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Improving Building Enclosures

TEDI changes how consulting
engineers design projects. P. 12

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So-called 'edge organizations' are structured to empower employees who operate at their edges, *i.e.* where they directly interface with clients and the external world.

ON THE COVER Now more than ever, a building enclosure's performance is paramount to achieving engineering success. See story on p. 12.

PHOTO BY SCOTT ARMSTRONG.



Comment

by Peter Saunders

The Great Leaks?

Between national discussions of much-needed infrastructure and the potential damage posed by climate change, both today and in the future, there are areas where these topics intersect. One major example concerns the Great Lakes and the St. Lawrence River.

A recent survey of 241 municipal jurisdictions in the two Canadian provinces (Ontario and Quebec) and eight American states throughout this region suggests coastal damage associated with climate change will cost at least US\$1.94 billion to address over the next five years, through such means as flood prevention and sewer upgrades. This is in addition to the US\$878 million shoreline communities report they have already spent to counter such challenges over the past two years.

"Climate change is exacerbating fluctuations." - Walter Sendzik, mayor of St. Catharines, Ont.

"While water levels in the Great Lakes-St. Lawrence River basin are naturally variable with cyclical highs and lows, climate change is exacerbating these fluctuations, with levels reaching record highs in recent years," says Walter Sendzik, mayor of St. Catharines, Ont., and chair of the Great Lakes and St. Lawrence Cities Initiative, a coalition of 128 mayors and local officials in Canada and the U.S. "High water levels, severe storm events and wave action are leading to greater erosion and flooding that threaten public and private properties, critical infrastructure and recreation and tourism amenities in shoreline communities."

The coalition hopes that by illustrating

the scope and magnitude of climate impacts on its communities, the survey will emphasize the need for federal assistance. Along with other regional organizations, it is calling for new funding to improve resilience.

"We need both the federal governments to assist with the necessary investments," says Tom Barrett, mayor of Milwaukee, Wisc. "Our coastal infrastructure is vital to the health of our communities. Co-ordinated action is required."

The coalition conducted the survey in partnership with the University of Illinois Urbana-Champaign (UIUC) Applied Research Institute (ARI), an initiative of the Grainger College of Engineering. They received nearly 300 responses from the 241 jurisdictions.

More than 95% of respondents expressed moderate to high concern about coastal issues, while more than 80% said water level and flooding forecasts would be very important to their jurisdictions' work on coastal planning.

While most communities report they have taken actions—including planning, data collection, zoning code and ordinance updates and coastal resilience projects and practices—only half of respondents are currently incorporating strategies to anticipate, accommodate and adapt to changing coastal conditions in their planning efforts. They cite a lack of technical expertise, low staff capacity and a lack of funding as the primary barriers.

Will new funding arrive to meet their needs? Stay tuned. **CCE**

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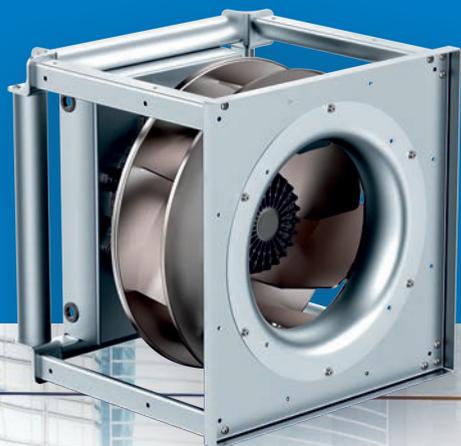
CCE GETS FACELIFT

This issue introduces Canadian Consulting Engineer's bold new logo and design. What do you think? Let us know at psaunders@ccemag.com!

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Engineering associations form FIDIC North America

La Fédération Internationale Des Ingénieurs-Conseils (FIDIC) has launched a new banner, 'FIDIC North America,' following the signing of a memorandum of understanding (MoU) by ACEC-Canada, the American Council of Engineering Companies (ACEC) and la Cámara Nacional de Empresas de Consultoría (CNEC) Mexico—i.e. all of FIDIC's key member associations in the region—aimed at strengthening co-operation between them. This follows the renaming of other regional bodies, including FIDIC Africa, FIDIC Europe and FIDIC Asia-Pacific.

2022
to
2023

Canada's first turn to chair FIDIC North America.

Feds to fund 'natural infrastructure'

In June, Infrastructure Canada announced a first-of-its-kind \$200-million natural

infrastructure fund. The federal government plans to invest up to \$120

million to improve access to parks, waterfronts and green space and better adapt to the effects of climate change. Major cities will be invited to apply for up to \$20 million for large projects, while an additional stream will address smaller projects. A minimum of 10% of overall funding will be allocated to Indigenous recipients.



PHOTO FROM TORONTO RAVINE STRATEGY VIDEO.

GHD appoints EGM for Canada



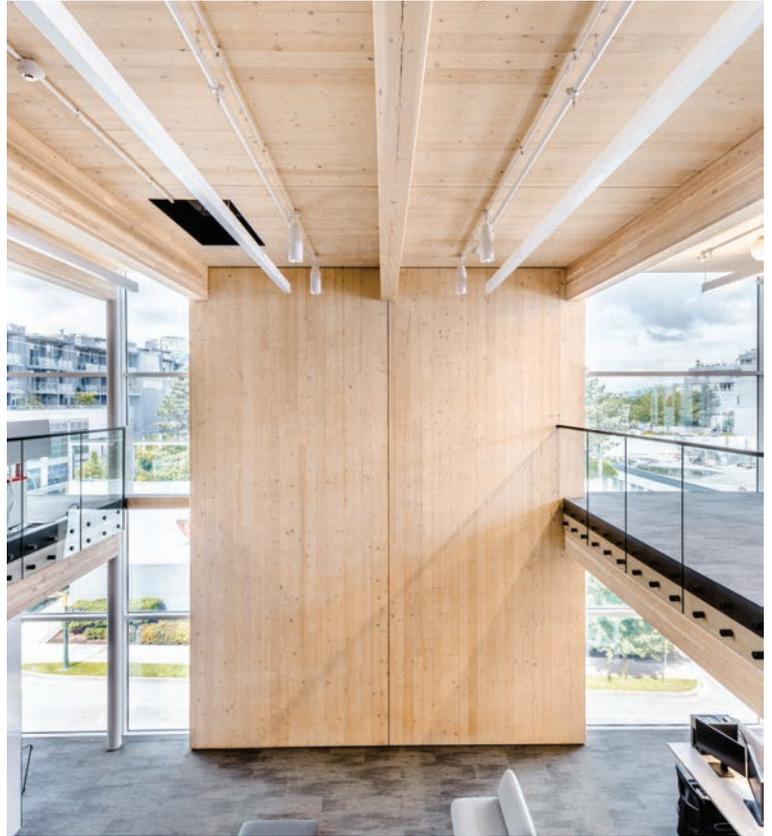
GHD appointed Chris Hunter executive general manager (EGM) for Canada. He has

been with the firm since 1999, most recently as regional general manager (RGM) for Ontario, during which time GHD was recognized as one of the Waterloo area's top employers.

PHOTO COURTESY GHD

\$120
million

Federal goal for investment in natural infrastructure.



Fast + Epp completes its mass-timber office building

Construction has completed for consulting engineering firm Fast + Epp's new four-storey mass-timber head office building in Vancouver's Mount Pleasant district.

The 'hybrid' structure of mass timber and steel was designed to demonstrate efficiency, cost-effectiveness and sustainability. It also marks the first time Tectonus shock-absorbent technology has been installed in North America; these devices reportedly not only dissipate and dampen energy, but also allow the building to 'snap back' to its original position following an earthquake, enabling an immediate return to occupancy.

Glazing facilitates ample daylighting of the interiors, while 'smart glass' technology automatically adjust tint levels to reduce energy consumption, improve am-

biance and eliminate the need for window blinds.

Also, apparently unique to the structural engineering industry, the ground floor features a new integrated laboratory space for developing, testing and fabricating prototypes. Dubbed 'Concept Lab,' it is slated to open in the fall.

