and leaving gaps that allow even more water in, accelerating the damage. Additionally, moisture can wick upward from the foundation, leading to capillary rise, which can cause cracking and settlement at the base of the wall, compromising the entire structure.

Beyond structural concerns, moisture leads to esthetic degradation. Staining and discolouration are common, along with the possibility of algae or mould growth, which looks unpleasant and is often costly and difficult to remove. Surface spalling occurs when trapped moisture causes the brick's surface to flake off, permanently affecting the wall's appearance. Thermal and energy efficiency may also suffer as moisture reduces the effectiveness of insulation, leading to increased thermal bridging where wet materials conduct heat more easily, raising energy consumption. High humidity levels also degrade indoor air quality, leading to damp, musty odours that fill the building. Without proper moisture management, building owners will face costly repairs and maintenance. Leaks due to improperly placed flashing, weep holes, or vents are expensive to diagnose and repair, and accelerated deterioration can result in premature replacement of bricks or mortar. Ultimately, unchecked moisture reduces the building's lifespan, often necessitating extensive or complete restoration to restore structural stability.

Therefore, there needs to be a robust system for moisture management to tackle moisture issues. The clay brick rainscreen system uses an outer cladding layer of clay brick or any other masonry to protect the structure from direct exposure to rain and environmental elements. Behind the brick veneer lies an air cavity that facilitates drainage, ventilation, and the drying of any moisture that may penetrate the cladding. This combination of traditional material benefits and advanced engineering

Key performance examples:

Description	Sound transmission class (STC)	Wall thickness	Test number	Notes
102-mm (4-in.) face brick wall	STC 45	76–95 mm (3–3.75 in.)	TL 67-70	
152-mm (6-in.) "SCR brick" wall, with 9.5 mm (0.375 in.) gypsum board over 25.4-mm (1-in.) extruded polystyrene (XPS) insulation one face	STC 49	152–175 mm (6–6.87 in.)	TL 70-39	Styrofoam placed with adhesive, spot applied 304.8 mm (12 in.) o.c. both vertically and horizontally; 22-mm (0.87-in.) gypsum board applied vertically.
203-mm (8-in.) face brick and structural clay tile composite wall	STC 50	203 mm (8 in.)	TL 67-65	
254-mm (10-in.) face brick cavity wall, with 50.8-mm (2-in.) air space	STC 50	254 mm (10 in.)	TL 68-31	Two wythes of masonry tied with metal wall ties.
102-mm (4-in.) brick wall, with 5-mm (0.5-in.) sanded plaster, two-coat one face	STC 50	50.8–105 mm (4–4.125 in.)	TL 69-283	
152-mm (6-in.) "SCR brick" wall	STC 51	127–138 mm (5–5.5 in.)	TL 69-286	
203-mm (8-in.) solid face brick wall	STC 52	203 mm (8 in.)	TL 67-68	
203-mm (8-in.) solid brick wall, with 5-mm (0.5-in.) gypsum board on furring strips one face	STC 53	229–235 mm (9–9.25 in.)	TL 69-287	Collar joint filled with mortar; metal Z ties spaced at 610 mm (24 in.) o.c.; gypsum board applied vertically.
152-mm (6-in.) 'SCR brick' wall, with 5-mm (0.5-in.) plaster one face	STC 53	152 mm (6 in.)	TL 70-70	

makes it the optimal choice for safeguarding structures over the long term.

Beyond moisture control, the durability of the clay brick rainscreen system is unparalleled. Clay bricks are naturally resistant to weathering, including UV exposure, rain, wind, and freeze-thaw cycles, making them ideal for protecting structures in harsh climates. Other sections of this article talk about pores or absorption of clay bricks, which are crucial parts of temperature regulation. Also, the pores are important in masonry to bond strongly with mortar. Clay bricks' controlled porosity allows them to absorb moisture during exposure and gradually release it, preventing water buildup.

How moisture exits the wall

Once moisture has entered the wall, the rainscreen system uses an air cavity and a series of components to direct the water out of the wall assembly and prevent it from damaging the underlying structure.

