Stantec

Design *Quarterly*

Thoughts, trends, and innovation from Stantec's Buildings practice

ISSUE 25

Regrowth and Renewal

Progress never ends

Design can help us regrow our communities, lessen our carbon impact, and improve our quality of life.

In this issue, we're looking at why and how universities can renovate. We explore a modular design for rebuilding community in Ukraine. We show how battery electric buses will reshape the maintenance bay.

A building scientist shares an innovation that can enhance safety and efficiency in many new or retrofitted buildings. Plus: a sustainability standard renewed? Read our take on LEED v5.

Ridgeway Science & Technology
Boulder, CO

ISSUE 25

Regrowth and Renewal

The Stantec Design Quarterly tells stories that showcase thoughtful, forward-looking approaches to design that build community.

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Retrofit for regrowth: Learning from design for damaged housing

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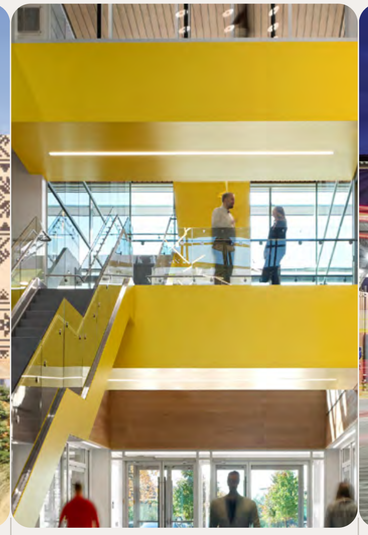
By Tracy Eich and Aida Sanchez-Gomez



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Three big questions about LEED v5

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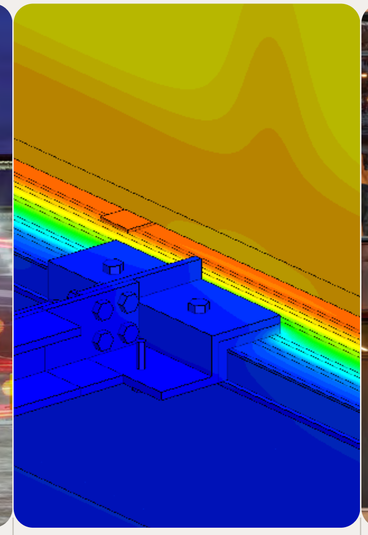

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How Passive House led us to a next generation building window connection

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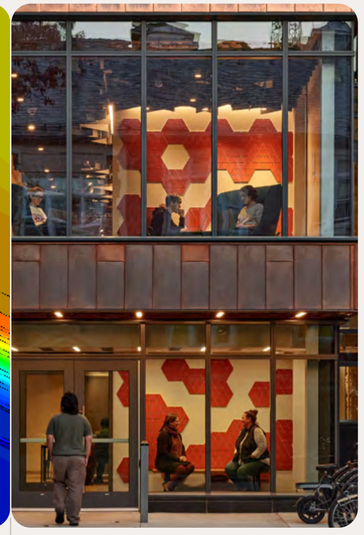
By Cody Belton



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Campus updates: Renovate that university building or build new?

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By Kate Ryan

With your reading experience in mind, we have built in easy ways for you to navigate this document. Use the bottom menu, arrows, and the table of contents to flip to different sections. Watch for information icons, arrows, buttons, and underlined hyperlinks throughout the document. They will lead you to more information.

Retrofit for regrowth: Learning from design for damaged housing

9 strategies for revitalizing communities that emerged from our modular retrofit solution for Kharkiv, Ukraine

By: Tracy Eich and Aida Sanchez-Gomez

The Healing Network
Kharkiv, Ukraine

What is the role of design in revitalizing distressed apartment blocks?

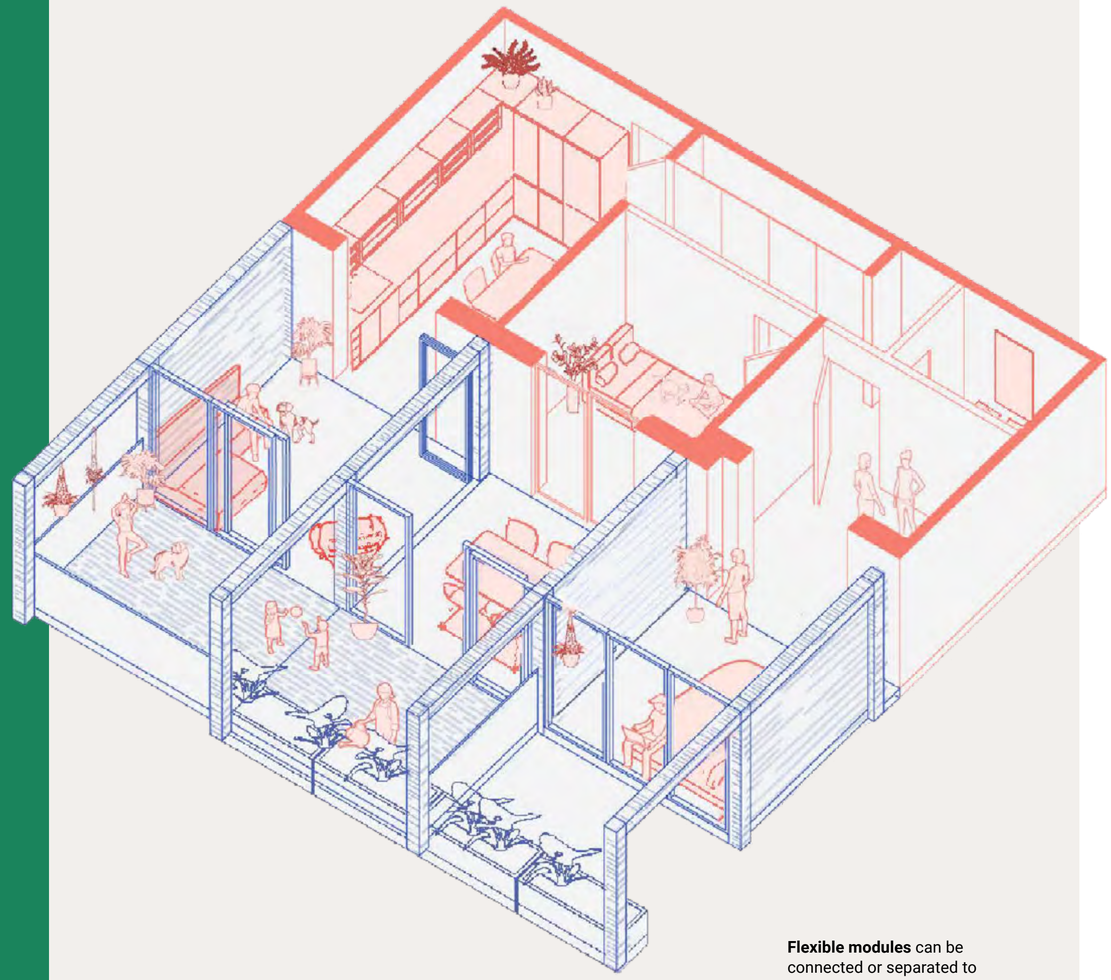
Can design strategies promote regrowth and revitalize urban fabric, too? How can we retrofit at various scales—from the dwelling unit to the building to neighborhood to the city—to promote rapid regrowth? Our team considered the role of design in revitalizing housing battered by conflict in a recent design competition for a community in Kharkiv, Ukraine.

The Norman Foster Foundation Kharkiv Housing Challenge competition tested architects and designers to develop a modular system to retrofit existing concrete housing blocks. Entries were to focus on creating safe, efficient, vibrant neighborhoods. The task was to create a modular façade and bomb shelter while enhancing public areas and ground floor activity. The modular system had to re-erect the damaged building with a renewed, locally-rooted identity. The competition was part of a larger effort to rebuild Kharkiv's communities and public spaces.

The Healing Network was our competition entry. We designed the Regrowth Modular construction system to transform the Block 86 housing development. Our entry took a holistic multi-disciplinary approach to building healing networks at various scales. Our design was one of six projects in the international competition recognized with an honorable mention.

As our approach to urban revitalization in the heart of Kharkiv took shape, we realized our design approach was suited to wider application. And even those that are more specific to Block 86 Kharkiv could be adapted to urban neighborhoods elsewhere. Regrowth is more than rebuilding. It's about reconnecting people to their home, their neighborhoods, nature, and each other, socially, emotionally, and economically.

Let's talk about nine ways we designed for community regrowth from the unit to the building to the network.



Flexible modules can be connected or separated to create privacy or enhance connection.

PART I

Regrowth at the unit scale

01.

Update housing to today's preferences and lifestyles

People want their dwellings to support the way they live today. We can invigorate multifamily dwellings by bringing housing units up to today's standards. We can infuse living units with access to natural light and outfit them with modern amenities and appliances. We can retrofit them for flexibility and energy efficiency.

At Block 86, our design modernizes Soviet-era housing into flexible, desirable city dwellings. A flexible open plan supports a modern lifestyle with an updated kitchen, laundry, and storage areas. We created multiple unit types to support varying families. The open-plan units can flex to the evolving needs of residents with the use of interior sliding panels. Rooms can become offices or entertainment areas. We added outdoor terrace space to living units and floor to ceiling glass to encourage social and natural reconnection.

PART II

Regrowth at the building scale

02.

Refresh the building identity (and tell a story)

Architecture can tell an inspiring story. And with a multi-family building, the façade faces the public. It's the personality of the building.

At Block 86, we gave the building a new identity in a bold new façade. In the Japanese art of Kintsugi, craftspeople repair ceramics showing off the former cracks with metallic finish. Inspired by nature's resiliency and Kintsugi, we designed calming blue rooms or "gems" to fill the demolished areas at Block 86. These gems can be used as shelter or to host events. These blue rooms turn scars of war into symbols of renewal.

Our module adds new elements to the dwelling units and the building façade, becoming another layer in the story of Block 86. The Regrowth Module system extends from the ground plan to the roof. Newly insulated skin expands the living units and gives residents attractive outdoor terrace spaces. The new façade, adorned with a vertical garden, sits atop a foundation that doubles as a bomb shelter—an element required by the competition. And a new community vertical pathway encourages community interaction and easy access. Exterior panels celebrate Ukrainian culture with subtle graphic patterns derived from vyshyvanka embroidery.

03.

Revitalize assets with new uses

Regrowth requires us to come up with creative uses for existing and new spaces. It's a chance to reprogram and activate the building, to foster social, natural, and economic connections. In the Healing Network, we give spaces multiple identities to increase resiliency. The required long-stay bomb shelter becomes the concrete foundation for the new façade. The new exterior community path provides pedestrian access from the ground to the roof. A roof deck hosts verdant gardens, recreational amenities, and leisure activities. And the building's central hall doubles as a short-term safe room.