"Our new home office celebrates structural engineering," says Paul Fast, founder and partner in Fast + Epp. "This space is a result of pushing the boundaries on innovation, while involving thoughtful and engaging design."

Fast + Epp collaborated on the project with design architects F2A, interior designers HCMA, contractor Companion Construction, mass timber installers Seagate Structures and smart glass manufacturer View.

PHOTO COURTESY FAST + EPP.



Ensuring Successful Infrastructure

Over the years, ACEC-Canada has been recognized by the federal government and other national stakeholders for its effective advocacy on behalf of its members and its contributions to influencing public policy that benefits all Canadians. A current and important example of ACEC-Canada's advocacy is its response and input into the federal government's engagement paper, *Canada's First National Infrastructure Assessment: Building the Canada We Want in 2050*. The engagement paper sets out the purpose and benefits of undertaking a National Infrastructure Assessment and seeks input from the public, Indigenous peoples, provinces, territories, municipalities and stakeholders on three main priorities of the assessment:

- *Assessing Canada's infrastructure needs and establishing a long-term vision;*
- *Improving co-ordination among infrastructure owners and funders; and*
- *Determining the best ways to fund and finance infrastructure.*

ACEC-Canada has long advocated for federal infrastructure policy based upon a long-term vision and upon robust and reliable data. And while there have been incremental steps in this direction over the years by the current and recent governments, a National Infrastructure Assessment represents tremendous opportunity for informed policies

and effective investments. ACEC-Canada is viewed by the federal government as an authority on infrastructure policy. This has provided us with a number of opportunities to discuss the concept of a National Infrastructure Assessment directly with Infrastructure and Communities Minister Catherine McKenna and with senior officials at Infrastructure Canada.

Leading up to submitting a formal written response to the engagement paper, ACEC-Canada has consulted with its own subject matter experts within our industry and with our stakeholder partners. ACEC-Canada also consulted with its counterparts in the United Kingdom, where a National Infrastructure Assessment has been implemented (which was a major inspiration for the Canadian federal government's proposal).

We have focused our feedback on the need for a National Infrastructure Assessment to be arms-length from government and transparent. While elected officials must ultimately be responsible for public policy and the funding of programs, it is important that they do so with credible and reliable information in which Canadians have confidence. Consequently, a number of ACEC-Canada's recommendations are related to the importance of having clear and transparent governance, mandate, scope and stakeholder engagement.

We have also emphasized the need to develop an inte-

grated economic and environmental vision to guide the Assessment. A vision for Canada's environment and the economy must go hand-in-hand to be successful. Launching the National Infrastructure Assessment within this vision will establish the Assessment as a central tool for improving infrastructure, as well as the social, environmental and economic quality of life of all Canadians.

For example, much like the concrete goals for climate change and transformational social policy, Canada should develop and implement targets to achieve a vision of the environment and the economy, with infrastructure playing a key role. Therefore, the National Infrastructure Assessment should not only include community-focused public infrastructure, but also infrastructure that makes Canada attractive to private-sector proponents in industries and sectors critical to a sustainable and prosperous future. Environmental and economic visions can and must be mutually supportive.

Another potential benefit is that long-term, predictable infrastructure programs based on a National Infrastructure Assessment could end the 'start and stop' infrastructure cycles as one program ends and another begins, while creating attractive and feasible investment opportunities for public funding agencies and private investors. The industries and supply chains that plan, design, build, operate and maintain infrastructure

could make informed investments in people, resources and technology. The same would be true for communities and public agencies, who could plan for the matching of funding often required by federal and provincial infrastructure programs.

This shift is critical to improving co-ordination among infrastructure owners and funders, as disjointed and inconsistent infrastructure cycles play a significant role in discouraging investments that build connective infrastructure and improve communities. As such, the National Infrastructure Assessment should establish a long-range pathway of projects and programming that allows for clear and consistent financial and resource planning.

Canada's consulting engineering firms are ready and eager to play an invaluable role in building the National Infrastructure Agency to help Canada recover from the impacts of the pandemic and develop grand, national economic goals. Ensuring a strong economic vision with infrastructure playing a lead role in achieving it, the federal government's goals of creating one million jobs, generating lasting community assets and improving the quality of life for all Canadians can become a reality.

You can find ACEC-Canada's submission and recommendations for creating a successful National Infrastructure Assessment, as well as other advocacy initiatives, on the ACEC-Canada website.



Strong Governance to Achieve Canada's Vision

ACEC makes recommendations for Canada's National Infrastructure Assessment.

Throughout Canada's history, connective infrastructure has brought our communities together and linked people from across the country. Despite the strong foundations of these investments, in the last few decades, Canada has fallen behind in ensuring a consistent flow of core infrastructure. As we continue to battle the COVID-19 pandemic, this unique moment offers us an opportunity to fundamentally shift our perspective, priorities and how we look toward the future. How we envision the future of our infrastructure—and the Canada we want to build in 2050—must be a part of this shift.

The federal government launched in March of this year an engagement paper on Canada's first-ever National Infrastructure Assessment, a timely, critical, and laudable initiative. In response, ACEC-Canada has made a written submission that focuses on developing an economic and environmental vision to guide the Assessment and considerations related to its governance, mandate, scope and stakeholder engagement. ACEC-Canada also believes a vision for Canada's environment and the economy go hand-in-hand. Launching the National Infrastructure Assessment within this vision will establish the Assessment as a central tool for improving



infrastructure and improving the social, environmental and economic quality of life of all Canadians. Part of achieving this vision from the outset will be developing an Assessment with the proper governance structure.

In learning from other jurisdictions, ACEC recommends in its submission the establishment of a permanent, independent and arms-length National Infrastructure Agency that would house and support the Assessment. This model would not only benefit the Assessment, but could also serve as a larger repository of best practices and industry expertise. This agency should also be provided with a mandate that outlines clear responsibilities to the National Infrastructure Assessment. These responsibilities should be ongoing,

A long-term vision and plan will require broad stakeholder engagement.

on a cyclical basis, to include development, regular updates, monitoring and progress reports on the Assessment.

Understanding a shared goal of the Assessment to map out the Canada we want to build in 2050, it is certain that this initiative will require a carefully considered scope. To support the Agency in fulfilling their mandate, ACEC-Canada recommends the scope of the Assessment should include a vision for the next 30 years of infrastructure, a review of the current state of Canada's infrastructure, a clear roadmap forward for the next 10 years and a consistent cycle of evaluation and improvement to ensure the Assessment continues to support Canada's infrastructure goals for 2050 and beyond.

Finally, developing this long-

term vision and plan for Canada's infrastructure will require broad stakeholder engagement with involvement from industry, municipalities, Indigenous communities and civil society. Part of this engagement would be achieved through the composition of the National Infrastructure Agency. However, ACEC-Canada believes ensuring the involvement and participation of those who are not on the Agency itself will also be critical to ensuring all the appropriate stakeholders are engaged in the Assessment.

Summary of ACEC-Canada's Recommendations:

Governance of the National Infrastructure Assessment

- ACEC recommends that a permanent, independent and arms-length National Infrastructure Agency be established to house and support the Assessment. This model would benefit the Assessment and serve as a larger repository of best practices and industry expertise.
- ACEC recommends that when making appointments for the

ACEC recommends that when making appointments for leadership, the minister should strive for diversity and inclusion to ensure a balanced board.

Agency's leadership, the minister should strive for diversity and inclusion to ensure a balanced board.

- ACEC recommends the creation of thematic working groups that can provide expert insight into key areas of development, to compliment the Agency's leadership. ACEC welcomes the opportunity to join the Agency's leadership or working groups or assist in the process of identifying stakeholders for consideration.

