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MARCH/APRIL 2020

# CANADIAN ■ CONSULTING engineer

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Smart Water Technology

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## on topic

### LEGAL

The rule of joint and several liability is a particularly problematic example of how construction litigation involving engineers has become more common and complex.

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## Pushing the envelope

“Engineers are capturing more of the construction industry through the building envelope,” commented Nova Scotia’s Gary Ruitenbergh, P.Eng., in an interview with *Canadian Consulting Engineer* magazine a few days after attending The Buildings Show at the Metro Toronto Convention Centre (MTCC) last December.

As it sprawls across the MTCC’s two buildings each year, the show is about a lot more than engineering. Contractors rub elbows with property managers, architects, real estate developers and renovators.

To Ruitenbergh’s point, though, there are opportunities for engineering firms to play a larger role in the future of Canada’s buildings. By way of example, seminar presenter Jeremiah Vanderlaan, P.Eng., manager of business development for Newton Group in Guelph, Ont., discussed how civil and structural engineers can work with architects to challenge the traditional ways of doing things in the construction industry.

“Buildings need to perform better in terms of energy consumption, durability and the building envelope,” he said.

While Vanderlaan highlighted some of the benefits of prefabrication, Paul Kocsis, P.Eng., of Hamilton-based Kocsis Engineering sang the praises of insulated concrete forms (ICFs).

“Nothing else on the market is a better insulating material,” he said in his seminar. “There is negligible thermal bridging across the mass of a concrete core. The exterior faces meet air and vapour barrier standards. And an ICF foundation wall cures continuously in all weather conditions, with negligible moisture loss.”

As an example, he previewed Discovery House, a ‘net-positive’ greenhouse planned for construction in Creemore, Ont., with support from federal and provincial ministries of agriculture. In addition to an ICF building envelope, it is expected to use two-way solar, tinted glazing (to diffuse light for optimal crop growth) and Tesla Powerwall on-site energy storage.

In another session, Peter Adams, P.Eng., principal and building science specialist with Toronto-based Morrison Hershfield, focused on the importance of building envelope commissioning (BECx) in measuring, documenting and verifying performance.

“Buildings used to be big, dumb and stupid,” he laughed. “Now they are much more complicated and building standards are becoming aggressive on energy performance.”

Beyond opportunities to enhance building envelope performance in new construction, “deep retrofits will also play an important role,” said Ali Hoss, P.Eng., Toronto-based manager of existing building energy management for WSP, in a seminar about energy efficiency.

This point was echoed by Pravin Pai, P.Eng., principal with Stephenson Engineering, who used two aging apartment buildings in Mississauga, Ont., as case studies. From energy modelling to intrusive investigations, his team measured on-site conditions before determining strategies for reducing heat loss, preventing solar heat gain and stopping moisture from passing through the building envelope.

“The philosophy of new building design has changed to address energy efficiency,” he said, “and the same changes can be applied to retrofit jobs.”

Peter Saunders



## CANADIAN CONSULTING engineer

### Editor

Peter Saunders (416) 510-5119  
psaunders@ccemag.com

### Senior Publisher

Maureen Levy (416) 510-5111  
mlevy@ccemag.com

### Media Designer

Andrea M. Smith

### Contributing Editor

Rosalind Cairncross, P.Eng.

### Editorial Advisors

Bruce Bodden, P.Eng., Gerald Epp, P.Eng.,  
Chris Newcomb, P.Eng., Laurier Nichols, ing.,  
Jonathan Rubes, P.Eng., Paul Ruffell, P.Eng.,  
Andrew Steeves, P.Eng.

### Circulation Manager

Shawn Arul (416) 510-5181  
sarul@annexbusinessmedia.com

### Account Co-ordinator

Cheryl Fisher (416) 510-5194  
cfisher@annexbusinessmedia.com

### Vice-president/Executive Publisher

Tim Dimopoulos (416) 510-5100  
tdimopoulos@annexbusinessmedia.com

### COO

Scott Jamieson

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111 Gordon Baker Road, Suite 400,  
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Tel: (416) 442-5600

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# WOMEN IN CONSTRUCTION

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To celebrate **International Women's Day**, four of Canada's leading magazines serving the construction sector have teamed up to bring you "Women in Construction." It's a month-long celebration of successful women in the industry, featuring interviews, articles and a podcast.