The Healing Network design aims to turn scars of war into symbols of renewal.

04.

Make it repeatable, scalable, and flexible

The competition asked us for a scalable and repeatable solution. To be effective in conflict zones or other areas in need, a regrowth strategy should be easy to adapt. It should be simple for builders to implement in different building types, scales, and situations.

We designed a highly flexible modular system to use on Block 86. It can be repeated across any standard block housing found in Ukraine. It is scalable across varying site conditions in Kharkiv and elsewhere in Ukraine. It's a versatile solution for urban development. Modular housing unit design provides unparalleled flexibility, enabling customization to meet diverse needs.

05.

Design for rapid deployment

In areas where buildings have been destroyed or damaged by war or disaster, the community can't wait. It needs fast-track solutions to achieve a degree of normalcy. Kiev-based studio Zikzak's Revival, for example, uses prefabricated, portable "blocks" to create schools.

We designed the Regrowth Module for rapid deployment on damaged apartment buildings. This flat pack system is composed of timber, steel, and concrete components. All can be fabricated in the region and easily shipped to sites in Ukraine. Contractors can quickly assemble framing for the outdoor balconies, stairs, and shared areas on site. The design aligns seamlessly with the existing load-bearing walls and concrete plank floors at Block 86. But we've made it scalable to different building types and sites.

The Healing Network design features a vertical garden on the façade, adding visual appeal.

06.

Apply a sustainable approach

Research has shown that natural materials can have health benefits, reducing stress and speeding healing—even inspiring positive emotions. Biophilia hypothesizes that humans have evolved to benefit biologically from being around or seeing nature.

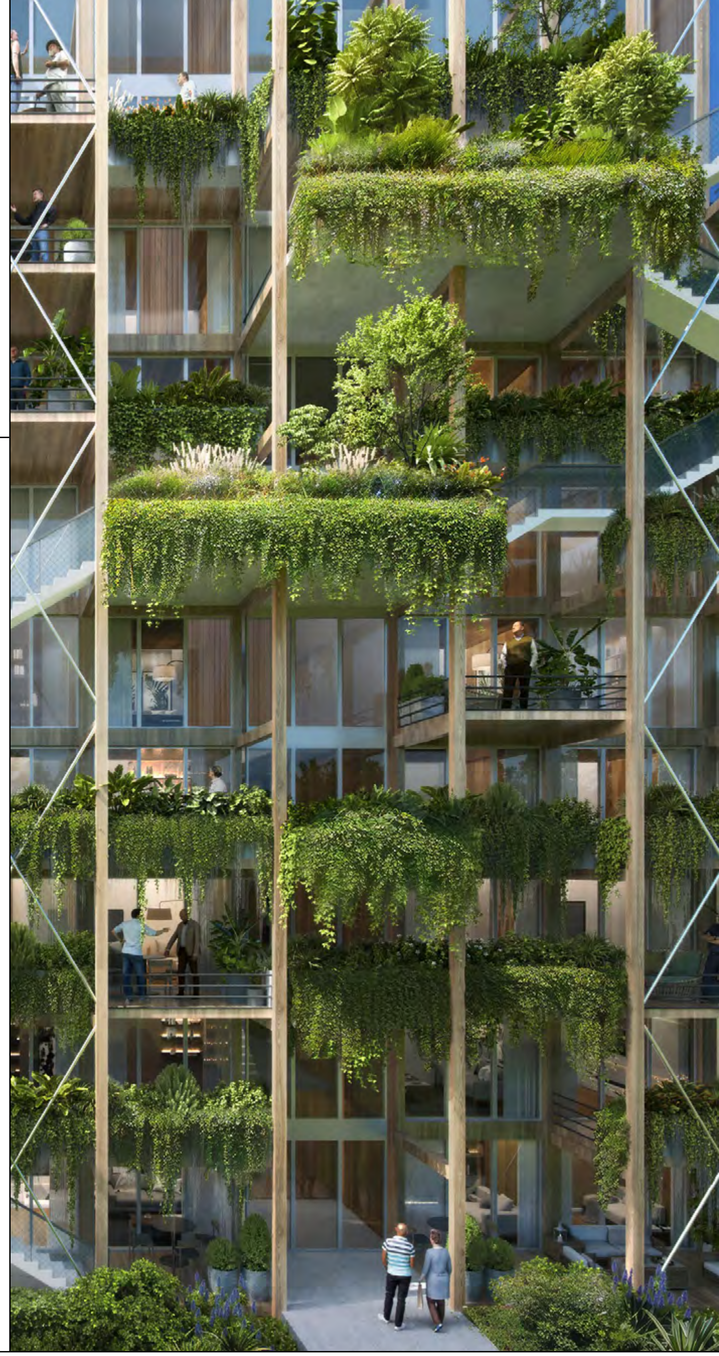
Rebuilding communities in damaged areas should not further strain the natural systems in these areas or elsewhere. We thought about sustainable construction in our design for the modular system.

Contractors can build the Regrowth Module from locally sourced materials and renewable timber. This reduces the carbon impact from transportation and fabrication. Its balconies contain recycled materials.

Nature informs our design. We integrated a vertical garden into the façade to enhance the building's visual appeal. It adds a heavy dose of biophilia, improves air quality and reduces the urban heat island effect. On the building's green roof, you'll find renewable energy production, rainwater harvesting, and passive solar heating. We upgrade the building with high-performance insulation, energy-efficient windows, and solar panels.

PART III

Regrowth at the network scale



07.

Embrace the outdoors

When we zoom out and see the building and its landscape as part of the larger living system of the city and its ecology, we can tap into a larger network of regrowth. The Healing Network design for open space and landscape at Block 86 North Saltivka promotes healing and connection in the community and positions the neighborhood to flourish as a part of a dynamic Kharkiv.

Blurring the lines between landscape and architecture, the open space design draws inspiration from Kharkiv's cherished parks. The Healing Network seamlessly integrates native plants, hardscape, and water features into a restorative, park-like setting where residents can relax, recreate, and reconnect.

We envision the Healing Network building as a living system, harmoniously sustaining itself with nature. The plants, trees, and timber form a closed-loop ecosystem. Growth and renewal are continuous. Our landscape design features a flexible pavilion and community garden for urban farming.

The multi-function pavilion supports flexible programming at the ground level, fostering community and purpose. Residents can use it for community gatherings, storage, or retail.

08.

Strengthen economic and social resilience

In recent years, the 15-minute city has taken hold as a goal for urban planners. Research shows that walkable or bikeable neighborhoods can boost equity and local business in the community while reducing emissions from cars. Researchers tout its economic and health benefits.

Our plan embraces the 15-minute city approach as a tool for revitalization and strengthens the relationship between the community and the surrounding city. It enhances opportunities for residents to thrive economically.

Our design strengthens the neighborhood connection to the surrounding city. It incorporates walkways and cycling paths that connect the residents to the city, its transportation networks, and the famed Lisopark, the city center and "future science neighborhood."

The Healing Network design for open space offers a vision for community healing and connection, positioning the neighborhood to thrive as an integral part of a vibrant, reinvigorated Kharkiv.

The Kharkiv Housing Challenge

Judges evaluated the Norman Foster Foundation Kharkiv Housing Challenge entries in four areas:

Versatility and adaptability
The ability of the modular system to address a wide range of damage scenarios and building types

Sustainability
The environmental impact of the proposed solutions, focusing on energy efficiency and material recycling

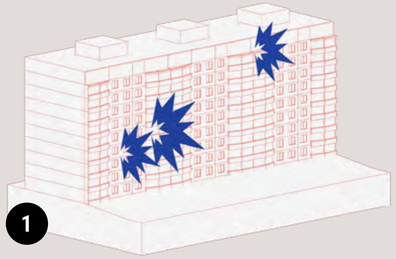
Cultural sensitivity
The design's respect for the existing urban fabric and architectural heritage

Feasibility
The practicality of implementing the modular components in real-world settings

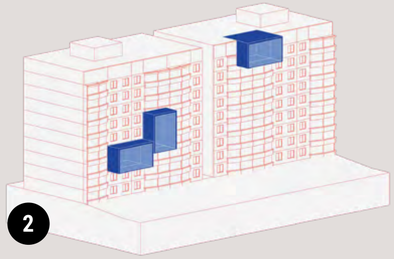
Read more about the Norman Foster Foundation Kharkiv Housing Challenge competition.

SEE THE WINNERS →

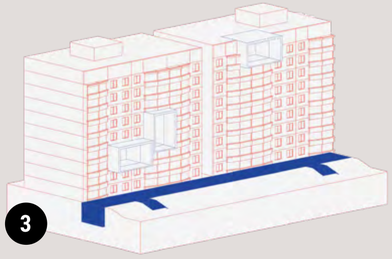
Construction Phasing



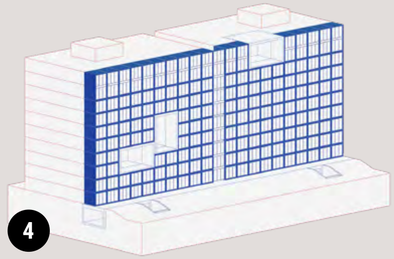
Existing condition: Parts of the façade are demolished and some apartments are unusable.



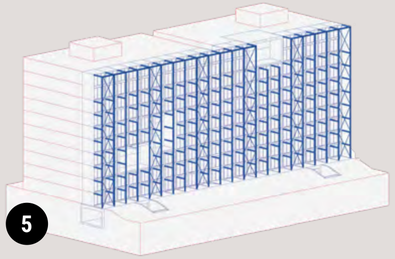
Community areas or gems: Transform demolished areas into common spaces and relocate users to newly rebuilt buildings.



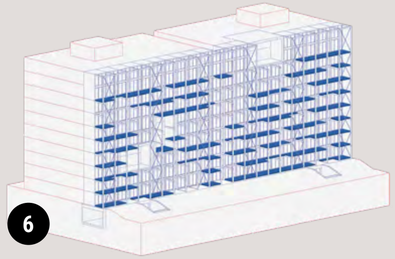
Bomb shelter: Prefabricated concrete structure with multiple access points serves as a foundation and base for housing modules and balconies.



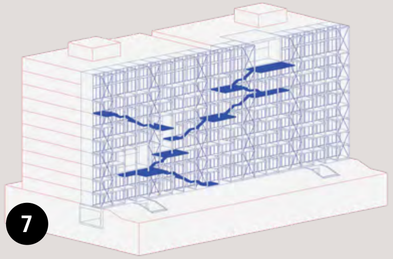
Housing module: Prefabricated module for housing expansion offers flexibility and natural light. New insulated roof improves building envelope and thermal comfort.