Mandate and Scope of the Assessment

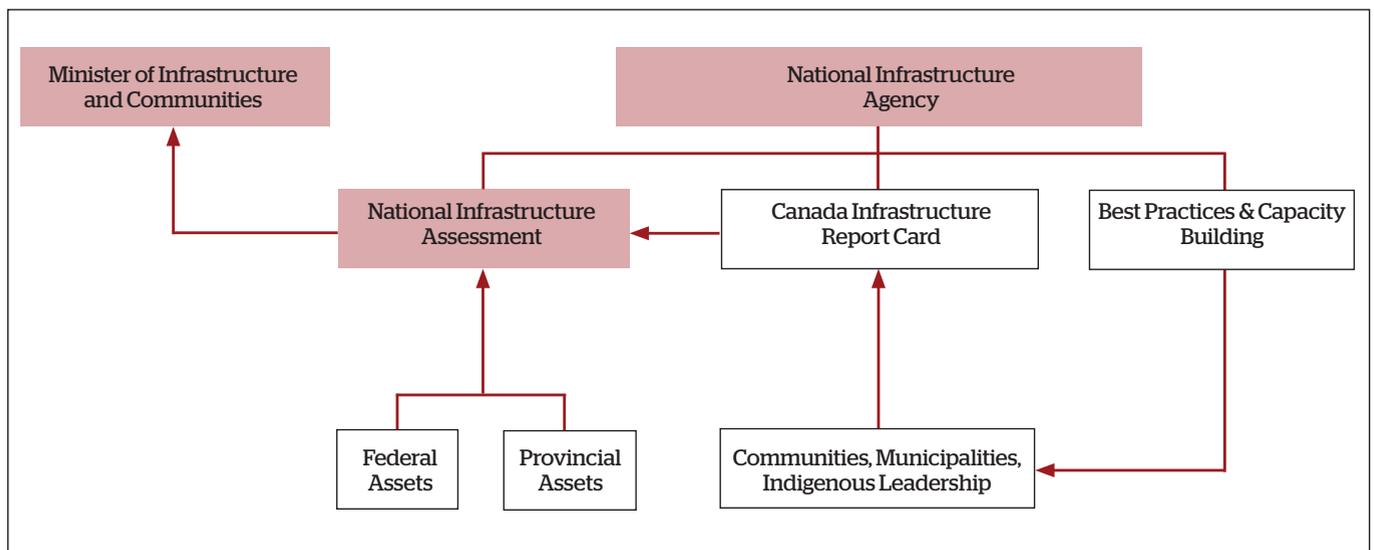
- ACEC recommends that this Agency be provided with a mandate that outlines clear responsibilities to the National Infrastructure Assessment. These responsibilities should be executed on a cyclical basis and should include development, regular updates, monitoring and progress reports on the Assessment.
- ACEC recommends that the scope of the Assessment include a vision for the next 30 years of

infrastructure, a review of the current state of Canada's infrastructure, a clear roadmap forward for the next 10 years and a consistent cycle of evaluation and improvement to ensure the Assessment continues to support Canada's infrastructure goals for 2050 and beyond.

Stakeholder Engagement

- ACEC recommends that the National Infrastructure Assessment be developed with broad stakeholder engagement and involvement from industry, municipalities, Indigenous communities and civil society. Part of this engagement would be achieved through the composition of the National Infrastructure Agency; however, ensuring the involvement and participation of those who are not on the Agency itself will also be critical to ensuring all the appropriate stakeholders are engaged.

To read ACEC-Canada's complete submission, please visit www.acec.ca.



ACEC strongly recommends that the federal government create an independent body to conduct, assess and monitor progress, similar to the National Infrastructure Assessment in the UK, which is under the umbrella of a National Infrastructure Agency.



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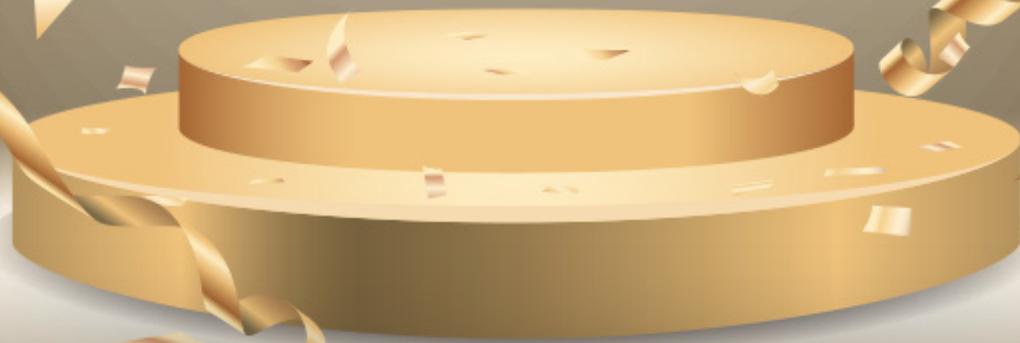
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Analyzing Thermal Bridging

TEDI provides focus for enclosure performance improvements.
By Scott Armstrong

As “per cent better than code” is a fading metric, the construction industry has seen the rise of a new performance paradigm: thermal energy demand intensity (TEDI). Simply defined, TEDI is the measure of heating energy required to offset enclosure losses and to heat fresh ventilation air. Thus, enclosure performance is no longer subject to trade-offs with highly efficient mechanical systems. Indeed, it’s paramount to achieving success.

TEDI has been adopted as a compliance metric for the Canada Green Building Council’s (CaGBC’s) Zero Carbon Building (ZCB) program and the Toronto Green Standard (TGS). It has also been a requirement of Passive House projects since that certification’s inception. Coupled with requirements to incorporate thermal bridging into whole-building performance values, TEDI is changing the way consulting engineers design and construct buildings.

Design strategies and performance

There is increasing awareness in the design and construction community of the importance of achieving a thermally efficient building enclosure, with some provinces and municipalities referencing Passive House or the CaGBC ZCB standard. These programs include performance-based targets for three primary metrics: TEDI, total energy use intensity (TEUI) and greenhouse gas intensity (GHGI). Building enclosure performance influences each of these metrics, but is often most noticeable through TEDI.

TEDI accounts for the energy required to offset enclosure gains and losses and to temper ventilation air.

Adding more insulation will not necessarily result in dramatically more efficient assemblies.

Spaces requiring high ventilation rates, such as laboratories and hospitals, can overwhelm enclosure-related TEDI measures, but these types of buildings still benefit from thermally efficient enclosures by improving their resilience to alternate uses, ensuring passive survivability, improving occupant comfort and enabling low-energy mechanical HVAC systems.

Low-energy HVAC systems also support fuel switching, which can significantly reduce a project’s operational carbon emissions.

Solar heat gain

TEDI can be improved (*i.e.* reduced) by including higher solar heat gain glazing balanced with fixed or dynamic shading. This approach helps maximize passive solar gains in the winter, then reduces solar gain and overheating in summer.

These strategies should be refined following a more detailed solar study for a proposed design, but some options (applicable within Ontario’s Golden Horseshoe) include:

- higher solar gain with dynamic or fixed shading on





the south elevation to control overheating.

- lower solar heat gain or dynamic glazing systems on the east and west elevations.
- higher solar gain on the north elevation without shading.

Wellness-oriented spaces, like eateries, activity rooms, gyms and meditation/yoga rooms, could also benefit from larger windows and associated views, daylight and passive solar heating. Hallways with larger glazed areas could also be considered along the south façade as a buffer for open or closed offices, benefiting from controlled solar heat gain in the winter.

Glare issues from large spans of glazing can be mitigated by using lower visible light transmittance, dynamic glazing, diffuse glazing or creative shading strategies. Consideration could also be given for 'cascading' conditioning of different spaces or redistribution of energy between compatible spaces.

It is important to understand the solar exposure for each site and the effect of geographic location, building orientation, building form and adjacent/ overshadow-

Low-energy HVAC systems support fuel switching, which can reduce a project's carbon emissions.

ing conditions. These unique aspects for each site could also inform the façade design, by incorporating bespoke shading solutions. One example would be a custom exterior shade profile that traces the line of highest largest solar gain, giving architectural expression to climate adaptation.

Highly glazed façade assemblies must be thermally efficient to avoid offsetting passive heating benefits. Passive solar benefits can be achieved with modest glazing ratios and by balancing the highly glazed façades with opaque walls.

Thermal bridging effects

Thermal bridging occurs when heat flow bypasses insulated building enclosure elements through highly conductive materials, reducing the overall effective thermal value of the enclosure and creating uncomfortable living conditions for occupants.