[Women-in-Construction.ca](http://Women-in-Construction.ca)

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**Crane & Hoist**  
The Business Of Heavy Lifting CANADA

**On-Site**  
CANADA'S CONSTRUCTION MAGAZINE

**ROCK TO ROAD**





Photo courtesy Mediagroup Canada

### Engineering firms among Canada's top employers for young people

Dialog, GHD, Hatch, Hemmera, Mott MacDonald and R.F. Binnie & Associates are among the winners in this year's Canada's Top Employers for Young People competition, organized by Mediagroup Canada.

Now in its 18<sup>th</sup> year, the project recognizes employers for offering Canada's best workplaces, programs and initiatives to attract and retain younger people starting their careers.

By way of example, Dialog pairs young employees with development coaches for leadership training; GHD's Talent X program broadens early-career professionals' (ECPs') skills through international assignments; Hatch's Young Professionals Committees drive a professional development program (PDP) that helps recent grads transition to the working world; Hemmera's Consulting School facilitates employee workshops relating to its practices and business; Mott MacDonald's ECP committee (members pictured) presents monthly Teachable Moments lunch-and-learns; and R.F. Binnie's engineer-in-training

program supports professional accreditation for employees through mentoring, training and reimbursement for Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) membership dues and examination costs.

### OIQ celebrates 100 years in Quebec engineering



Photo courtesy OIQ

The Ordre des Ingénieurs du Québec (OIQ) marked its 100<sup>th</sup> birthday on Feb. 14. Originally founded as the Corporation of Professional Engineers of Quebec (CPEQ) in 1920 to ensure competence and ethical behaviour for approximately 500 members, it now comprises 65,000 engineering professionals, who represent the province's largest profession in the field of

#### PEOPLE

##### TMP

At the end of 2019, John Lowden retired as president of The Mitchell Partnership (TMP). He spent 40 years with the mechanical engineering firm, starting in its Calgary office as a designer before working in London, England, and Toronto and on projects in Canada, the U.S. and Bermuda. Over time, he advanced to associate, associate partner, U.K. director, partner and finally president.



John Lowden

##### JLR

Ottawa-based J.L. Richards & Associates (JLR) has appointed Joël Primeau, P.Eng., its new chief mechanical engineer. He has more than 30 years' industry experience and first joined JLR in June 2019 as senior mechanical design engineer. In his new role, he leads the firm's mechanical engineering practice.



Joël Primeau

##### Smith + Andersen

Smith + Andersen promoted Jonas Liang, P.Eng., and Filip Artukovic, P.Eng., to the associate level at its Vancouver and Toronto offices, respectively, and Brandon Hayes, Sr., and Chris Pappas, Sr., P.Eng., to the senior associate level, both at its Toronto office.

applied sciences.

“Quebec engineering has shown impressive growth in the last hundred years,” says OIQ president Kathy Baig, Eng., FEC, MBA (pictured), who plans to give a commemorative speech to the Canadian Club of Montreal in April.

In May, more than 350 participants are expected to attend OIQ’s 100<sup>th</sup> anniversary gala at the Montreal Science Centre, which will honour excellence in the profession.

### Revitalized biosciences complex opens at UBC



Photo by Andrew Latreille

In late January, the University of British Columbia (UBC) opened the second phase of its revitalized biosciences complex in Vancouver, designed by Diamond Schmitt Architects (DSA) with engineering firm Henningson, Durham and Richardson (HDR).

The new four-storey east wing and renovations to the north wing have improved energy efficiency for ventilation and thermal comfort, putting the facility on track for Leadership in Energy and Environmental Design (LEED) Gold certification.