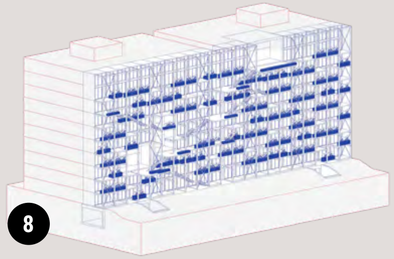
Framing structure: A modulated structure is in place for balconies, stairs, and shared areas.



Exterior balconies: Prefabricated concrete structures using recycled aggregate form exterior balconies.



Community connection: Modulated stairs and balconies strengthen community interaction and outdoor connection.



Biophilia: Modulated planters integrate vegetation on the façade.

Our biggest takeaway?

09.

Be ambitious in retrofits

We often think of retrofitting buildings to use less energy. That's important. The world needs to retrofit more buildings to reduce the emissions associated with climate change. **A JLL report says the US will need to triple its retrofit rate to meet net-zero targets.** But when we retrofit for decarbonization, we can do more. We can also update our buildings to strengthen connections to nature and community and expand economic opportunity.

Simply repairing the damage at Block 86 North Saltivka, making its systems more efficient and moving on would make the building livable, but not much more. The Healing Network suggests a blueprint for a sustainable, connected, and thriving community. It shows how a rapid retrofit can enhance community, wellness, sustainability, flexibility, and resilience. It offers a comprehensive solution to updating modern housing. As cities continue to grow and evolve, innovative approaches like the Healing Network will play a crucial role in shaping the future of urban living.

Based in Austin, TX, **Tracy Eich** serves as our Texas design leader.

Aida Sanchez-Gomez, a senior architect in the Miami office, brings a broad skill set to every project.

MORE RESIDENTIAL →

Healing Network team

Porus Antia
Bahige Chaaban
Eugene Chumakov
Anshuman Dogra
John Dugan
Aida Sanchez-Gomez
Tracy Eich
Natalia Holmes
Aeron Hodges
Ali Kazmi
Eunjee Kim
Raul Pinol
Suzanne Serna

All images are by Stantec for the Healing Network competition entry in the Norman Foster Foundation Kharkiv Housing Challenge.

Three **big** questions about LEED v5

What does the new emphasis on decarbonization, resilience, quality of life, and ecological conservation mean for design?

By: Kenneth Griffin and Vanessa Nelson

evolv1 Waterloo, ON
Photograph by Ben Rahn/A-Frame

The first commercial building to be certified under the CAGBC Zero Carbon Building Standard, evolve1 is LEED Platinum.

The other day someone asked us if we've ever added up the energy savings from all the LEED (Leadership in Energy and Environmental Design) projects we've worked on since 2005.

UC Davis Student Housing: The Green at West Village Davis, CA
The Green at West Village at UC Davis, one of the largest zero-net energy (ZNE) communities in North America, targeted LEED Silver.

That might take us a while. But we do know that those projects would not have achieved what they did without LEED as a framework. LEED helped our team set goals, stay on track, and keep sustainability measures from falling through the cracks. It also challenged us to stay ahead of the curve and strive to do more to address the most urgent needs in the building industry. As those needs have evolved, so has LEED. Naturally, we're curious about what the new LEED v5 means for design.

This year, the U.S. Green Building Council (USGBC) launched LEED v5, the long-awaited update to the USGBC's highly influential sustainability standard. LEED v5 makes some exciting changes that we're enthusiastic about. But it also has us wondering a few things.

Why LEED succeeded and why it needed to change

Introduced in 1998, LEED gained industry acceptance by providing an internationally recognized standard. It was user friendly, offering flexibility in credits so designers could tailor their approach to specific project needs. LEED raised awareness of the role of the built environment in global emissions. It has significantly influenced the evolution and adoption of green building codes by elevating the baseline standards for sustainable construction.

LEED was also effective. It changed the conversation and made buildings more efficient and affordable. **Cushman and Wakefield's data** says LEED projects reduce waste, water, and energy consumption by 20% and that "LEED buildings achieve a 21.4% higher average market sales price per square foot over non-LEED buildings" and attract more favorable **financing.** But the conversation about the built environment and climate change has evolved.

Enter LEED v5

LEED heightened our consciousness around the built environment and its contribution to carbon emissions and climate change. The industry's original focus on sustainability has long since shifted to mitigating climate change. With LEED v5, the USGBC responds to pressure to address global warming. It has created LEED v5 to align with the climate goals adopted in the AIA 2030 and Paris Agreement.

With what we've seen in LEED v5, we're enthusiastic, but we have questions. Let's start with three:

1. Will LEED v5 catch on, or does it go too far?
2. Will LEED v5 require more experts and take more time?
3. Where is regenerative design in v5?

Ch-Ch-Changes

What's new in LEED v5? A lot. Here are some of the most significant changes we see in each of the focus areas and elsewhere.

Decarbonization

- Decarbonization accounts for half of the available points in v5.
- LEED v5 Platinum requires net zero operational emissions, full electrification, renewable energy, and reduced embodied carbon emissions.
- LEED v5 requires an operational carbon projection, decarbonization plan, and an embodied carbon assessment.

Quality of life

- V5 requires projects to complete a human impact assessment as a prerequisite.

Ecological conservation and restoration

- V5 awards credits for features that protect natural habitats and resources.

Resilience

- While resilience has been a focus in previous versions, it now has its own prerequisite and credit.
- Every LEED v5 project must complete a climate resilience assessment.

QUESTION

Will LEED v5 catch on, or does it go too far?

1

Most of the chatter about LEED v5 is about decarbonization, which is one of LEED's three new focus areas. Decarbonization accounts for half of the available points in v5. V5 requires an operational carbon projection, decarbonization plan, and an embodied carbon assessment. LEED Platinum certification requires projects to be all electric, feature renewable energy, and reduce embodied carbon emissions. LEED wants to push the envelope, but is the push for full electrification too much too soon?

Looking back at LEED v4, contractors and owners were initially resistant due to additional effort and documentation requirements. Eventually LEED v4 became standard. When LEED v4.1 was released, it didn't have the decarbonization emphasis the industry felt was needed, and it was never officially balloted. Designers stuck with v4 and chose credits from v4.1 where advantageous.

OUR TAKE

As the new v5 phases in, building owners and design teams will need to adapt to the new requirements of LEED v5, but we believe that time will be worth the investment.

Certification still comes at a cost. The cost of LEED v5 certification includes registration and review fees, which are based on the square footage of the project, in addition to fees for administration, consulting, and commissioning.

We consider certification and registration strategy an industry best practice on projects. And studies show that return on investment for LEED can be seen in higher rental premiums and lower operational costs. Some studies show that hidden benefits of LEED can also include lower insurance premiums. LEED v5 introduces new prerequisite studies that intend to push teams to analyze carbon, human impact, and climate resilience early in the design phase. These studies will add upfront fees. Owners and designers will need to recalculate the ROI for their LEED v5 projects.

LEED v5 is a big jump. And we've seen LEED overreach before. Some of the LEED v4 materials transparency requirements had to be reduced in v4.1. Only now are they becoming achievable as the market has caught up. We wonder if a stage in between would have been helpful on the path to healthy materials with v4 and now decarbonization with v5.

Weyerhaeuser Headquarters Seattle, WA
Architect: Mithun

This LEED Platinum certified building features wood from the company's own timber mills as well as hand-picked salvaged materials. The project diverted more than 75% of its construction waste from landfills.

QUESTION

Will LEED v5 require more experts and take more time?

LEED v5 pushes decarbonization and will require an LCA (life cycle assessment) practitioner. But there's much more to LEED v5. There are two more focus areas: quality of life, and ecological conservation and restoration. And then there's resilience, a theme which runs through much of LEED v5. Resilience is now a prerequisite for every project. USGBC defines resilience as the "ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events."

LEED v5 encourages us to assess the impact of projects on climate risk and ecosystem health, the local economy, and safety. In the new iteration, LEED-certified projects will need to account for their impact on biodiversity and local businesses.

Every v5 project must complete a climate resilience assessment. This assessment requires design teams to analyze climate hazards, evaluate risk, and identify high priority hazards. Economic resilience is also a consideration. An equitable development credit encourages teams to develop contaminated or historic sites, employ local labor, provide job training, and include affordable housing.

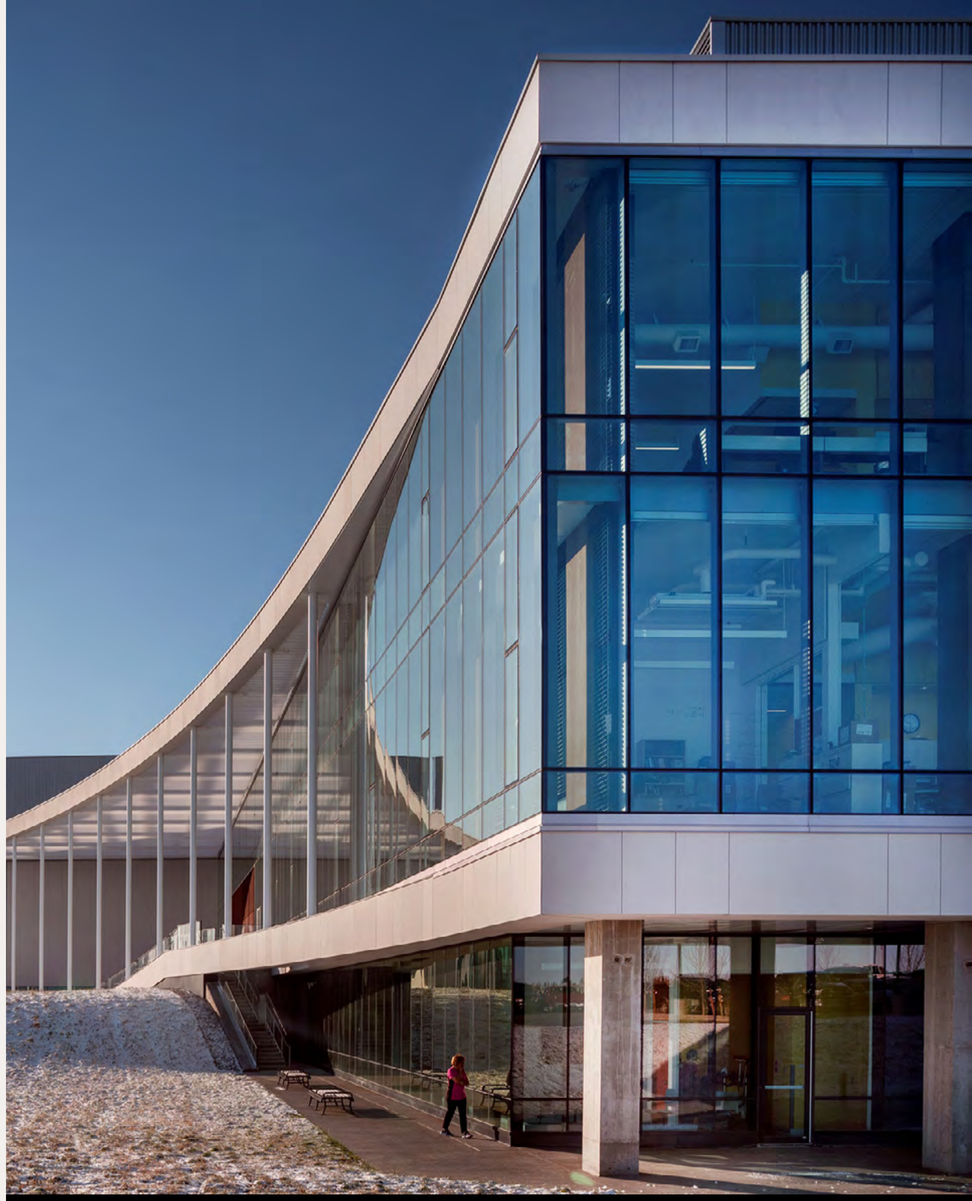
2

OUR TAKE

The climate resilience assessment and embodied carbon prerequisite will require additional specialists. Additional budget will be required to complete the resilience assessment. For project teams pursuing a more rigorous optional embodied carbon credit, additional specialists or fees should not be required.