Most energy analyses account for thermal bridging only through clear field wall assemblies (e.g. cladding attachments) and standard National Fenestration Rating Council (NFRC) window assemblies. However,



There is increasing awareness in the design and construction community of the importance of achieving a thermally efficient building enclosure.

programs like the National Energy Code for Buildings (NECB) 2015, TGS, Passive House and CaGBC's ZCB require teams to account for other regular and irregular thermal bridging, including:

- linear conditions: projecting concrete floor slabs, parapets, masonry shelf angles, window-to-wall transitions and building corners.
- point conditions: structural penetrations, shade supports and roof anchors.

There is growing demand for detailed analyses that include these elements. As designers, it is important for consulting engineers to use the same terminology when discussing an enclosure's thermal performance.

Apart from providing accurate input data for energy modelling, a thermal bridging analysis can provide direction for improving the thermal performance of the building envelope through small design modifications.

Experience shows the thermal bridging effect of standard practice detailing can reduce the actual performance of a clear field thermal value by upward of 50%. The reduction is more pronounced for higher clear field thermal values.

Adding more insulation will not necessarily result in dramatically more efficient assemblies. It is essential to address the thermal bridge. Conducting a parametric or sensitivity analysis of thermal bridging conditions can help determine where detail updates may produce

57%

of total heat flow in a typical Toronto MURB is accounted for by window perimeters.

Spaces like gyms could benefit from larger windows.

the most benefit to a given project. The following are some examples:

- Adding a thermal break can help to mitigate heat loss through the slab.
- Continuous insulation layers should be ensured at junctions, such as corners, parapets and wall type transitions.
- Bridging elements on the exterior, such as structural penetrations, should be insulated.

This level of analysis has led to discussions of omitting a second energy recovery ventilator (ERV) in a residential suite, eliminating perimeter heating in commercial buildings or targeting a higher tier as per TGS (i.e. Tier 2 instead of Tier 1). This flips the script on traditional discussions about whether enclosure upgrades are worth doing at all.

Making improvements

This article is further illustrated at ccemag.com/features/tedi, where Chart 1 provides an overview of the thermal bridging analysis for a typical mid-rise multi-unit residential building (MURB) in Toronto, focusing on above-grade opaque wall assemblies. The assembly for this project includes a precast cladding panel with an effective R-16 clear field thermal value.

Factoring in the thermal bridging from panel anchors, building corners, balcony slabs and window perimeters, the clear-field R-16 is reduced to a whole-wall R-3.5. That is a 78% reduction in thermal performance!

The following are a few of the key findings of the analysis:

- Insulated precast panels, comprising 96% of the total surface area of the opaque enclosure, account for only 21% of total heat flow.
- Precast anchors account for approximately 6.5% of heat flow.
- Balcony slabs account for nearly 13% of heat flow.

- Window perimeters account for nearly 57% of heat flow.
- Building corners and soffit interfaces account for slightly more than 1% of heat flow.

This data helps steer attention to the detail that most significantly influences thermal performance in this building: the window perimeter.

Using thermal modelling software, it is possible to make improvements to the details and calculate project-specific linear transmittance (PSI or ψ) values for the window-to-wall interface detail or point transmittance (CHI or χ) values for penetrations.

Charts 2 and 3 (also online) illustrate the process for determining custom linear transmittance values for project-specific conditions. Based on this data, the value for the window perimeter can be reduced from 0.35 W/m K to 0.06 W/m K for the jamb and head and 0.12 W/m K for the sill. Substituting these values into the thermal bridging analysis demonstrates the influence of adding a thermal break at the window anchor and corresponding improvement in whole-wall thermal value (see Chart 4, online).

This single detail improvement results in a near doubling of the total wall R-value! This is the power of parametric thermal bridging analysis.

It is possible to parameterize specific elements in this analysis in a computation design workflow, including materials within the details and the thermal modelling process itself. Doing so could reduce the time needed for custom modelling, particularly in the early design stages when fewer details are available.

The time is right

Low-energy, low-carbon buildings demand thermally efficient building enclosures. Analyzing these buildings using energy modelling tools requires accurate metrics for their enclosures' thermal performance.

Performing a parametric analysis of thermal bridging conditions allows design and construction teams to understand the effects of seemingly minor details on the overall thermal value. This

process also helps teams manage critical decisions regarding enclosure design, adding thermal breaks where needed to optimize performance.

As code and local jurisdictions introduce requirements for detailed thermal bridging

analysis, the time is right to incorporate this process into more projects. **CCE**

Scott Armstrong is a senior façade specialist with WSP in Canada. For more information, contact him at scott.armstrong@wsp.com.



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Designing the Dalewood Bridge

There was no known point of comparison.

By Stephen Brown and Andrew Lehan

The City of St. Thomas, Ont., retained Entuitive as a structural engineering consultant, working in partnership with BT Engineering (BTE), to design a unique bridge for Dalewood Road on an affordable budget, featuring steel tube stays to support the girders, similar in concept to extradosed concrete bridges. Completed in 2019, the \$4-million project replaced an existing modular Bailey bridge that was built in 1983 and had fallen into poor condition.

Design challenge

The main challenge was how to design a distinctive and easy-to-maintain bridge on a relatively small budget. BTE and Entuitive held a value engineering and constructability workshop during the design phase to better understand the client's needs. Such sessions are not typical for projects of this small scale, but the process proved important for this project, particularly in learning about expectations concerning adjacent recreational lands, the Kettle Creek watercourse and the surrounding conservation area.

The design team involved the

city, the Kettle Creek Conservation Authority (KCCA), Robert Davies of Montgomery Sisam Architects and constructability experts in brainstorming ideas to meet the project's functional requirements, constructability constraints and context-sensitive design opportunities. A second workshop was held post-tender with the successful contractor, McLean Taylor, to make additional changes that reduced construction costs while preserving the desired esthetic.

The resulting structural system enabled a visually interesting bridge as low to the water as possible. The design offered a strong separation between pedestrians and vehicular traffic, appropriate for a bridge that serves both as a vehicle transportation link to the city and a bridge for a major natural park for the city.

The 50-m long bridge consists of two 25-m spans and a central pier. Its total width of 11.85 m accommodates two lanes of traffic and a 3.35-m wide multi-use path.

The superstructure features two steel box girders and a composite concrete deck. Unlike typical U-shaped steel box girders, the Dalewood Bridge's girders were designed with full-width top flanges to increase their slenderness and stiffness, an innovation that allowed them to be erected without falsework or bracing, thereby reducing the project's cost and environmental impact.

The design is also innovative in its use of steel tube stays to support the girders, similar to the design of extradosed concrete bridges. The

stays were erected after the girders and before casting the deck. The deck weight sufficiently tensioned the stays, such that they would not experience compression under combined dead and live loads. This innovation precluded a deliberate tensioning procedure, which would have added cost and complexity. Finally, using integral abutments resulted in a jointless bridge without permanent bearings.

Complexity in construction

Construction was complicated by poor ground conditions and variable water depth. The solution was to create a circular cofferdam that could be installed with the same equipment that would be used to install the piles. The cofferdam could be sealed with a tremie plug anchored to the piles, thereby allowing the rest of the pier foundation to be constructed in the dry.

The south abutment also had to span over a previous bridge foundation that would have been prohibitively costly to remove. The abutment acted as a deep beam that allowed piles to be driven outboard of the obstructing previous abutment.

The solutions to both these problems were resolved through a design optimization process, but the first challenge was constructing an 'extradosed steel bridge' with no known comparable design. Technical design was carried out using a time-dependent staged construction analysis, with careful consideration of the construction sequence and service life but using conventional analysis tools. Reviews were



Slender box girders were erected without falsework or bracing, reducing costs.



voke pride in the community and enhance local life.

The bridge was constructed on an improved horizontal and vertical road alignment, but included traffic calming by narrowing the lane widths. A reduction in speed was consistent with the recreational setting of the project.