Other members of the project team include:

- Structural engineering: Read Jones Christoffersen (RJC).
- Mechanical engineering: AME Group.
- Electrical engineering: AES.
- Landscape architecture: PFS Studio.
- Building envelope: JRS Engineering.
- Sustainability consulting: Recollective.
- Civil engineering: Aplin Martin.
- Code consulting: Jensen Hughes.

### Funding announced for Portage la Prairie wastewater facility expansion

The government of Manitoba has announced it will provide upward of \$61 million to help upgrade Portage la Prairie’s municipally owned and operated water pollution control facility (WPCF), which treats wastewater—including that from local agri-businesses, such as Nutri-Pea and Roquette pea processing plants

and a McCain Foods potato processing plant—before it is discharged into the Assiniboine River.

“This investment will bring wastewater treatment for the city and surrounding areas into compliance with provincial and federal regulations,” says Brian Pallister, the province’s premier.

Funding for the facility’s expansion is being provided through the Investing in Canada Plan. In addition to provincial support, the federal government is supplying \$60 million and the municipal government is providing \$59 million. Construction is expected to begin in the summer of 2022.

### B.C. government plans to replace West Fraser Road

The government of British Columbia says funding is in place and plans are moving ahead to rebuild and realign West Fraser Road, which was heavily damaged in 2018 by flooding. With an estimated cost of \$103.4 million, the project has been approved in principle for support from Public Safety Canada’s Disaster Financial Assistance Arrangement.

High water levels from the spring freshet in April 2018 caused Narcosli Creek to erode five sections of the road on the west side of the Fraser River, some 17 km south of Quesnel, B.C. As a result of the severe damage (pictured), a 3-km section of the road was







Flickr image courtesy B.C. government

closed and a detour route was designated via the Garner and Webster Lake Road system, which local ministry staff and a maintenance contractor ensure continues to provide access to the Esdilaigh First Nation community, ranches, homes, logging activities and farming lands.

The ministry is finalizing a detailed design for the new road, which will bypass the active slide areas that were washed out. The work will include the construction of 5 km of a two-lane road on a new alignment, a new bridge crossing the creek and rock stabilization along the new route.

Upon completion of the final engineering design, the ministry will hold a public information session in spring 2020 to share it and the project timelines. At this point, construction is expected to begin in 2020 and finish by late 2022.

### MUHC achieves second LEED Gold certification

Montreal-based McGill University Health Centre's (MUHC's) Glen site has become the first hospital in Quebec to be twice certified to Leadership in Energy and Environmental Design (LEED) Gold.

The Canada Green Building Council (CaGBC) awarded the certification to the McGill Healthcare Infrastructure Group (MHIG), comprising

SNC-Lavalin and Innisfree Canada, which designed, built and financed the complex as part of a public-private partnership (P3) and will operate it until 2044. The site opened in 2015 and obtained its first LEED Gold certification for new construction (NC) in 2016. This second certification is for existing buildings (EBs).

"MHIG is proud to have obtained LEED Gold EB certification," says Jean-Pierre Dumont, president of MHIG. "Thanks to the efforts of an accomplished team from Johnson Controls Quebec and SNC-Lavalin, we have succeeded in building a hospital complex that ranks among the greenest in North America."

The following are some the hospital's measures that save energy and improve indoor air quality (IAQ):

- Adapted fixtures that minimize light pollution and emphasize natural light.
- Low-flow faucets that reduce potable water consumption by 40% in relation to comparable buildings.
- Highly reflective materials mitigate the 'heat island' effect, as do green spaces with trees, perennials and shrubs that do not require watering.

MHIG reports these and other energy-efficient initiatives have yielded savings of approximately \$2.5 million per year.

### PEOPLE

#### Exp

Exp appointed Reece Bailey executive vice-president (EVP) for major projects. He joins the firm from SNC-Lavalin and has more than 25 years' experience in transit and rail design, operations, facilities and systems engineering.