LEED v5 also requires a new zero waste plan, which will require a bit more thought but should not require reinventing the wheel for every project. LEED v5 also scales back the acoustics credit and tucks it into a new occupant experience credit.

V5 requires more experts to provide data to support the sustainable design process. But the embodied carbon, climate resilience assessment, and zero waste plans are relatively small studies. Some credits have been consolidated or integrated into others. Whether these changes will require more time overall remains to be seen.



University of Lethbridge - Isttaniokaksini, Science Commons Lethbridge, AB
Joint Venture / Association / Collaboration: KPMB/Stantec

The LEED Gold certified Science Commons has been operating at an energy cost reduction of 75% for the offices and meeting spaces, and at an energy reduction of 55% for the lab and lab support spaces.

QUESTION

Where is regenerative design in v5?

3

USGBC says its third goal, ecological conservation and restoration, is about “emphasizing strategies that limit environmental degradation and contribute to the restoration of ecosystems, ensuring that our built environment exists harmoniously with nature.” Rather than emissions reductions, this category awards credits for features that protect natural habitats and resources.

Regenerative design is an emerging approach to design and planning projects. In regenerative design, we focus on the role of the built environment in creating and enhancing ecosystems to restore and revitalize nature and the environment.

OUR TAKE

While the ecological conservation and restoration credits emphasize a built environment that harmonizes with nature, the USGBC could take the restorative aspect of this focus area further. Merely protecting existing habitats is low stakes.

We’d like to see regenerative design in a future version of LEED. Regenerative design is at the cutting edge in what was once sustainable design. We are finding it a worthy approach on projects around the globe—using the stormwater runoff from a new building to invigorate a biodiverse green area in an arid region, for example, or requiring that projects deliver a 10% net gain in biodiversity like the UK’s Biodiversity Net Gain (BNG) program.

Confidential workplace
Madison, WI

LEED is evolving.

It’s important for design professionals like us to remember that LEED will continue to evolve. We can’t rest on our laurels and get comfortable with version four or five. The USGBC says that LEED v5 was developed to serve as the standard through 2030.

Now that v5 has been activated, we’re already thinking about what will come in v6. Our wish list is centered on negative emissions technology. These technologies such as carbon capture storage, direct air capture, and bioenergy remove carbon through the atmosphere.

Look for more thoughts on LEED v5 and wish list items for v6 on the Stantec Ideas blog.

IDEAS

UCSF Bayfront Medical Building (Block 34)
San Francisco, CA

Kenneth Griffin is a building performance consultant based in Chicago.

Senior sustainability consultant **Vanessa Nelson** works in our San Francisco studio.

MORE SUSTAINABILITY AND BUILDING PERFORMANCE →

Understanding battery electric bus maintenance

Maintenance facilities should be thoughtfully retrofitted to accommodate battery electric buses.

By: Natalia Lacima

TriMet Powell Bus Operations & Maintenance Facility Portland, OR

Many transit agencies in Canada are replacing their diesel bus fleets with battery electric buses (BEBs).

It’s no simple matter, especially when it comes to updating their OMSF (operations, maintenance, and storage facility) and support infrastructure they need to keep their fleets running smoothly.

Upgrading maintenance facilities for battery electric buses requires a comprehensive approach. Operators must coordinate battery electric bus maintenance upgrades to infrastructure, protection, and operations in their facilities while maintaining industry standards for safety. It requires a carefully managed process to ensure a smooth transition to a bus fleet with minimal emissions.

We have years of experience with diesel bus fleets and their OMSF infrastructure in Canada. And now we are working on retrofitting existing and designing new transit spaces to accommodate zero-emissions technology.

At a basic level, bus maintenance requires space; it’s about getting buses in and out and in position to be serviced by technicians.

Napa Valley Transportation Authority Bus Operations & Maintenance Facility Napa, CA

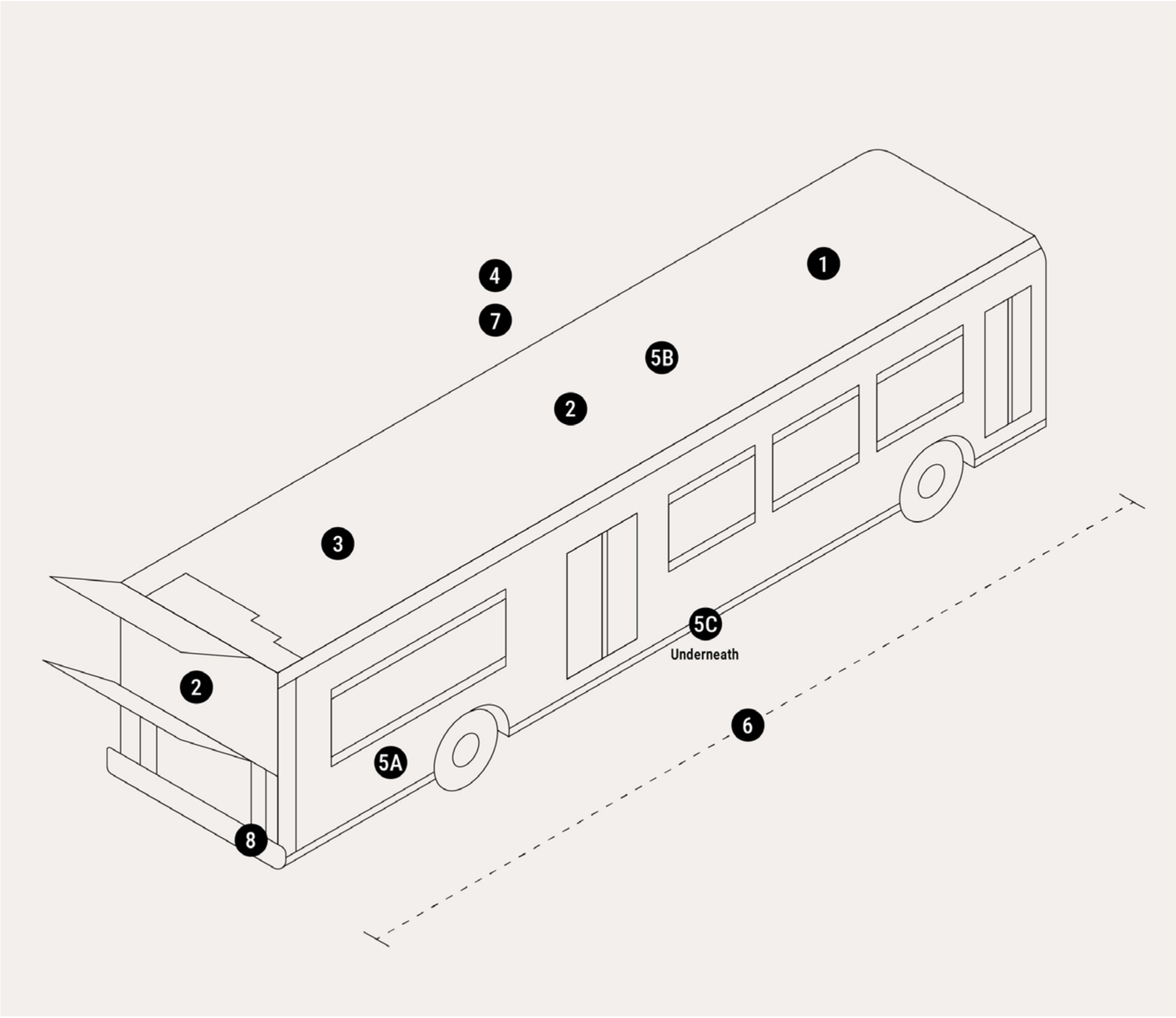
We are well acquainted with the various battery electric buses on the market, and those in development.

We also understand that the transition to an electrified fleet rarely happens overnight. At a basic level, bus maintenance requires space, equipment and other infrastructure. It's about getting buses in and out and readying them for service.

To design operations and maintenance facilities for battery electric buses, we need to understand what makes these new buses different from their diesel predecessors.

To design BEB OMSF you must be familiar with the following aspects of battery electric buses themselves:

1. **Battery packs and high-voltage systems**
2. **Rooftop work safety**
3. **Coolant loops**
4. **Lifting systems**
5. **Charging systems**
   - **A. Plug-in dispenser**
   - **B. Pantographs**
   - **C. Wireless inductive charging**
6. **Bus length**
7. **Bus weight**
8. **Heating systems**



1 Battery packs and high-voltage systems

Battery electric buses run on batteries, and at present these batteries use Lithium-Ion (Li-Ion) storage technology. Rechargeable Li-Ion battery packs are part of a BEB's high-voltage system which delivers the power to its drivetrain.

Technicians require space to access and work on the Li-Ion batteries and BEB high-voltage systems. Facilities must set up keep-out areas to maintain safety. Technicians will find Li-Ion battery packs in multiple areas on the bus. Some are in the roof while others are on the side or back of the bus.

Even if transit agencies aren't repairing Li-Ion battery packs on-site, they need a temporary location to store new batteries to be installed or used batteries that need to be sent back to the vendor.

2 Rooftop work safety

Technicians require safe access to components in the battery electric bus roof to inspect or replace parts. Agencies are leaning away from fall arrest systems (which usually feature a harness or body belt) and are leaning towards platforms.

The type of charging system you have will influence design and infrastructure decisions.

Platforms (fixed or mobile) prevent falls from happening instead of reacting to them. Designers need to analyze placement, access, and clearances to ensure the systems are coordinated with surrounding equipment properly.