- Air cavity: The space between the brick veneer and the backup wall is critical for moisture management. This air cavity allows water that penetrates the brick veneer to drain downward toward the base of the wall. The cavity also facilitates airflow, which helps dry residual moisture over time.
- Flashing: Flashing is strategically installed at critical points of the wall, such as above windows and doors, at the base of the wall, and at any location that needs to be drained. Flashing directs water that enters the cavity toward the weep holes. It acts as a barrier to prevent moisture from travelling deeper into the structure and remaining there. This ensures the water exits the system rather than penetrating the internal building materials or staying in the wall system to cause harm. Flashing must slope toward the exterior and extend past the brick face to guide the moisture out effectively. It must have a drip edge to ensure the moisture is not falling back on the masonry.
- Weep holes: These are small openings on the base of the wall, often misunderstood by homeowners who mistakenly think the masons forgot to fill them with mortar—only to discover

later just how wrong they were. These crucial openings are located just above the flashing, allowing water to exit the wall system. These small openings allow accumulated water in the cavity to drain out. Weep holes prevent moisture from pooling within the cavity, which could lead to issues such as mould, efflorescence, or structural damage. Properly spaced weep holes, typically no more than 610 mm (24 in.) apart, ensure efficient drainage of any infiltrated water.

- Vents: These are placed at the top of the wall. They may look similar to weep holes but serve a different purpose and are just as important. Unlike weep holes, homeowners do not typically clog vents, mainly because they are high up. Although not always required by code, vents are crucial in ensuring continuous airflow within the wall cavity. They help facilitate the evaporation of any residual moisture that remains after the flashing and weep holes have done their job. This airflow aids in drying out the cavity, preventing moisture buildup and preserving the integrity of the wall system. The combination of ventilation and drainage mechanisms ensures the wall cavity stays dry, reducing the risk of condensation or mould growth.

To summarize, effective moisture management is essential for maintaining the integrity, durability, and esthetic appeal of clay brick facades. The clay brick rainscreen system offers a comprehensive solution by combining the natural properties of clay brick with engineering features such as air cavities, flashing, weep holes, and vents. These components work together to prevent moisture infiltration, facilitate drainage, and promote airflow, ensuring that any moisture penetrating is effectively managed and evacuated.

Sustainability: A key component of clay masonry

Sustainability has become an important aspect of modern construction practices, and clay masonry could play a pivotal role in achieving a net-zero carbon-built environment. The only significant energy input for clay bricks occurs during the firing process, typically heating clay to more than 1,100 to 1,200 C (2,012 to 2,192 F). This is the only process that requires a considerable amount of energy, often sourced from natural gas. Currently, the manufacturing industry is making efforts to transition to low-carbon fuel sources, such as hydrogen, or to electrify production processes using renewable energy.

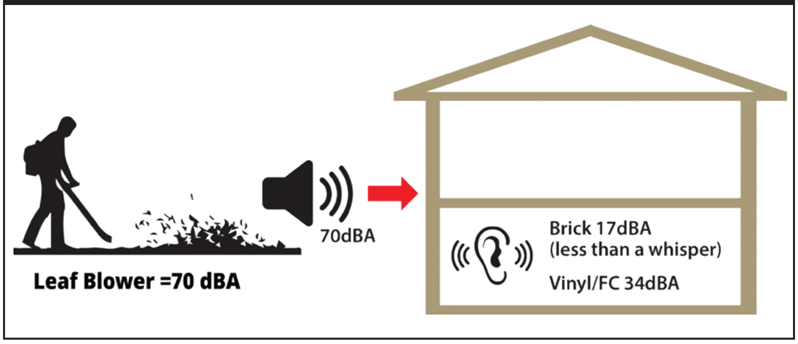
A highly ignored fact about clay masonry is that it is durable and recyclable at the end of its life. In 2023, Cheng H., in his paper on reuse of research progress on waste clay brick, indicated that around 90 per cent of brick construction waste can be recycled, usually down-cycled into aggregate for road fills or other construction uses. Canadian manufacturers often send their used bricks to be crushed and repurposed in tennis and baseball courts, exemplifying a circular economy approach that minimizes waste and resource consumption.

The recycling of waste clay bricks is gaining traction in sustainable construction. Waste clay brick (WCB) is classified as silicate solid waste, and its recycling holds significant environmental and social importance. Recent research has highlighted various applications for WCB, such as using it as recyclable coarse and fine aggregate in concrete and mortar, wall materials, and as a raw material or additive in producing recyclable cement.

Studies have shown that WCB can serve as a supplementary cementitious material, positively impacting the physical mechanics, deformation, and durability of cementitious materials. Additionally, WCB has been explored as an environmental material capable of eliminating fluorine, ammonia, nitrogen, and phosphates from wastewater, showcasing its versatility beyond construction.