Reece Bailey

#### Stantec

Stantec promoted Susan Walter, P.Eng., to executive vice-president (EVP) of infrastructure on a global basis. She has 35 years' industry experience, began her career as a civil engineer in transportation and has worked for Stantec since it acquired Vollmer Associates in 2007.



Susan Walter

#### Dillon Consulting

Sean Hanlon is now CEO of Toronto-headquartered Dillon Consulting. Based in Saint John, N.B., Hanlon is a chemical engineer with more than 28 years' industry experience. He joined Dillon in 2002, became a partner in 2007, began leading the environmental sciences group in 2014 and was appointed president in 2019 (after serving as interim president in 2018).



Sean Hanlon





## CHAIR'S MESSAGE

# ACEC recommendations to combat climate change ahead of 2020 Federal Budget



As ACEC member firms' public and private sector clients are increasingly committed to achieving more sustainable solutions, and in light of the government's environmental objectives, ACEC made the following recommendations within its submission for the Pre-Budget Consultations in advance of the

2020 Budget. In addition to improving the social and economic quality of life for Canadians, these recommendations show how the consulting engineering sector is part of efforts to mitigate and adapt to climate change while highlighting the role consulting engineers play in achieving these goals.

Infrastructure can be an effective investment in our social, economic and environmental quality of life. However, priority should be given to core infrastructure that grows the economy making further investments in community, social and environmental infrastructure viable and sustainable. Projects conceived of and designed by the consulting engineering industry can have a direct impact on climate change and all aspects of sustainability. This means that consulting engineering firms and their clients are in a position to influence mitigation (reduction in greenhouse gas release), and resilience (reduction in impact of more extreme climate conditions on human habitats).

There are a number of available approaches to mitigation and resilience with new engineering projects. Adaptation to the realities of climate change brings a different kind of engineering problem. New designs must now rely on climate prediction rather than history, which to date is a much less certain and specific basis for design. As a result, new projects will require greater factors of safety to achieve the same security and the projects will be more expensive and potentially carry more risk than those in the past. A bigger challenge is the large stock of past projects that will require creativity and ingenuity to reduce emissions or to improve resilience to the environment.

To combat climate change and be at the forefront of innovation, much of which is centered around green technology and infrastructure, confidence in consistent ongoing investment is essential. Both the Investing in Canada Plan and the Building Canada Plan are significantly back-end loaded, with most of the investments skewed toward the latter years of the program. To allow vital infrastructure investments to have positive economic and environmental

impacts in a timelier and more consistent manner, we recommended that the delivery of already-committed infrastructure funds and projects be expedited through a forward re-profiling of the existing Building Canada Plan, and that the planning and renegotiating of the next generation of federal infrastructure investments occur prior to the expiry of current programs.

Infrastructure projects do not exist in isolation of one another. Collectively, our infrastructure is what connects and enhances communities, enables commerce and trade, and protects our environment, but is only as effective as the weakest link. Therefore, to receive the best return on investment and most effectively address climate change, a coordinated and strategic approach should be taken to infrastructure planning and investment. In cases where municipalities have robust and well-considered asset management plans, ACEC recommends providing funding based on their investment program rather than on a project-by-project basis. This approach would allow multiple strategically-related projects to be efficiently approved under a single application and would serve as an incentive for municipalities to develop and adopt asset management plans to guide strategic investment decisions.

ACEC also urges the government to enact many of the recommendations from the 2017 Senate Report titled *National Corridor: Enhancing and Facilitating Commerce and Internal Trade* written by the Senate Committee on Banking, Trade and Commerce. Establishing the concept of such a corridor, which is in effect a pre-established, pre-approved right-of-way dedicated to accommodating multiple infrastructure assets (e.g. road, rail, pipeline, electrical transmission and communication), would require smaller geographical footprints and result in less impact on the environment and on surrounding land uses. This implementation would proactively address social and environmental concerns making the planning, development and implementation of both public and private infrastructure projects less costly and more time effective. A national corridor would help bring projects to fruition and limit the environmental impacts, both of which are in support of the government's objectives. However, because of the national scope of such a project and the many jurisdictions and stakeholders involved, national leadership is required from the government.