When fixed platforms are not feasible, mobile platforms are an option; however, they require a dedicated storage space.

3 Coolant loops

In diesel buses, the coolant loop runs in the engine compartment along the chassis. But battery electric buses often have coolant loops on the top or rear of the bus. The facility should provide access to the location of coolant loops for inspection and maintenance.

4 Lifting systems

Lithium-Ion battery packs can weigh up to approximately 700 kg. To remove and replace these battery packs technicians need a lifting system.

Monorails and cranes are good options for lifting; however, cranes provide better coverage and flexibility so techs can lift other components that might not be completely aligned with the centerline of the bus.

Charging systems

Battery electric buses are available with a variety of charging systems. These include:

5A Plug-in dispenser

This plug and cable system is like the typical gas pump for cars. They're light and can be put on pedestals or hung from the ceiling.

5B Pantographs

You may have seen pantographs on electric streetcars. These are similar. Pantographs *(see image)* transfer electrical power from an overhead wire to the top of the battery electric bus. They might be mounted on a gantry or a mast or building. They lower and connect to rails on the bus roof for rapid recharging.

5C Wireless inductive charging

Many of us are charging our cellphones wirelessly every day. Inductive bus charging uses the same principle. Pads on the ground transfer energy to a receiver mounted on the bottom of the bus using an electromagnetic field.

Each charging system has different spatial and infrastructure requirements. For example, plug-in dispensers require us to consider parking to minimize cable management issues. While pantographs could require us to perform a structural analysis. Inductive charging requires ground modifications. All these systems require us to coordinate engineering with mechanical and electrical infrastructure.

In our work, we see that sometimes we need to adapt the infrastructure for charging. It depends on the garage. We may need to upgrade it to support the pantograph. And buildings with in-floor heating may not be suitable for inductive charging. The most common issues with plug-in dispensers? Cable management and parking.

Inverters convert incoming power so it can be used by dispensers. We need to size inverters (also called charging cabinets or chargers) to the selected charging technology. Depending on the technology selected, there can be distance limitations from inverters to dispensers. So, we need to consider that when we locate them.

6 Bus length

When they are not driving or servicing them, transit agencies must park battery electric buses in fleet storage spaces. It's important that we analyze fleet storage parking when introducing battery electric buses. Their parking position is critical when planning for charging locations. We need to align charging infrastructure with the position of the bus. BEBs can be longer than the diesel buses in existing fleets. This extra length could potentially reduce the number of buses that agencies can park in existing spaces. We recommend conducting a turning simulation as with the introduction of any new vehicle to a fleet to ensure maneuverability in storage, charging, and service areas.

In our project work, we have observed that if you change the bus size and the stall size, your stacked bus capacity could change.

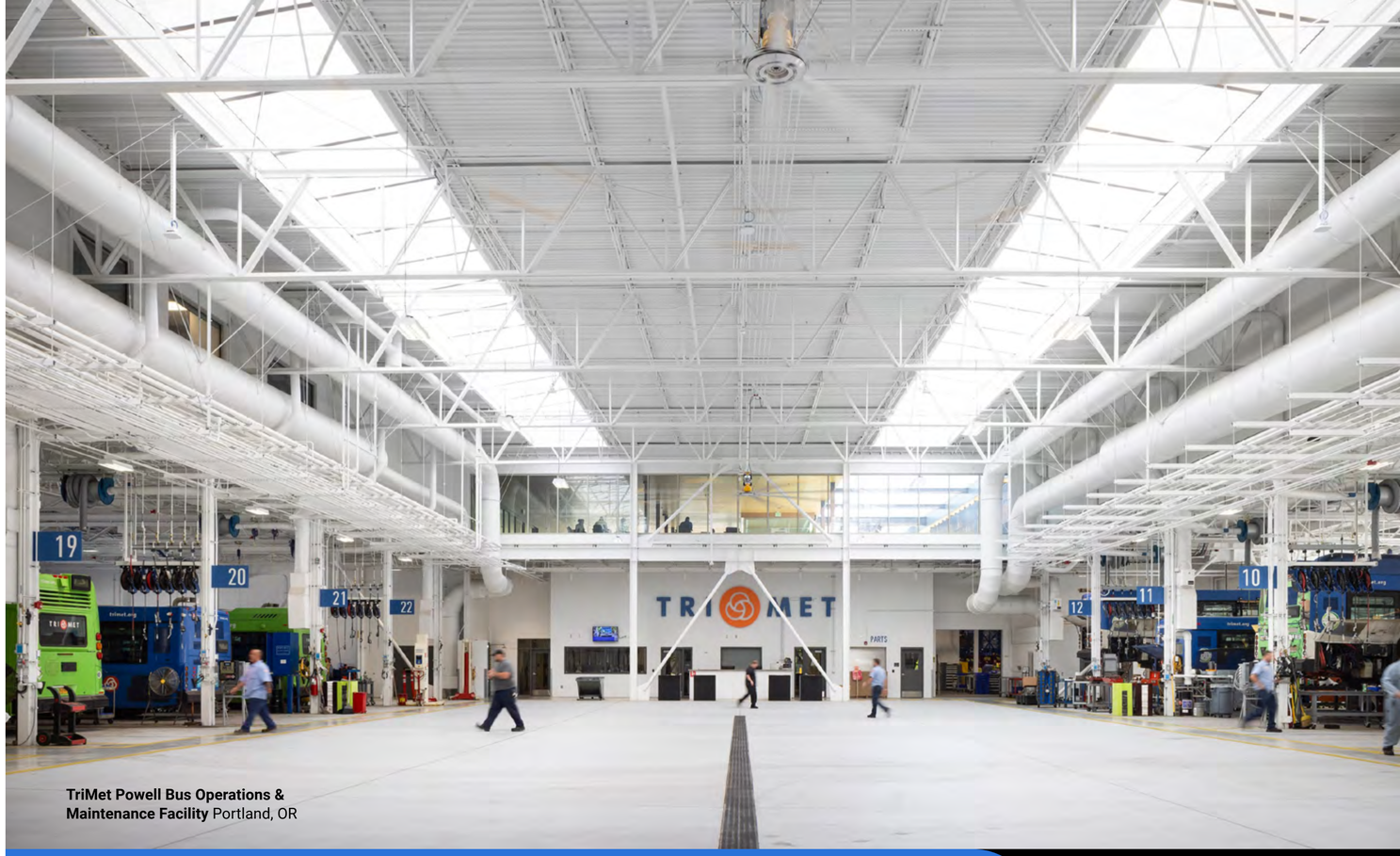
7 Bus weight

Battery electric buses are heavier than diesel buses. We need to assess existing in-ground hoists in maintenance to confirm they have the load capacity to lift the new bus. Also, we need to check the compatibility on the support point to see if an adaptor could potentially be required.

In the field, we see cases where older ground hoists can't lift BEBs. Agencies will need adaptors or new hoists to do the job.

8 Heating systems

In colder climates, like Canada, the battery electric bus often uses diesel in the heating system. This reduces the drain on the battery that would reduce the bus's trip mileage in cold weather. For this reason, we must consider retaining diesel infrastructure in existing facilities rather than decommissioning until all requirements are fully understood.



TriMet Powell Bus Operations & Maintenance Facility Portland, OR

A holistic understanding

The transition to battery electric and fuel-cell buses involves significant investment and planning from transit providers.

It requires transit providers to change their infrastructure, spaces, operational procedures, maintenance practices, and workforce training. Every transit situation is unique. And technology is changing rapidly.

Transit providers need custom-tailored solutions to make the move to low emissions vehicles. And they need guidance to keep buses on the road serving our communities during the transition. Understanding the bus itself is a great place to start.

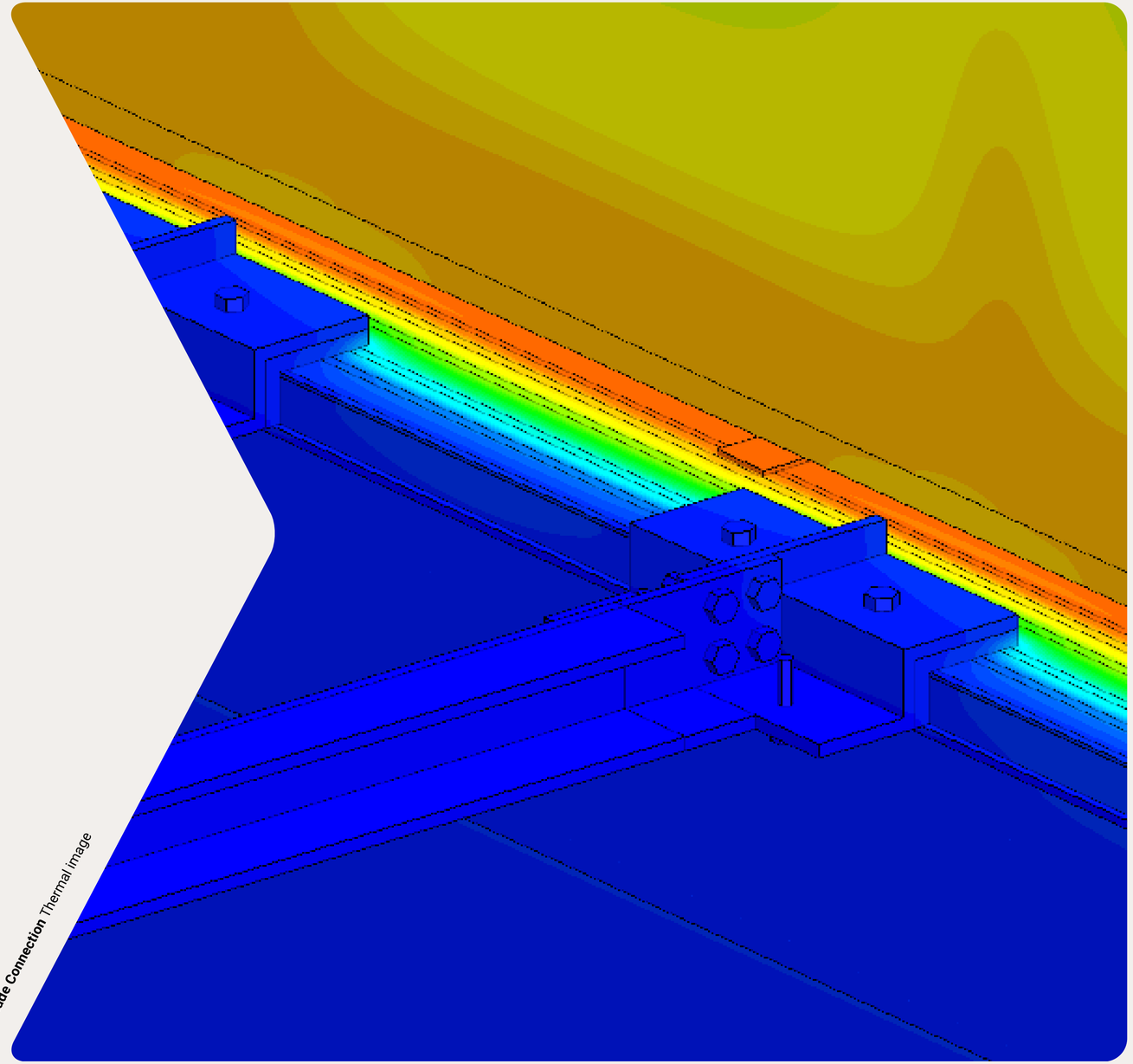
MORE OPERATIONS, MAINTENANCE & STORAGE FACILITIES →

Industrial engineer **Natalia Lacima** leads operations and facility planning, mainly in the transit and manufacturing sectors from our Vancouver, BC office.