The design was also efficient from a cost perspective, enabling the city to stay on budget. The steel pier cap was integrated with the superstructure, eliminating the pier diaphragm and bearings and avoiding a grade raise on the approaches, owing to a shallower superstructure. As the bridge does not have any permanent bearings, it will not require bearing replacement in the future. The design's lack of joints will also reduce future rehabilitation needs, ultimately reducing the project's life-cycle environmental footprint.

A competing concrete bridge design would have required a grade raise with additional cost and resulted in a negative impact on the park, as it would have required prestressed concrete girders much

deeper than the shallow steel box girders of the selected design. It also would have been heavier, necessitating more expensive foundations.

The general contractor and the steel fabricator/erector were both locally based, providing jobs and economic stimulus within southwestern Ontario.

There were environmental challenges to building the bridge in a natural area. Wildlife concerns included the local fish habitat and upstream earth embankments that are part of the Kettle Creek dam. The project plan included the reconstruction and stabilization of these embankments, the creation of new fish habitat to compensate fisheries for new road embankments and the construction of a new parking lot and canoe launch to tie in with the sidewalk and multi-use pathway crossing over the bridge. **CCE**

The earlier bridge's foundation would have been prohibitively costly to remove.

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undertaken using alternate methods and hand calculations to demonstrate the design would be safe, durable and functional as both a pedestrian and a vehicle bridge.

Social, economic and environmental benefits

As a signature bridge, the project was tasked with providing a memorable access point to the city and complementing the existing natural park setting. It was designed to suit the site and its surroundings, with interesting approaches to the structure and views of a reservoir. By making the park a more accessible place, the bridge can help in-

Two Canadian Firms Celebrate 75 Years

Associated Engineering and Morrison Hershfield are competitors and sometime partners. By Janet Jensen and Jimmy Kokaji

For the last 75 years, Morrison Hershfield and Associated Engineering have participated in tens of thousands of projects nationwide and worked to ensure the quality, reliability and safety of Canada's infrastructure. They are proud of their successes and the contributions they've made to improving the quality of life in communities across the country, while navigating economic downturns, upturns and periods of growth.

Although they are competitors by nature, their similar corporate cultures and ownership models have led the two firms to partner on many projects over the years, from Toronto's Basement Flooding Protection Program to Alberta's South Edmonton Hospital, Smith Crossing Pedestrian Bridge and Highway 63-12.

Both firms credit strategic and sustainable growth strategies, a focus on continuous improvement,

a steady emphasis on relationship-building and a commitment to employee ownership for their longevity. They have thrived by developing and maintaining meaningful, long-standing relationships with clients, peers and employees.

From humble beginnings

In Toronto in 1946, Carson Morrison, Charlie Hershfield, Joe Millman and Mark Huggins formed a partnership to offer civil, structural and mechanical engineering services. Today, that firm is known as Morrison Hershfield.

That same year, Herb Ripley, Norm Lawrence and Al Rowand formed Associated Engineering Services in Edmonton. The company initially worked on water and sewer assignments for municipalities throughout Alberta.

Now, 75 years later, both firms have grown to more than 1,000 employees and have expanded their markets, services and geographic reach. Associated Engineering has remained wholly Canadian, with 21 offices across the country, while Morrison Hershfield operates 23 offices: 11 in Canada, 11 in the U.S. and one in India.

Associated Engineering has expanded its service offerings to include planning, environmental science, landscape architecture, project management, climate change adaptation and mitigation, community resiliency, asset management and quality management.

"Since Associated Engineering was founded 75 years ago, we have risen to many challenges, created better communities and achieved our collective goals," says Martin Jobke, the firm's president and CEO. "Confidence, resilience and a keen eye to the future defined the men and women who built the Associated group of companies. Our previous strategic plans inspired us to reach new heights. We have done so, achieving our vision to be a leader in our industry."

Morrison Hershfield has become a multidisciplinary firm, involved in building, critical facility, environmental, land development, solid waste, telecommunications, transit, transportation and water projects from coast to coast to coast, from rehabilitating Toronto's Gardiner Expressway to engineering and managing the fixed wireless portion of Alberta's SuperNet. Current areas of specialty include transit maintenance facilities and energy-efficient building envelopes.

The ownership advantage

Both firms are 100% employee-owned. Indeed, they cite the offer of share ownership to employees as a key factor in their success, one that has helped attract and retain talent. Staff is highly involved in planning and goal-setting, with a focus on creating a common vision for the future.

"Our journey as an employee-owned firm is something we

PHOTO COURTESY MORRISON HERSHFIELD



Both firms are 100% employee-owned.

2025

Target year for Morrison Hershfield's current 'Ambition' goals.



Morrison Hershfield won awards for the Cloudraker Skybridge and Raven's Eye Cliffwalk at Whistler Blackcomb.



Associated Engineering has been honoured as one of Canada's best-managed companies.

PHOTO COURTESY ASSOCIATED ENGINEERING.

take great pride in,” says Anthony Karakatsanis, president and CEO of Morrison Hershfield. “We are always looking for opportunities to do things better, smarter and more efficiently. Some things are out of our control, but we can take ownership in fine-tuning the way we do business. Engaging our employees in continuous improvement initiatives, even just incremental changes, is critical in terms of achieving long-term gains. We also have the

flexibility to make longer-term investments to create opportunities for future generations of the firm. Our 2025 Ambition, for example, will provide us with a compelling journey and create a destination that inspires the next generations to achieve even greater success.”

The 2025 Ambition goals relate to agility, focus, technology, corporate social responsibility (CSR) and culture.

“As an employee-owned firm,

our focus is on long-term decisions, rather than reacting to short-term quarterly results,” says Jobke. “We listen to staff’s ideas and if they make sense, we grow in that direction, which has created opportunities for entrepreneurship, to improve systems and to create programs. Key initiatives, such as our Carbon Neutral program and Climate Change Basic Awareness Training, came from our staff and their commitment.”

Following a commitment in 2007, the firm achieved carbon-neutral status in 2009. The training program followed in 2016, showing staff how to collaborate with clients to develop more sustainable, resilient projects.

A culture for continuous improvement

Planning for sustainable growth requires detailed road maps for success. It also requires the implementation and continuous improvement of processes and tools to ensure efficiency, quality and exceptional experiences for clients and employees alike.

“A strong and ongoing focus on improvement helps us maintain and increase performance, respond to changes in internal or external conditions and create new opportunities,” says Joan Vinci, Morrison Hershfield’s corporate quality management system (QMS) director. “It’s a mindset, an ongoing philosophy, that helps us stay ahead of the game.”

“Our goal is to continually improve project delivery and our clients’ experience.” - Lance Kubrak

“We are continuously evolving and improving our systems and tools, from production and QMSs to information management and communications,” says Lance Kubrak, Associated Engineering’s chief operating officer (COO). “Our goal is to continually improve project delivery and our clients’ experience.”

Both firms pay particular attention to where they invest time, how they improve success rates and where they can find efficiencies to deliver higher levels of growth with lower costs. Morrison Hershfield’s ISO 9001:2015-certified QMS, for example, was put in place to help identify new opportunities, manage and mitigate risks and provide

Martin Jobke is president and CEO of Associated Engineering.

PHOTO COURTESY ASSOCIATED ENGINEERING.



Anthony Karakatsanis is president and CEO of Morrison Hershfield.

PHOTO COURTESY MORRISON HERSHFIELD.



guidelines that reduce ambiguity. This way, there is a constant drive for improvement at all levels.

Project delivery is core to the success of consulting engineering firms. Continuously finding opportunities for greater efficiency of project management processes, technology and training is simply good business—and having staff involved in identifying incremental improvements leads to a greater sense of ownership, increased productivity and a common drive to succeed. Finding the right blend of delivery systems that improve the client experience and that are faster and easier for employees to execute is a win-win-win for clients, employees and the firm.

Investing in people

Both privately held firms invest

heavily in their staff through professional development, training, awards and community and industry involvement.

Facilitating continuous learning and personal and professional development are key elements of their corporate culture. Individuals at all levels are given the opportunity to enhance their skills and competencies and contribute ideas and efforts toward enhancing value in the eyes of clients, their fellow employees and stakeholders.