LAWRENCE LUKEY, P.ENG.  
CHAIR, BOARD OF DIRECTORS, ACEC - CANADA

# IN DISCUSSION

with

# ACEC

**I**n *Discussion with ACEC* is a series of informal conversations between ACEC-Canada and government decision makers and business leaders. This edition is with Goldy Hyder, President and CEO of the Business Council of Canada, a not-for-profit, non-partisan organization whose mission is to make Canada the best place in the world in which to live, work, invest and grow. Representing 150 chief executives and entrepreneurs from businesses in every region and sector of the country, its member companies employ 1.7 million Canadians, contribute the largest share of federal corporate taxes, and are responsible for most of Canada's exports, corporate philanthropy, and private-sector investments in research and development.

**During your keynote address at our conference last fall, you expressed concern for Canada's competitiveness and our economy's rank amongst other G7 and emerging nations. The Council's report *A Better Future for Canadians* offers several recommendations to address this issue. Which do you believe our government should address first?**

My main message to ACEC's leadership conference last fall was that Canadians should be proud of what we've achieved over the past 150-plus years. For example, we continuously rank first in the world when it comes to quality of life. However, we cannot take our past success for granted. As we enter the 2020s, I strongly believe that we need an honest conversation about the challenges we face in the decade ahead and what kind of country we are leaving behind.

Whenever I talk to the members of

the Business Council, they tell me that their number one motivation is what kind of opportunities await their children, grandchildren and future generations of Canadians. They know of no other way to improve lives and take on the challenges we face – from climate change to the impact of an aging population – than to grow our economy. That is why we launched the Task Force on Canada's Economic Future as a collaborative process engaging diverse groups of stakeholders and to hear from Canadians from all regions, walks of life and backgrounds. Our findings, which were published in our report *A better future for Canadians*, identify six specific, practical and achievable recommendations that Canada's government can implement to accelerate the pace of economic growth.

In our view, regulatory modernization has the greatest potential to improve the lives of citizens, drive innovation and enhance business activity across the board. Again and again during our consultations, participants cited inefficient regulation as the single greatest obstacle to Canadian competitiveness and economic growth. In fact, on the same week that I addressed ACEC's leadership conference, the World Bank downgraded Canada from 22nd to 23rd in its Ease of Doing Business index. This drop of just one spot may seem small, but it is especially disconcerting when you consider that Canada ranked fourth in the world less than 15 years ago in 2006.

Every government pays lip service to red-tape reduction, and now and then there are moves in the right direction. Yet the regulatory environment continues to increase in both complex-

ity and unpredictability, creating unnecessary barriers to innovation and growth. It is time for a new approach.

We're calling on Canada to commit to becoming the most efficiently regulated country on earth. We're proposing an independent, arm's-length oversight agency similar to ones in Germany and Denmark that works to improve the transparency and accountability of the regulatory system while reducing the regulatory burden on businesses and citizens.

**You also spoke during your address for the need to "figure out" energy, the environment and infrastructure. Why is investing in infrastructure so critical to our natural resource sector and the environment?**

A country's productivity and prosperity are closely tied to its infrastructure—a fact that can be observed in any country you visit. This is particularly true for Canada, with its vast size and dependence on international trade, yet Canada lags its international peers in quality of trade and transportation infrastructure. The World Bank ranks Canada 21st in the world based on the quality of trade and transportation infrastructure, such as ports, railroads and highways. Germany is in first place and the United States is in seventh.

I always remind audiences that the Business Council of Canada was the very first business organization in North America to endorse carbon pricing. We're already on board with the environmental agenda. We've got lots of people talking about that, but we better figure out how to make sure that we're building the infrastructure for





Photo credit: iStock.com/SergeyNivens

our resources right across this country.

While we support the new Canada Infrastructure Bank, our Task Force report proposes the adoption of a more methodical, transparent and strategic process for prioritizing major infrastructure projects. The easiest way to do that would be to borrow from Australia the model of an independent, non-partisan body to provide independent research and advice to all levels of government as well as to investors and owners of nationally significant infrastructure.