How Passive House led us to a next generation building window connection

Building science innovations in fenestration and shading

By: Cody Akira Belton



Akira Shade Connection Thermal image

Buildings aren’t done evolving. And Building Science is one area where designers are innovating.

I am particularly excited about a new window and shade connection we have designed that supports key Passive House design principles.

Building science or the building physics discipline is largely concerned with the integrity of the building envelope. Building science is about understanding the physics around a building and its materials and how they keep two distinct environments (often the indoors and the outdoors, but sometimes interior environments) separated.

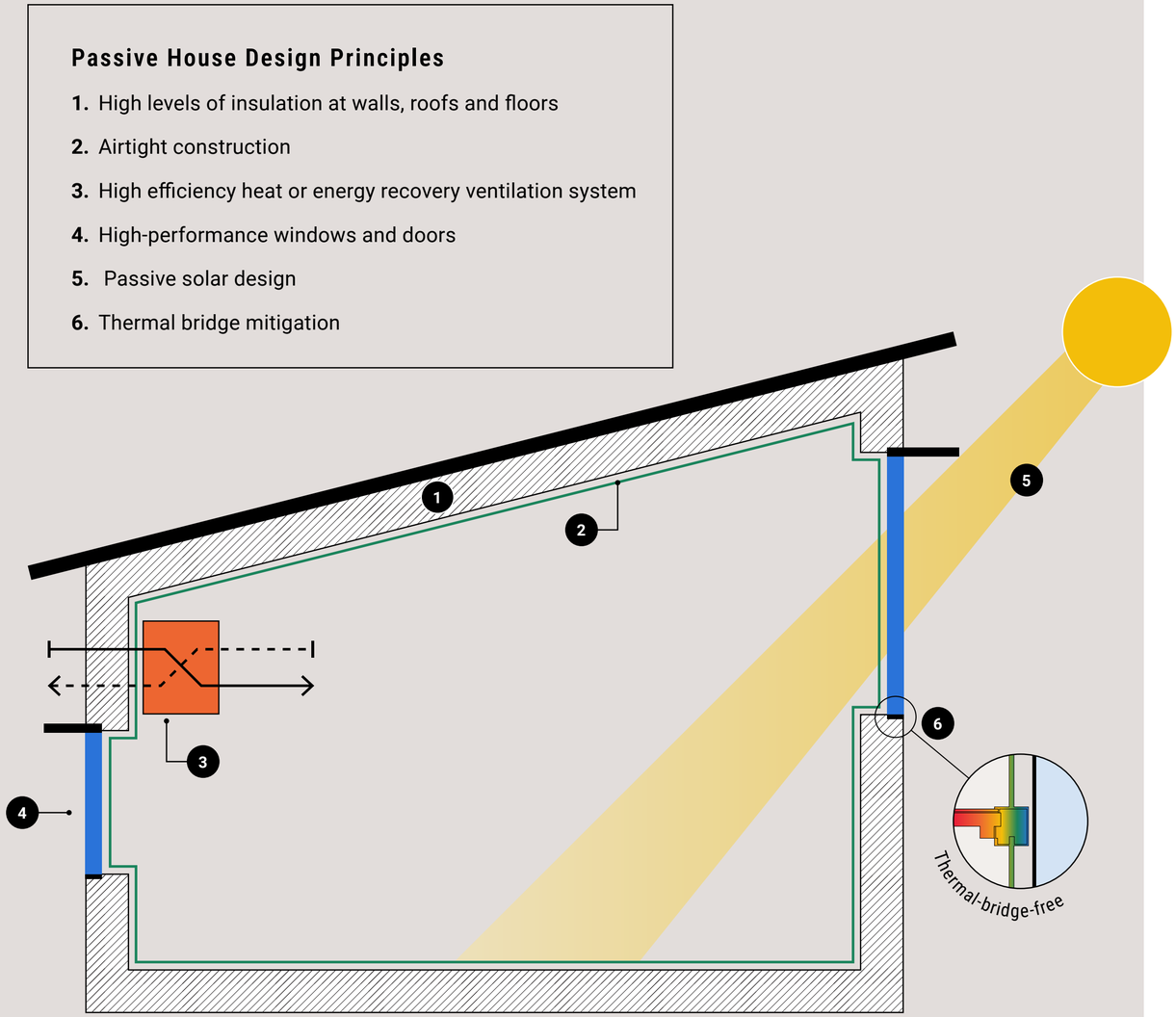
Targeting high impact thermal bridges

As a Passive House Specialist, I’m always looking for ways we can make our buildings more energy efficient. This includes tightening up the air barrier system to mitigate heat loss in the winter. “Airtight construction” is one key Passive House design principle.

Today, we use energy modeling software to apply the Passive House principles. Passive House requires us to minimize and account for building heat loss through thermal bridges. We often find these thermal bridges in building envelope transitions or penetrations that conduct heat at an accelerated rate. Understanding thermal bridges and heat loss/gain is critical to us for sizing the building’s mechanical heating and cooling systems correctly.

So, where are the high impact thermal bridges? In my experience, the most common and largest linear length thermal bridge is the window-to-wall transition. In a Passive House building, the window frame and glazing (the glass) are highly insulated to suit a particular climate zone, which is great. The issue is how the window is positioned in the wall and how it is structurally attached to the wall.

If we find a way to lower the heat loss from our window-to-wall transitions, we can reduce the energy demand on our heating/cooling systems. We will also lessen the insulation used at other locations, such as the external walls. Inspired by this issue, our team of building envelope consultants, facade engineers, and thermal modelers came up with a solution, Akira Window Connection.



Passive House Design Principles Stantec

A new window/door connection method

Let's look at the conventional approach. High-performance buildings commonly specify wall assemblies with continuous exterior insulation. Traditionally, windows and doors are positioned within the rough opening so the frames are not aligned with the walls' primary thermal barrier—the continuous exterior insulation, leading to excessive heat loss via thermal bridging. So, the construction industry made improvements by repositioning the window/door outwards to align more with the continuous exterior insulation.

Designers accomplished this by placing wood bucks at the rough opening perimeter and fastening metal angles to the backup wall structure for support. Our thermal analysis, however, shows the improved conventional option still leads to thermal bridging heat loss. The typical solution for maintaining watertight and airtight transitions is complex and awkward. It involves wrapping membranes over the wood buck to connect back to the window/door frame.

Our design solution is intended to handle the vertical load and reduce heat loss simply and elegantly. Akira Window Connection can support the weight of windows (or doors). And it almost completely eliminates thermal bridging heat loss at the window-to-wall transitions.

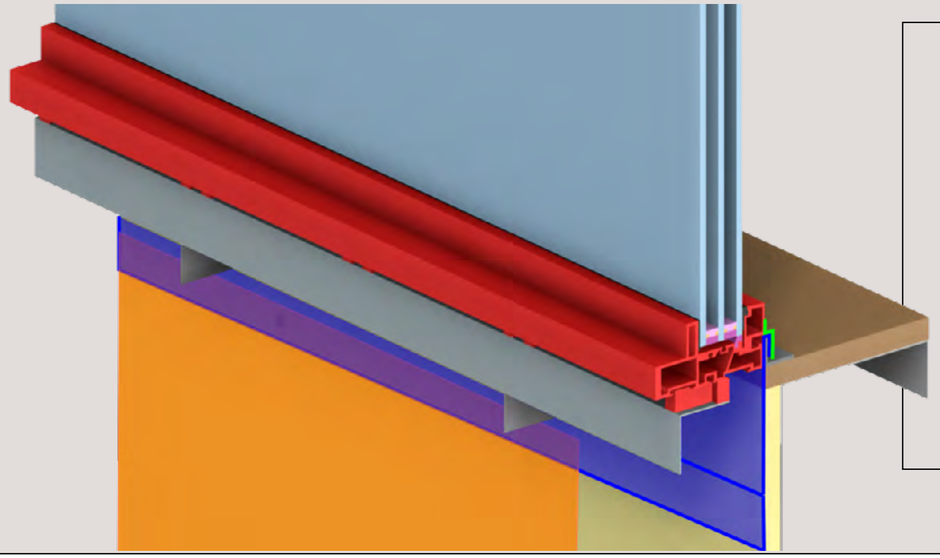
This method consists of intermittent thermal brackets fastened to the wall structure plus a horizontal angle at the brackets' outer edge where the window sits. This method aligns the window frame with the walls' exterior insulation. We repurpose intermittent brackets, traditionally used for siding installation, to support the window weight. The system can support large windows.

This enables architects to exercise more design freedom with performance-based energy codes. The design's beauty lies in its horizontal angle. It leaves space from the wall so exterior insulation can meet the window frame directly, reducing heat loss and simplifying construction.

We are simplifying the detail, speeding up construction, while making the whole building more energy efficient. Akira Window Connection mitigates water penetration risk. It's more durable in terms of water penetration control. And it improves drainage. We believe all buildings that specify wall assemblies with continuous exterior insulation and use punched windows/doors with rebate style frames should consider an Akira Window Connection. And we're excited to work with window manufacturers to support their window and door components.

Going Live

We are already using Akira Window Connection on our designs. At PNE Amphitheater's Back of House, the connection will support 13-foot tall fiberglass framed windows by Cascadia Windows Ltd.