Shaping the next 75 years

As the world goes through important changes, Associated Engineering and Morrison Hershfield have worked to be future-ready, with thoughtful strategies in place to help them remain focused during times of uncertainty and new opportunity.

Both firms are committed to remaining employee-owned. Creating opportunities for staff to grow and build their professional careers will produce forward-looking, proactive and creative people who are influential in their professional fields and in society in general. They are not only creating a legacy in their firms, but also in the communities where they work and live.

“While our company has changed a lot over the years, one thing remains constant: the heart and dedication of the people who make up our organization,” says Jobke. “We are excited to commemorate our anniversary.”

“We look forward with optimism, confidence and determination to meet the challenges of the future and realize the possibilities that lay ahead,” says Karakatsanis. **CCE**

Janet Jensen is corporate communications co-ordinator for Morrison Hershfield and Jimmy Kokaji is a senior marketing specialist for Associated Engineering. For more information, contact them at jjensen@morrison-hershfield.com and kokajij@ae.ca, respectively.



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Recordbreaking Aeration

A plant upgrade reminds the village of Montrose, B.C., how long its original technology has lasted.

By Chris French

When the *Trail Times* reported last year that the village of Montrose, B.C., had successfully applied for Infrastructure Canada Grant Program funding for upgrades to its 56-year-old wastewater treatment plant, the local newspaper did not happen to mention the plant's original aeration technology—installed by Lakeside Equipment in 1963—was still in operation. Indeed, it is very probably the longest-lasting engineering of its type to remain in working order anywhere in Canada and even North America, if not the world.

It takes a village

It was even further back, in 1942, that Leon Simmons had the idea of developing what was then known as Woods Flats—an area of about 220 acres—into a retirement village for workers from the nearby Cominco (now Teck) smelter.

Woods Flats was incorporated as a village in 1956 and, consistent with historic connections between Canada and Scotland, was renamed after the Scottish coastal town of



Martin Walsh, who first campaigned for a water treatment facility, later became mayor. Today, his son Mike holds that same position.

Montrose, razed to the ground by the Danes in the 10th century.

In the late 1950s and early '60s, raw drinking water in Montrose came from a well drilled near the mouth of the Columbia River, into which Beaver Valley Creek flows. One determined local campaigned for a water treatment facility. At first, his concerns fell on deaf ears, but he formed a committee, then ran for council and eventually became mayor, during which time he successfully secured a grant for Montrose to have not only its fresh water treated, but also a sewer system.

The man behind this campaign, along with the introduction of

Lakeside's oxidation ditches in 1963, was Martin Walsh. Today, nearly 60 years later, his son Mike is mayor of Montrose, overseeing the wastewater treatment plant upgrade.

"At the time, the installation was state-of-the-art," he says. "We are going ahead with an upgrade, but the Lakeside equipment is amazing for how old it is and still working fine after all these years. My father pushed very hard for Montrose to have efficient and long-lasting treatment systems. Together with his colleagues, they certainly chose wisely."

The plant featured a racetrack installation, now known as the

PHOTO: NAME TKHERIOUS

Lakeside closed loop reactor (CLR) process.

“When the racetrack was installed, it was small, of course, for our small village,” says Walsh, “but even then, it was designed with room for expansion, which we took advantage of in 1980. We’ve had no major problems at all. It has just kept on working away.”

“This installation has been in operation much longer than most aeration companies have been in business!” says Warren Kerstein, vice-president (VP) of Lakeside. “It was our first oxidation ditch installation and, remarkably, it still has the original rotor aerators in use.”

Regional support is provided by Promag Enviro, Lakeside’s representative in Burnaby, B.C.

A common option

The racetrack design with common wall construction has proved an economical option for most wastewater treatment plants. Over time, reactors have been developed in several shapes, including the folded U, concentric multi-channel and, for small plants, a round packaged design with an internal final clarifier that reduces construction and equipment costs.

The CLR process features one or more reactors with a single feed point for raw wastewater and return sludge. Montrose’s simple racetrack configuration provides a straight-line flow pattern for wastewater between the headworks and the final clarifiers.

At the core of the CLR process is the horizontal magna rotor aerator, which sustains a high population of micro-organisms in the reactor to provide simple process control. The rotor provides precise oxygen input into the biological process through adjustment of its immersion, by raising or lowering the level control weir and adjusting the rotational speed.



Top: The equipment installed in 1963 is still going strong.

Bottom: Mike Walsh (left), the current mayor of Montrose, is helping oversee an upgrade with treatment plant operator Greg Parker (right).

As the rotor provides oxygen to the biological mass, it mixes the micro-organisms uniformly and adds mixing velocity to the channel to prevent solids from settling. Its blades are die-formed 10-gauge AISI Type 304 stainless steel for stiffness and rigidity. They can handle a 250-lb impact load without deformation.

The CLR process has become known for stable operation over a wide range of influent flows and organic loadings. Even in cold weather conditions, when micro-organism activity decreases, the process can operate efficiently without special attention. The technology is designed to minimize the time and effort needed to control or adjust the system.

Time for an update

Since Montrose’s inaugural instal-

lation in 1963, more than 2,000 Lakeside systems of the same type have been introduced to other wastewater treatment plants across Canada and the U.S. Many of them, too, are still going strong.

“Our products are low-maintenance, but it is still a massive credit to the operators at Montrose that they clearly take very good care of their equipment,” says Kerstein.

Nevertheless, it is finally time for an update.

The racetrack configuration provides a straight-line flow pattern for wastewater between the headworks and the final clarifiers.

“Since 1963, when my father helped introduce our treatment plant, the number of homes in Montrose has almost doubled from 250 to 430, so we’ve had to reinvest,” says Walsh. “We have had great service from Lakeside and are pleased to be the owners of the longest-serving oxidation ditches, but we can’t expect the equipment to last forever.”

The plant upgrades are currently underway and should be completed by this fall.

“Winning a joint federal and provincial grant through the Investing in Canada infrastructure plan and New Building Canada Fund to upgrade our water and wastewater treatment was great news for our village,” says Walsh. “It was also welcome news for our operators, because much of the treatment plant operation has been a hands-on job, including the manual cleaning of screens, which isn’t the most pleasant!” **CCE**

Chris French provides public relations (PR) for Lakeside Equipment. For more information, visit www.lakeside-equipment.com.



Are Prefabricated Modular Buildings Lienable?

The vagaries of off-site construction are open to legal interpretation.

The construction lien is a powerful remedy in the nature of a charge against an interest in lands and premises to secure a preference of payment for services or materials supplied for an improvement. It ensures contractors and other professionals enjoy protection of payment for their contributions to a project.

The rules surrounding such liens are governed by the *Construction Act*, R.S.O. 1990, c C.30. The availability of the lien remedy is typically straightforward in cases where a contractor supplies materials or services at the construction site itself. However, other situations call into question the scope of lien rights under the Act.

If a home is built off-site in a modular prefabrication factory, for example, and subsequently installed at a construction site, do the contractors who worked on it enjoy lien rights in the land where the home is ultimately located? Do lien rights exist with respect to other modular structures, such as portable classrooms for schools?

As with all construction law matters, case law suggests the answer in any particular case will be both highly fact-driven and highly context-dependent.

Three examples

In *Hank's Plumbing and Gas Fitting Ltd. v Stanhope Construction Ltd.*, the Alberta District Court con-



1978

The availability of lien rights for prefabricated modular structures is first considered by the courts.

sidered—in 1978, for what appears to have been the first time—the availability of lien rights in relation to prefabricated modular structures.

In this case, the plaintiff performed work on modular homes that were constructed at the defendant's factory. The homes were virtually finished in the factory, left the factory in two pieces and were assembled at their ultimate destination. The plaintiff only performed work on the homes in the factory.

True chattels are not affixed to specific lands.

The court held the plaintiff's services were not lienable, as the homes had "all the attributes of a chattel." Key to the court's conclusion was the fact the owner of the

homes could direct where the home would be installed. In other words, the homes had no connection to specific land and could be moved around at the direction of the owner.