Research also suggests grinding brick waste into recycled brick powder (RBP) and using it instead of cement is a feasible method to create sustainable construction materials. RBP is rich in silica (SiO2), alumina (Al2O3), and iron oxide (Fe2O3), exhibiting pozzolanic activity that can enhance the properties of cement-based materials. By partially replacing Portland cement

FIGURE 4



Sound insulation because of clay masonry veneer.

Stretching more than 20,921 km (13,000 miles), much of the Great Wall of China is constructed from clay bricks. It has endured for more than 2,000 years, with sections still standing strong despite natural and man-made wear.

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with RBP (typically five to 15 per cent), the final product can improve workability, mechanical strength, and durability. This approach not only conserves landfill space by reducing the accumulation of brick waste but also decreases the concrete industry's reliance on traditional Portland cement, thereby supporting the sustainability of construction materials and promoting global prosperity.

Conclusion

In summary, clay masonry is an exceptional choice for facade materials, combining superior technical performance with sustainability and esthetic appeal. Its strength, thermal efficiency, and recyclability make it a critical component of modern building practices, particularly in Canada's unique climate challenges.

As the industry continues to evolve, brick masonry's timeless appeal and unmatched performance make it a cornerstone of sustainable architecture. From traditional heritage buildings to cutting-edge designs, clay bricks' potential as a holistic energy solution is boundless. By embracing this material's strengths, architects and builders can craft structures that exemplify efficiency, resilience, and beauty.

Notes

[1] Refer to Santarpia, L., Bologna, S., Ciancio, V., Golasi, I., & Salata, F. (2019). *Fire Temperature Based on the Time and Resistance of Buildings—Predicting the Adoption of Fire Safety Measures.* Fire, 2(19). DOI: 10.3390/fire2020019.

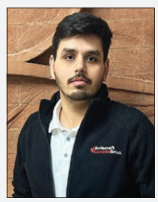
[2] See Heikal, M., Amin, M. S., Metwally, A. M., & Ibrahim, S. M. (2023). Improvement of the performance characteristics, fire resistance, anti-bacterial activity, and aggressive attack of polymer-impregnated fired clay bricks-fly ash-composite cements. *Journal of Building Engineering, 55*, 107987. https://doi.org/10.1016/j.jobe.2023.107987

[3] Original image from GreenSpec.

[4] Original image from Brick Industry Association (BIA).

References

- Cheng, H (2023). Reuse research progress on waste clay brick. College of Civil Engineering, North China University of Technology, Beijing.
- Bricks and net-zero building. Wienerberger UK. Retrieved from Wienerberger UK (2023).
- Clay brick could be the turning point in helping to decarbonize construction (2023). Retrieved from BM Careers.
- The role of bricks in achieving net-zero carbon emissions in construction (2023). Retrieved from *The Independent.*
- Research progress on recycled clay brick waste as an alternative to cement for sustainable construction materials (2023). Journal of Construction Materials Research.



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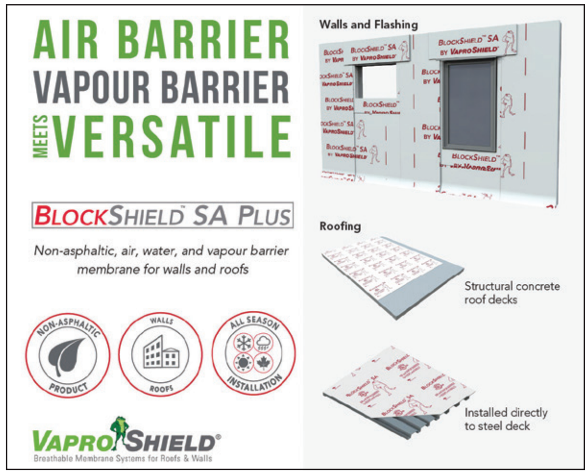

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Aluflam North America, a leader in fire-rated aluminum/glass construction, announces a significant advancement in their true aluminum framing system. Utilizing Vetrotech's groundbreaking CONTRAFLAM® One interlayer technology, Aluflam can now provide improved performance in a single intumescent chamber solution across all performance ratings.

The Aluflam aluminum framing system is already the preferred choice for a fire-rated solution without compromising on aesthetics with its ability to seamlessly blend with non-fire-rated glazing systems. By combining CONTRAFLAM® One interlayer glass technology with Aluflam framing, projects can now incorporate much larger openings, representing an increase of up to 40%. This opens up new possibilities to feature bigger windows and brighter, more inviting interiors.

www.aluflam-usa.com

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All Work and No Play?