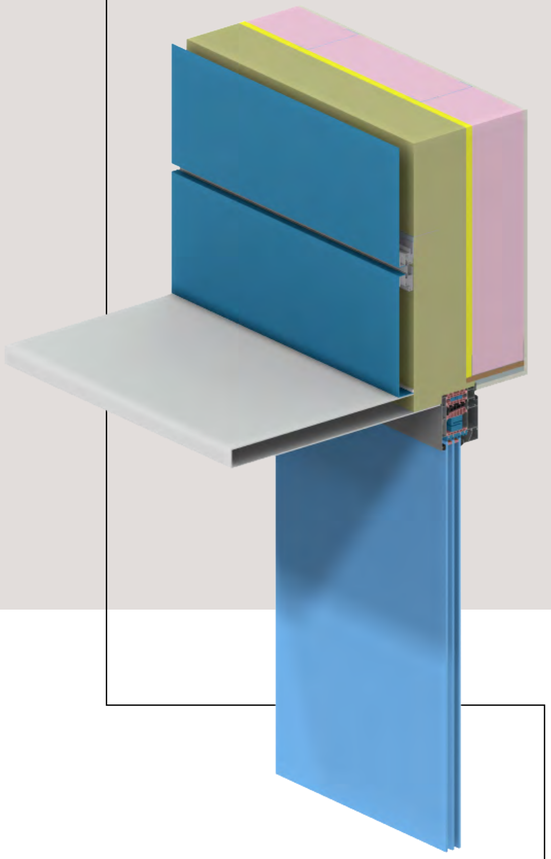


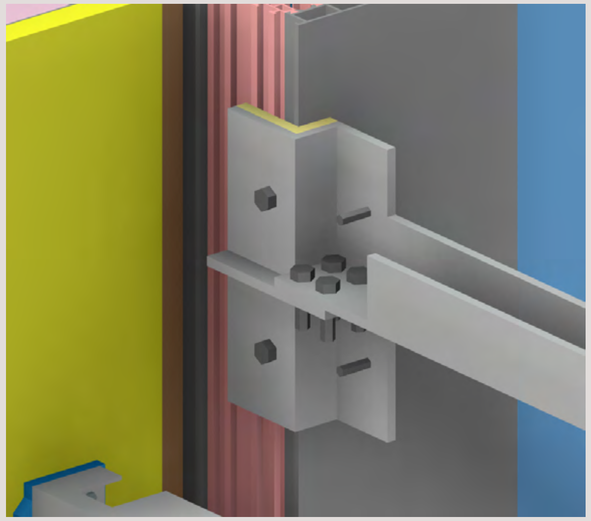
The design's beauty lies in its horizontal angle.

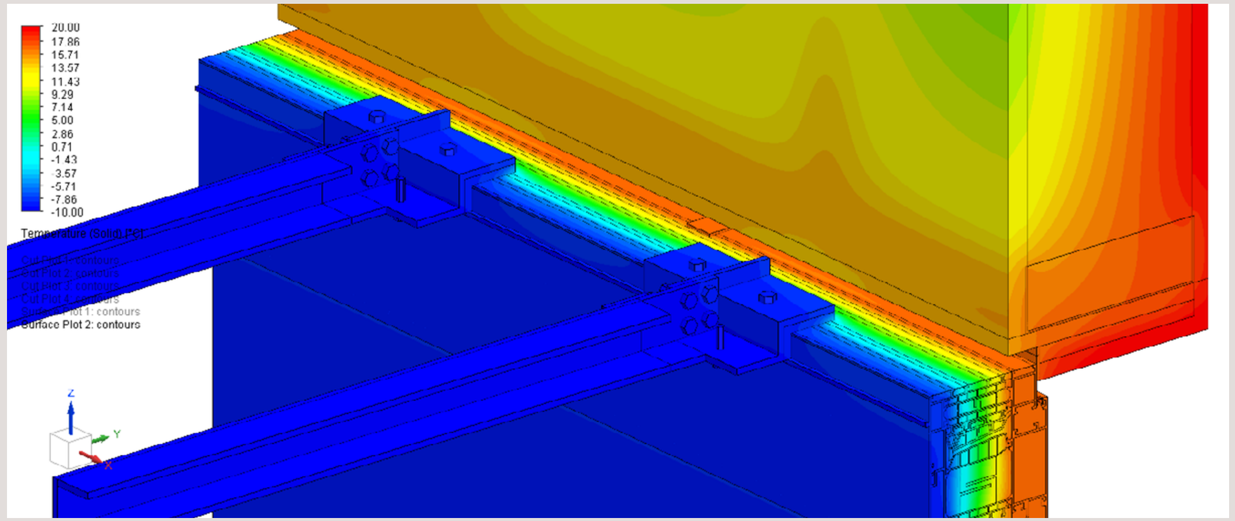
It leaves space from the wall so exterior insulation can meet the window frame directly, reducing heat loss and simplifying construction.

Left: Akira Window Connection Steel stud back-up

Right: Akira Window Connection Installed for a swing door mock-up in a mass timber wall system developed by Eric Wood of Stantec. On display at British Columbia Institute of Technology High Performance Building Lab, Burnaby, BC.







From Left:
Akira Shade Connection design
Akira Shade Connection bracket (detail)
Thermal modeling for Akira Shade Connection bracket
All images: Stantec

Next? An innovative shade design

Passive House encourages us to control solar heat gain so we can use it to passively warm our buildings or mitigate direct sun exposure to keep them cool. We can reduce solar gain through external shading. But conventional external shades, like window-to-wall transitions, can act as high-impact thermal bridges.

Recently, I am noticing that many Passive House buildings are incorporating more external shading elements to combat overheating risk. These external shades, typically made from high thermally conductive materials such as metal, introduce high impact thermal bridges that increase space heating/cooling demand beyond compliance limits where a building may no longer fulfill Passive House energy criteria. What can we do in this situation? If we delete external shades, are we sacrificing occupant health and thermal comfort to achieve the Passive House Standard? Or do we add excessive insulation to the walls, roofs, and floors to counteract the heat loss borne from external shade connections?

Our integrated design team came up with another solution, Akira Shade Connection. This external shading solution offers climate resilience without adding heat loss to the external walls. Instead of attaching external shades to the building's wall, we're attaching external shades to the window/door frames' internal structure itself. This shade system and method for attachment uses proprietary intermittent brackets that are fastened directly into the window/door frame edges. Then we introduce a cantilevered web fastened into those brackets. This patent pending shade system allows us to use a shading element on the building and further reduce window-to-wall transition thermal bridges by providing space to over-insulate the exterior frame face, complementing Akira Window Connection.

We hope this innovation will allow Passive House designers to incorporate more shading elements into their buildings, improving occupants' comfort.

The ripple effects could be significant. Incorporating external shade to control heat gain means that Passive House buildings may be able to use less insulation or smaller mechanical heating/cooling systems, reducing their associated emissions even further while lowering construction cost.

Both Akira Window Connection and Akira Shade Connection could be gamechangers for exterior retrofit projects and new construction alike, making buildings more energy efficient than previously possible, and with happier occupants.

Akira Shade Connection solves several building envelope issues simultaneously.

1. Adds external shading element without a thermal bridging penalty
2. Provides a simple way to over-insulate the window/door frame to improve thermal performance
3. Doubles as a window/door return finish to conceal exterior insulation edges (if applicable)
4. Lowers wind-driven rain exposure at windows/door to increase finish lifespan and further mitigates rain-water ingress potential

Connaught Triplex
Building Envelope and Passive House consultant Stantec used Akira Window Connection to support targeted windows and doors for the Connaught Triplex project in Vancouver, BC.

Architect: SHAPE Architecture. Image courtesy of SHAPE Architecture.

Based in Vancouver, BC, **Cody Akira Belton** serves as the Passive House lead for North America overseeing all projects pursuing Passive House building certification through the Passive House Institute (PHI) or Passive House Institute US (Phius).

MORE PASSIVE HOUSE →

Campus updates: Renovate that university building or build new?

How to take adaptive reuse and modernization of campus buildings to the next level

By: Kate Ryan

Worcester Polytechnic Institute
Worcester, MA

Take a look at any university brochure sent to prospective students. It probably showcases historic buildings on campus.

(both images)
Yale University – Kline Tower
New Haven, CT

There may be no better example of the connection between people, emotion, and the built environment than the university building on campus. For many alumni, the campus structures are a portal to the past—the best years. For prospective students, the campus represents a future full of possibilities and community. The university's prestige and tradition are wrapped up in the campus buildings themselves. At universities, the urge for preservation is strong.

And yet they need to modernize. Universities need to stay competitive to survive. They need to consider adaptive reuse of campus buildings to stay relevant.

Universities face a demographic drop-off. **By 2041, the number of traditional-age incoming college students will be down 13 percent.** Higher education institutions need to show that they're worth the tuition. They need spaces that fit today's students and the way they learn. Meanwhile, their older buildings are showing their limitations.

As an interior designer, I find these campus adaptive reuse projects as exciting as they are challenging. I've worked on them for large, well-known universities and smaller schools. The Northeast is especially rich in universities and colleges with historic character. But institutions all over North America have facilities or university buildings worth updating.

What elements of the university building are institutions updating?

Student experience

Collaboration, community building
Many universities want to add enhanced social and collaborative spaces to their campuses. They want to promote collaboration and interaction while supporting mental health.

Older university buildings often have smaller interior proportions. When we renovate them, we can create multipurpose areas. With the emergence of hybrid learning, these interactive spaces have become very important as places where students come together. Libraries are emerging as new centers for engagement.

Universities are ordering flexible, multi-purpose social gathering spaces for study, collaboration, and faculty-student interaction.

Mental health and wellness
Experts are concerned about a mental health crisis on campus. **Seventy percent of students surveyed in 2024 said they have struggled with mental health since starting college.**

Universities want to increase engagement and build community by offering students a welcoming space where they can socialize or study. These multi-purpose collaboration spaces, in addition to dedicated wellness spaces and convenient dining halls, are integral to supporting mental health.

Many mid-century university buildings were not built with health in mind. Older buildings may suffer from lack of natural light, poor ventilation, and even harmful materials.

Universal design, accessibility and inclusivity
Universities want to present an inclusive environment. Many older buildings lack modern accessibility features. Some lack connections to the rest of campus. Renovations may include adding elevators, widening egress stairs, clarifying navigation, making spaces inclusive, and improving overall accessibility and connection.

According to Genio.co, **16.5% of learners in higher ed identify as neurodivergent.** With more students identifying as neurodivergent, universities are updating their spaces for universal design for learning (UDL). They want spaces that foster belonging.

Long-term flexibility and maintenance

Universities need buildings that can grow and adapt with them, as they adjust their programming. Most older buildings were built for one purpose versus many purposes. When they renovate a university building, they don't want to be stuck in 2025.

Many campus buildings are more than a half-century old. According to Sightlines data, the biggest booms in higher education construction took place in the post-war period and in the early 2000s. APPA (formerly the Association of Physical Plant Administrators) says that at many institutions, **three-quarters of facilities are 30 to 40 years old and already missed their first renewal.** Older campus buildings that haven't been renovated can be costly to maintain. An APPA report says work orders in buildings 25 to 50 years old average $2.35 per square foot versus $1.40 for buildings under 10.

Centennial College – Bombardier Centre for Aerospace and Aviation Toronto, ON
Joint Venture / Association / Collaboration: MJMA Architects / Stantec Architecture

What makes adaptive reuse attractive on campus?