Two years later, the Alberta Court of Queen's Bench reached the opposite result in *Aspen Lumber Co. v Depner*. In this case, a contractor supplied lumber that was used to make pre-fabricated condominium sections (i.e. framing). The contractor cut the lumber at its own factory, while the building of the sections was completed at another factory.

The court held the contractor was entitled to a lien, notwithstanding the facts the contractor supplied services off-site and the framing was constructed off-site. The court distinguished the facts from the earlier *Hank's Plumbing*

case on the basis that (a) Hank's Plumbing dealt with true chattels that were not affixed to the land, while (b) in this case, the prefabricated sections were manufactured with the specific land in mind.

Finally, in *Inseco Ltd. (Trustee of)*, Re, a 1986 decision by the Ontario Supreme Court's bankruptcy division held a contractor who assembled portable school buildings had no lien rights. In this case, the portables were delivered to the site completely finished and then installed on cement blocks. The court observed the portables were self-contained units that could be moved from place to place, like a trailer or mobile home, and in this regard they resembled chattels more than anything else. Further, the school portables were not manufactured for a specific site and could be installed at any school at the direction of the school board.

Applying the nexus test

As these cases illustrate, the availability of lien rights in the context of prefabricated mod-

ular structures depends, in large part, on whether there is a connection to specific land.

If a structure is manufactured with no particular end destination in mind, it is considered a chattel that can be moved around at will. However, lien rights may exist where the structure is manufactured for specific land or in respect of a specific construction project.

The cases that have considered this issue are somewhat dated. A more modern 'nexus test' is now used to determine whether the supply of services or materials is lienable.

Pursuant to the nexus test, the supply of services or materials will give rise to lien rights where the construction parties and, particularly, the owner consider the subject services or materials necessary for the completion of the project, as well as where the services or materials benefit the majority of the contractors and subcontractors.

In applying this test in the context of prefabricated modular structures, it is clear, so

long as there is a sufficient nexus between the contractor's contribution and the project itself, the fact the services or materials are supplied off-site and in relation to a prefabricated structure will ultimately be a red herring. In the above-noted cases, the courts appeared to arrive at the correct results by focusing on the degree of connection between the contractor's work and the lands in question.

Lien rights depend on the specific facts of each case.

Considering the context

Indeed, as all of the above

makes clear, the availability of lien rights under the act is highly context-dependent. No two cases are alike and the specific facts of the case must be leveraged one way or another to prove or disprove the existence of lien rights.

Given the complex and technical nature of this area of law, consulting engineers and contractors are encouraged to seek legal counsel to understand the nature and scope of lien rights available to them. Moreover, the timelines for preserving and perfecting construction liens under the act are strict and show no mercy, requiring great caution and care. **CCE**



PHOT: ©CLSDSIGN / ADOBE STOCK

Portable classrooms are a common example of modular prefabrication.



Tetra Tech Welcomes Grant Hallam as Vice President of Municipal Infrastructure

Grant brings over 30 years of municipal engineering project expertise to Tetra Tech's growing team. Grant will lead Tetra Tech's Municipal Infrastructure business group in western Canada. Tetra Tech is excited to introduce Grant to our valued clients as we grow our engineering services to design and build world-class municipal infrastructure.

Grant's extensive expertise, project leadership and attentive client care support Tetra Tech's approach to deliver technical excellence and unsurpassed client satisfaction.

Grant Hallam, P.Eng.
Calgary, Alberta



How Close to the Edge is Your Company?

By Bryan Leach, P.Eng.



Today's rapidly changing business environment calls into question the effectiveness of the traditional command-and-control management structure, a vestige of the Industrial Age that focuses on a strict hierarchy of concentrated decision-making and interactions, with tightly controlled access to information.

In the Information Age, a more agile management structure is becoming more common. So-called 'edge organizations' are structured to empower employees who operate at their edges, i.e. where they directly interface with clients and the external world. They need to be especially adaptable to dynamic situations.

The sweet spot

How near to the edge an organization is operating can be assessed in terms of the following three attributes:

- Allocation of decision rights: The freedom and authority to make decisions at all levels.

- Patterns of interaction: The freedom to interact with whoever in the organization.
- Distribution of information: The free flow of information to those that need it.

Being at the edge requires the empowerment of unconstrained employees. For most companies, the preference is to operate in a 'sweet spot' for each of the three aforementioned dimensions, one that is compatible with the company's business, organizational culture and risk management policy.

The unconstrained allocation of decision rights, for example, represents chaos and risk. In any company, there needs to be clarity in the decision-making process and in each individual's appropriate level of responsibility. Patterns of interaction, meanwhile, represent a spectrum from 'everyone is in it for themselves' to 'we are all in this together,' but the aim is a collegial atmosphere where employees will share ideas, approaches and decisions freely. Finally, transparency regarding access to information can

do much good, but some details need to be kept 'confidential,' with limited circulation, given the need to respect privacy and security.

The 'sweet spot' for a knowledge-based consulting engineering firm is likely different to that of, say, a traditional manufacturer.

A real-world assessment

An edge organization assessment was undertaken for an employee-owned international consulting engineering firm, a couple of years after it had experienced a decade of strong growth and organizational change. The assessment saw 16 senior practitioners participate, rating the firm on each of the three edge organization dimensions with a numerical score from 1 (tightly constrained/controlled) to 5 (unconstrained/uncontrolled).

They also rated the company at four levels: (a) overall organization, (b) national/regional corporate, (c) local corporate and (d) project. Their scores for each of these four levels were then averaged for each of the three dimensions (see Table 1 on page 27).

The scores help indicate

the extent (a) to which the company has developed into an edge organization and (b) to which employees feel empowered. Noticeably, they increase moving from the higher corporate level to the lower project level, in all three dimensions. This is to be expected in a project-driven work environment where senior members interface with clients and therefore need to be empowered to execute work effectively.

The lowest scores, for the allocation of decision rights at the higher and local corporate levels, may reflect a move toward centralizing certain decision-making rights to better manage risk as the company grew. Overall, the participants considered the company to be a moderate to strong edge organization—and their comments tell a more complete story than the average scores:

"In terms of the organization overall, I am talking about the decision-making rights given to junior through intermediate to senior staff, who have the skills and experience to make decisions and provide opinions commensurate with their level and know when



they should/are expected to consult with others before making certain decisions. This freedom to decide should not be confused with the implementation of certain processes and tools and the request/expectation that staff at all levels will use them and follow procedures; these are intended to bring some consistency to how we do our work as a global company with global clients, manage our risk and facilitate global collaboration.”

“Although the company actively advocates and encourages all employees to directly interact with anyone in the organization, the individual employee may be hesitant to do so because of perceived

Members of your team who interface with clients need to feel empowered.

hierarchical expectations in a professional firm, especially as the firm grows substantially. It may be viewed that senior management does not have the time for interactions at all levels. Following a chain (hierarchy) of command may be expected (i.e. not prudent to do an ‘end run’ around one’s immediate supervisor unless prior attempts to resolve an issue with the supervisor have not been successful).”

“Although at times it can appear that information is more tightly controlled at the organization and higher corporate levels, there have been marked improvements in the dissemination of information and efforts to improve transparency through more effective and direct communication. Sometimes, the pace of our growth results in quick adoption of processes (sometimes poorly tested) or less timely communication. The intent is genuine.”

The participants also indicated if they thought the performance of the company over the past year had improved (assigned a value of +1), deteriorated (assigned a value of -1) or remained unchanged (assigned a value of 0), with respect to each of the three dimensions, at each of the four organizational levels. At the participant level, the perform-

ance values for the four organizational levels of each dimension were totalled and normalized by dividing by four (i.e. the number of aspects rated) to provide a participant performance rating for each dimension.

The participants’ scores and performance ratings for each dimension were then presented graphically (see Figure 1 on page 28). Each participant’s overall assessment of the company’s status as an edge organization was determined by combining and averaging their scores and performance ratings for all three dimensions at all four organizational levels.