In my last message, I touched on a concept many of us are familiar with—work-life balance. But what does it truly mean, and can we realistically achieve it in our careers? Can we really "turn off" work at the end of the day?

My boss often jokes that we work "half days"—from 7 a.m. to 7 p.m. With that mindset, am I expected to completely disconnect from work at 7:01 p.m. and forget about it until 6:59 a.m. the next day? The truth is, it's not that straightforward. While work-life balance sounds appealing and is attainable in some fields, I believe work-life integration is a far more practical and achievable approach in today's flexible work environment.

Work-life balance revolves around maintaining a clear separation between work and personal life. It emphasizes allocating specific time for professional responsibilities and personal activities and ensuring neither encroaches on the other. This concept requires very structured boundaries, with no allowance for overlap, and prioritizes an allowance for downtime and rest.

In contrast, work-life integration is a more fluid approach where work and personal life are seamlessly blended rather than separated. This approach offers greater flexibility in managing both aspects of life. Integrating both allows work and personal lives to flow together without the rigid schedule and provides an avenue for both to coexist.

An analogy I read about these two concepts is to think of work-life balance as being a see-saw, where work and personal life are in opposition, and work-life integration resembling a Venn diagram, with both areas overlapping.

There are key differences between the two concepts, and the right approach depends on the person, their work environment and role, and obviously their personal preferences. Some careers and people allow for a clear separation of the two. Still, realistically, work-life integration tends to be more achievable and sustainable, as it supports our modern, flexible working arrangements, especially with remote work being much more common than a few years ago.

Regardless of your choice, the goals are the same... to create a satisfying and healthy balance between professional and personal commitments.

I am CSC.

Juste le travail et pas de jeu?

Dans mon dernier message, j'ai abordé un concept que bon nombre d'entre nous connaissent : l'équilibre travail-vie personnelle. Mais qu'est-ce que cela signifie vraiment et pouvons-nous l'atteindre de façon réaliste dans nos carrières? Pouvons-nous vraiment « arrêter » le travail à la fin de la journée?

Mon patron plaisante souvent en disant que nous travaillons une « demi-journée » de 7 h à 19 h. Avec cette mentalité, suis-je censé me déconnecter complètement du travail à 19 h 01 et l'oublier jusqu'à 6 h 59 le lendemain? La vérité est que ce n'est pas si simple. Bien que l'équilibre entre le travail et la vie personnelle semble attrayant et réalisable dans certains domaines, je crois que l'intégration du travail et de la vie personnelle est une approche beaucoup plus pratique et réalisable dans le milieu de travail souple d'aujourd'hui.

La conciliation entre le travail et la vie personnelle consiste à maintenir une séparation claire entre le travail et la vie privée. Il met l'accent sur l'attribution de temps spécifique aux responsabilités professionnelles et aux activités personnelles, sans empiéter sur les autres. Ce concept exige des limites très structurées, sans prise en compte du chevauchement, et accorde la priorité à l'importance du temps d'arrêt et de repos.

Par contre, l'intégration du travail et de la vie personnelle est une approche plus fluide où le travail et la vie personnelle sont parfaitement mélangés plutôt que séparés. Cette approche offre une plus grande souplesse dans la gestion des deux aspects de la vie. L'intégration des deux permet de faire coexister la vie professionnelle et la vie personnelle sans avoir à respecter un horaire rigide.

Une analogie que j'ai lue à propos de ces deux concepts est de considérer l'équilibre entre le travail et la vie personnelle comme un phénomène de sérénité, où le travail et la vie privée sont en opposition, et l'intégration du travail et de la vie personnelle ressemble à un diagramme de Venn, les deux domaines se chevauchant.

Il existe des différences essentielles entre les deux concepts, et la bonne approche dépend de la personne, de son environnement de travail et de son rôle, et évidemment de ses préférences personnelles. Certaines carrières et personnes permettent une séparation claire des deux. Pourtant, de façon réaliste, l'intégration du travail et de la vie personnelle tend à être plus réalisable et durable, puisqu'elle favorise nos modalités de travail modernes et flexibles, surtout que le télétravail est beaucoup plus courant qu'il y a quelques années.

Peu importe votre choix, les objectifs sont les mêmes... créer un équilibre satisfaisant et sain entre les engagements professionnels et personnels.

Je suis DCC.