Historic character and legacy

For many universities, the campus is sacrosanct. The school's traditions, stories, and history are woven into its buildings. This can apply to a 19th century library or a mid-century laboratory. So, schools want to maintain their built legacy. Alumni, faculty, students, and potential students want to see special places preserved on campus.

Limited space

Universities may need new spaces to suit their programs. Land acquisition may be impossible or expensive. Expansion may not be an option on many campuses. Schools need to figure out how to adapt the spaces they own to what they are offering.

Cost-Effectiveness

Universities are investing in building reuse to achieve more efficient use of the space they already have. **Traditional classrooms and lecture halls are often occupied less than 60% of the day.** So universities may want to rebalance their space. If they can transform existing buildings into modern spaces for learning, they will save money versus demolition or letting underutilized spaces languish. Schools want to be known as wise spenders to their alumni and students. And they may be eligible to receive grants for preserving their historic buildings .

Sustainability

Worldwide, more than 1,000 higher education institutions have taken the Race to Zero pledge to hit carbon neutrality by 2050. Universities are tracking and publishing their carbon emissions. Many are investing in renewables and energy efficient operations. Reusing buildings can help them reduce their embodied carbon investment. Reuse minimizes the waste associated with demolition.

Yale University – Kline Tower
New Haven, CT

70%

Seventy percent of students surveyed in 2024 said they have struggled with mental health since starting college

13%

By 2041, the number of traditional-age incoming college students will be down thirteen percent

60%

Traditional classrooms and lecture halls are often occupied less than sixty percent of the day.

2050

Worldwide, more than 1,000 higher education institutions have taken the Race to Zero pledge to hit carbon neutrality by 2050.

Let's take a look at three examples of what's possible in campus building reuse.

1 Update vertical labs for functionality and connectivity in a modernist tower.

Originally a mid-century tower designed by Phillip Johnson, Yale's Kline Tower labs were out of date; its science programs had been relocated to the Yale Science Building. Kline Tower's interior was dark, offering no opportunity for connection or collaboration. The challenge was to modernize the building and enhance its functionality while maintaining its historical presence.

Our redesign for the building emphasized vertical connectivity and collaboration, access to natural light, and reimagining existing spaces.

The renovation stripped down the existing structure and removed lab components of this university building to create classrooms and department floors, supporting what's known on campus as Science Hill. We added monumental "triplet" stairs to connect multiple floors, for accessibility and social interaction. We designed large, flexible gathering spaces, such as the Commons, which Yale uses for seminars, guest speakers, department meetings, and study areas. We opened window lines to allow natural light into the core of the building.

We transformed the 14th floor, previously a mechanical roof, into a faculty lounge with 360° views. The renovation increased accessibility and navigation by connecting the building at ground and underground levels to adjacent buildings.

Tufts University – The Collaborative Learning and Innovation Center
Medford, MA

The renovated **Kline Tower** features popular open-concept spaces which foster collaboration. This historic reuse project is targeting LEED Gold certification. *Bonus:* The rooftop lounge with a 360° view has emerged as a prestigious third place for faculty. The unique hospitality-inspired floor can host large seminars, special events, and faculty collaboration across campus.

2 **Improve navigation and add collaboration space to a 19th Century academic building.**

Built in 1894, Stratton Hall at Worcester Polytechnic Institute (WPI) originally housed WPI's engineering school and has been home to various departments since then. Typical of buildings from this era, the university building was not accessible, lacked study spaces and amenities, and had inefficient wayfinding, making the user experience lackluster.

Stratton Hall needed a gut renovation. A new 4-story copper-clad modern vestibule with an elevator created a safe and accessible connection up the building and to the adjacent Project Center building. Expanded central corridors allow for intuitive navigation, while incorporating study nooks between existing structural columns in the corridor. The design also restored the historic brick façade. New student study lounge areas and a multi-purpose tutoring center enhance collaboration and engagement.

The design makes the 32,000 SF building fully accessible, easier to navigate, and a more welcoming user experience. Math and science students have a new place to collaborate and tutor each other. *Bonus:* Updated energy efficient windows, mechanical systems and insulation make Stratton Hall more comfortable and resilient.

3 **Convert an old industrial space to a contemporary research hub.**

When Tufts University looked for a home for interdisciplinary research on its new Science and Technology Corridor, it discovered a centuries old timber frame warehouse building in dire need of repair.

The renovation retained the historic character of the building's timber structure. Inspired by the school's mascot, Jumbo The Elephant, the design celebrates interdisciplinary collaboration.

Our job was to reposition the warehouse as home to a variety of departments encouraging cross collaboration.

The renovation retained the historic character of the building's timber structure. Inspired by the school's mascot, Jumbo The Elephant, the design celebrates interdisciplinary collaboration. A whimsical connecting stair surrounded by break-out zones for learning and socializing acts like a modern-day watering hole. It brings students together from all disciplines to satisfy their thirst for knowledge. All of this supports new academic spaces in the university building: shared classrooms, open and closed offices, dry labs, and swing space.

Today, the 95,000 SF, four-storied **Collaborative Learning and Innovation Complex (CLIC)** is a historic gateway to the university. It now serves as a collaborative hub to various science and social science groups at Tufts.

Bonus: We boosted building envelope efficiency with triple-paned windows and six inches of spray insulation in the exterior walls. A rain garden collects storm water from the canopy roof; some of the many elements that helped achieve LEED Silver.

Higher Ed Building Booms

Post-War boom

Between 1950-1975, the U.S. built lots of university buildings and it built them fast. But a combination of experimentation and low-quality construction sometimes led to troubled mechanical systems and significant repair needs. In 2015, these buildings accounted for 40% of the existing higher education space.

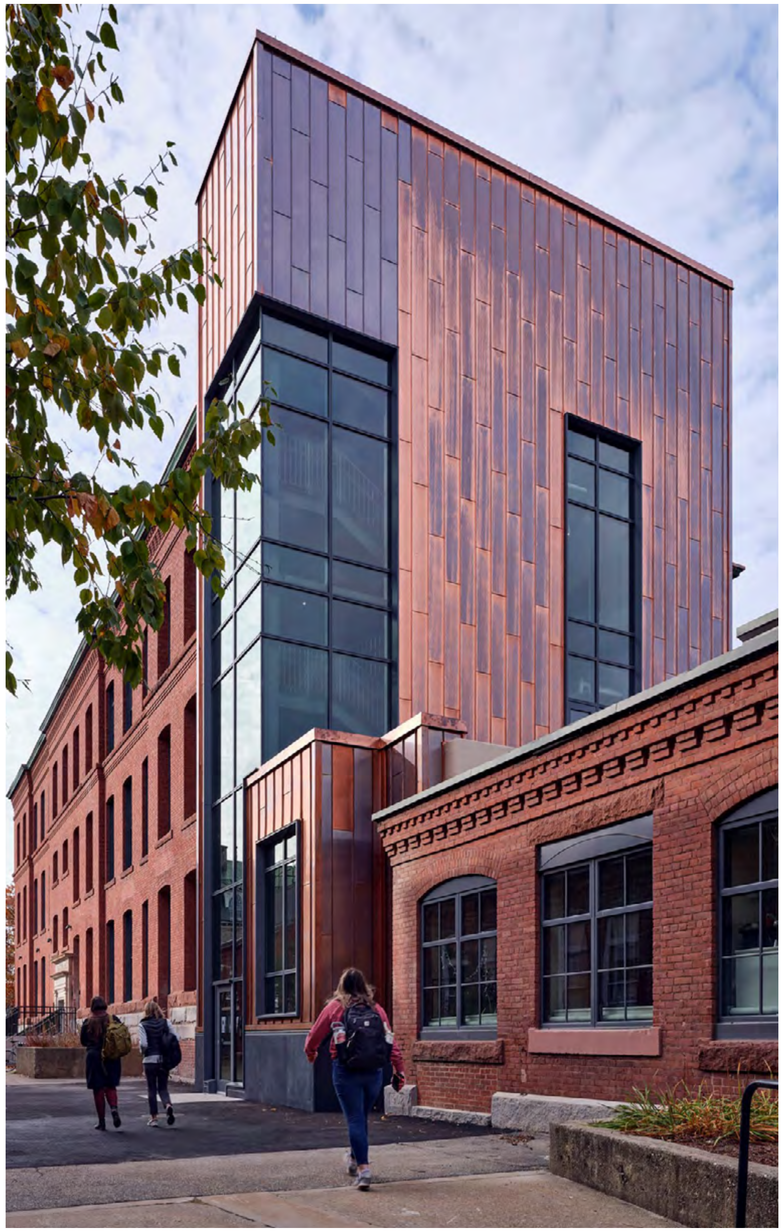
Millennial expansion

The next boom began in the late ‘90s, extending into the early 2000s. Many of these facilities are now in need of refurbishment.[1]

Canadian university expansion

In the ’60s and ’70s, Canada expanded its universities to meet the demand from the baby boom. The state funded the construction of many new university buildings and the demolition of some old ones. By 2021, however, Canadian higher education institutions were sitting on $13.4B (USD) in deferred maintenance.[2 3]

1. Gordian
2. University World News
3. Macleans



Worcester Polytechnic Institute Stratton Hall Renovation
Worcester, MA

How can universities take university building reuse to the next level?

Balance cost and functionality

Go ahead and run the numbers before you build new. Calculate the cost-effectiveness of renovation versus demolition and see what will deliver the best return on investment. And think about tomorrow’s needs, not just today.

Future-proof

Higher education is dynamic. The way universities teach is just as likely to change as the world and jobs for which they prepare students. So, it’s best to build flexibility into any renovation project. Thoughtful renovations should ensure that buildings can be adapted for future needs and functions, accommodating new educational practices and technologies.

Get creative

Find creative new uses for spaces that enhance campus life beyond the usual programmatic needs. Bringing back the faculty lounge at Kline Tower, for example, resulted in a new space serving multiple needs.

Promote the benefits of renovation

Communicate the benefits of renovation to the student body and alumni. Universities can showcase improvements like upgraded amenities, air quality, and accessibility to justify their spending and educate students and the public. On-site banners at construction sites may be just as effective as digital messaging here.

Balance legacy with mission

Show that you understand the importance of preserving the historical character and legacy of buildings for the institution’s identity. Remember that ultimately retrofitted buildings need to serve each university’s unique educational mission.

Interior designer **Kate Ryan** works on a wide range of projects from Stantec’s Boston office.

MORE HIGHER EDUCATION →

Stantec is a global leader in sustainable engineering, architecture, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what's previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what's possible.

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MORE BUILDINGS →

Denver Water Administration Building Denver, CO
The Denver Water Administration Building achieves a LEED Platinum designation and Net Zero Energy performance through a highly efficient building design, innovative central plant, and a 1.3 megawatt on-site solar array.