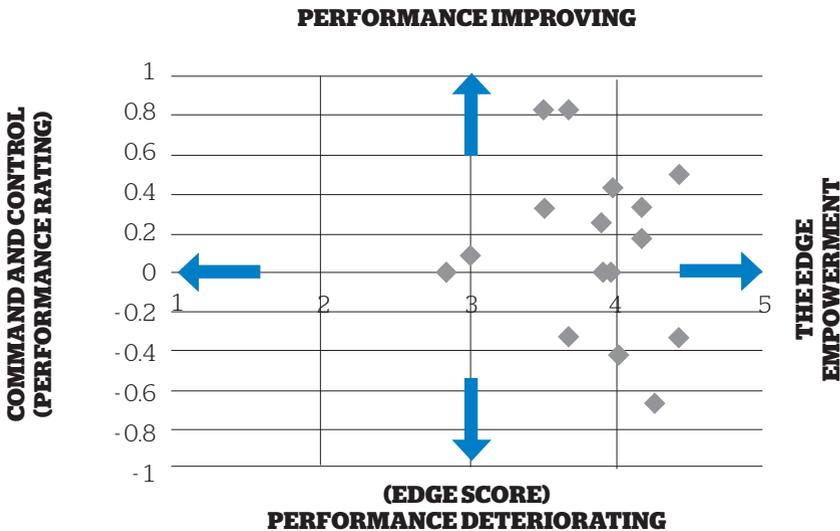
The range in the data presented in Figure 1 reflects the diversity of the experiences and roles of the participants. The four of them who considered the performance of the company to be deteriorating, for example, were generally long-serving individuals who joined the organization when it was much smaller, with a culture of local decision-making, open and broad distribution of information and interactions with colleagues. Some of them had held senior management positions in the past, but were now in technical roles, so they may have sensed their decision-making

Table 1: Average Scores for the Three Dimensions and the Four Organizational Levels

| ORGANIZATIONAL LEVEL | EDGE DIMENSIONS | | | ORGANIZATION OVERALL |
|----------------------|-------------------------------|-------------------------|-----------------------------|----------------------|
| | ALLOCATION OF DECISION RIGHTS | PATTERNS OF INTERACTION | DISTRIBUTION OF INFORMATION | |
| Organization Overall | 3.05 | 4.09 | 3.72 | 3.62 |
| Higher Corporate | 2.84 | 3.56 | 3.44 | 3.28 |
| Local Corporate | 3.31 | 4.13 | 3.81 | 3.75 |
| Project Execution | 4.31 | 4.31 | 4.31 | 4.31 |
| Dimension Average | 3.38 | 4.02 | 3.82 | 3.74 |

Note: Company’s overall score (all three dimensions and all four organizational levels) is 3.74.

Figure 1: Summary of the Company's Overall Edge Organization Assessment



ability, access to information and ability to interact with colleagues had become limited as the company had grown and centralized its management functions as part of its risk management strategy.

In contrast, the eight participants who considered the company to be improving its performance had been there for a shorter period. They were project-focused, with limited corporate management experience. Rather than feeling disenfranchised, they perceived the organization as trying to rationalize decision-making

processes, encourage interactions and improve the distribution of information.

Two respondents scored the organization at 3 or less, suggesting a 50% or less feeling of empowerment, and considered its performance to be unchanged overall. These two were technical specialists who tend to function as sole practitioners. Consequently, their responses may have reflected a sense of isolation from and/or frustration with the broader functioning and development of the company.

There needs to be clarity in the decision making process.

The path of growth

As a consulting engineering firm grows, it tends to evolve from a small collective of senior practitioners at the edge to a more centralized form of management with standardized policies and procedures.

This evolution can result in a cultural change, with senior practitioners feeling a sense of disenfranchisement and being pulled back from the edge, as limitations are placed on the allocation of decision rights, patterns of interaction and distribution of information.

In the sample edge organization assessment presented here, the subject company's 'sweet spot' represents moderate to strong employee empowerment, but with limited decision rights at the higher and local corporate levels. The assessment may help managers understand how the company is perceived by different generations of employees, with different histories, as the company continues to grow. **CCE**

Bryan Leach is a retired Calgary-based engineer who has been designated P.Eng. in Alberta and C.Eng. in the U.K. and now focuses on helping organizations learn. He can be reached at bryleach@telusplanet.net.



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Leading Research in Industrial Ventilation

University of Toronto (U of T) chemical engineering professor Howard D. Goodfellow, who began his career with Hatch and later worked with Stantec and Tenova Goodfellow, saw his *Industrial Ventilation Design Guidebook, Volume 2: Engineering Design and Applications* published this June. His other big project this summer was the 13th International Industrial Ventilation Conference for Contaminant Control; it was scheduled for this August, but due to COVID-19, it has been pushed back to next June, when it will lead into ASHRAE's Annual Conference at the Sheraton Centre Toronto Hotel.

Tell us about the roots of the industrial ventilation conference.

Back in the 1980s, we didn't have all the modern communication tools we have today. It was basically letters going back and forth. I had an opportunity to visit some key places of research in Europe. I was surprised to learn they were not aware of work going on in Japan or North America. So, we came up with the idea to hold an international conference to bring these researchers together to meet face-to-face.

We convinced U of T and the Occupational Hygiene Association of Ontario (OHAO) to host the conference in 1985. It was at the Royal York Hotel and we had more than 400 attendees. We thought of it as a one-off, but three years later, the British Occupational Hygiene Society (BOHS) sponsored a second conference in England, which more researchers from Europe were able to attend.

The next one was in Cincinnati, Ohio. We got into this pattern of

alternating between North America and Europe until 2015, when the conference was held in Shanghai, China.

How has your book evolved over that time?

The *Industrial Ventilation Design Guidebook* was first published in 2001, but now I'd say it really is global, with contributions from partners in Europe, Asia and North America.

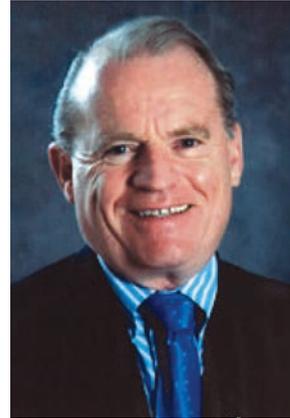
Back in 2001, the leading research was in Europe and the focus was on improving efficiency. They had very high energy costs, so they had decided to improve the performance of ventilation systems in industrial plants with smaller fans for smaller capital and operating costs.

The guidebook was the first to develop a 'link,' showing how you can have an energy-efficient ventilation system and also improve the workplace environment in terms of safety and health. There was real data from plants that we could relate to actual ventilation and find the right balance. We defined the most important design parameters.

COVID-19 not only delayed your conference, but also put ventilation on everyone's minds. What does it mean for industrial facilities?

It really is an airborne issue. And it's the same issue whether in your home, a commercial building, a hospital or a mall. For many years, there were silos of people working just on the commercial side who did not know what was happening on the industrial side. We need to transfer technologies developed in one area to researchers working in another. COVID-19 has brought that need to the forefront.

In Canada, given our climates,



"We need to transfer technologies developed in one area to researchers working in another."
- Howard D. Goodfellow

you have to be very creative to find a way to bring in 100% fresh air in an energy-efficient way. And the industrial environment is probably the most complex to deal with. We have to embrace disruptive technology to make better ventilation systems. Many industrial facilities have over-designed systems. We

need to collect data, set targets and know how to optimize them.

These systems are typically changed once in the spring and once in the fall, but you can certainly get winter weather in the spring! So, rather than manually changing them, you could have a 'smart' ventilation system that responds in real time to cold weather, wind or humidity.

Lots of models have been developed, but they're still moving from research into the practical world—and that's where there are going to be big opportunities for the consulting engineering community. And Canada, which is leading in this type of knowledge, is especially poised to take advantage of the science of ventilation to build better systems.

Why should engineers attend the conference next June?

There's been an acceleration of technology. The book is a working document that provides fundamental best practices, but there will be very specialized information presented for the first time at the conference. We'll have visitors from outside Canada and get a better sense of where the opportunities are in North America and around the globe. **CCE**

1985

The first industrial ventilation conference is held at Toronto's Royal York Hotel, attracting 400 attendees.

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