**ACEC has long advocated for a national infrastructure corridor which would permit proponents of major projects to build assets in an environment with more regulatory certainty. Would you agree that this nation building idea would help us remain competitive on the global economic stage?**

That's a very good question and I am so glad to hear that this is a priority for ACEC and its members.

Blessed with the incomparable advantage that our resource bounty represents, most other countries would have long ago developed a national vision of how to responsibly develop the products and technologies that the world needs. Yet the situation in Canada has been marked by polarization and paralysis by analysis. Complex approval processes, long wait times and the ever-present threat of court challenges have resulted in declining investment in key sectors, as both domestic and international firms seek out a more welcoming investment environment in other countries.

What too often gets lost in the debate is the extent to which our industries already are addressing the key challenges. Oil sands companies are spending billions to address GHG emissions. They have also chosen to forego intellectual property rights in order to share newly developed technologies that reduce environmental impact. We need a way forward and a vision that unites the country and finds common ground.

A key focus should be on the infrastructure the country requires to bring this vision to reality, including oil, gas and electricity transmission, rail, roads, ports and related transportation infrastructure. The goal should be to ensure that all regions realize added benefit from Canada's resource wealth, in part by expanding access to global markets so that Canadians get full value for their resources. That is why the Task Force report calls on the federal government to develop a national resource strategy in collaboration with the provinces. The goal should be to strengthen Canada as a location of choice for leading-edge resource companies that demonstrate how to achieve superior economic and environmental performance.

**You've stated that building the economy is not solely the responsibility of government but of business as well. What are the top 3 things businesses can do to step-up to the plate?**

This is something I strongly believe and every day it is becoming a more important topic.

In January, I attended the World Economic Forum in Davos where all



the talk was about defining the purpose of corporations. I am glad to report that Canadian businesses have long led the way. In fact, the goal of improving life for all Canadians goes back to the Business Council's founding in 1976. More than 20 years ago we established our motto of "making Canada the best country in the world in which to live, work, invest and grow." But as our report notes, ensuring a better future for Canadians is not just the responsibility of government. Business has to step up, too. As employers of nearly 2 million Canadians and as prominent leaders of the wider business community, our members identified six areas where they strongly felt they could have a meaningful impact on the lives of all Canadians.

Three of these commitments have been prioritized, including gender and diversity, mental health and Indigenous engagement. In each of these areas, we've either established CEO-led working groups to chart a path forward or developed protocols for our members to lead by example.

In the end, our goal is to broaden the tent and work with governments and other key stakeholders like the ACEC. Because here's the thing, we are the first generation in Canada's history who are not on track to provide our children and grandchildren with a better standard of living than the one we enjoyed. That alone should motivate us in the decade ahead.



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# JOINT & SEVERAL LIABILITY FOR ENGINEERS

The 1% rule is particularly problematic for consultants.

By Karen L. Weslowski

Construction litigation involving engineers has become more common, but also more complex. One example of this trend, which can be particularly problematic, is the rule of joint and several liability.

This rule can encourage a ‘shot-gun’ approach to litigation, give rise to frivolous claims and result in disproportionate settlements. While the potential unfairness arising from the application of the rule has been recognized and debated, no legislative reform has yet been implemented in Canada.

## What is the rule?

Also known by some as ‘the 1% rule,’ the rule of joint and several liability is a common-law principle, whereby each of those who have combined to cause a single, indivisible loss is liable

to the injured person for the full amount of the damage suffered. Thus, a defendant who is found to be only 1% at fault can be obliged to pay the plaintiff’s entire judgment.

The underlying policy rationale is to ensure an injured plaintiff is made whole. The at-fault defendants, who may have paid the plaintiff’s damages disproportionately, can seek contribution and indemnity between themselves.

The rule has been codified into statute in every Canadian province and territory except for Quebec and Prince Edward Island. (In British Columbia, the rule does not apply

where a plaintiff is held to be contributorily negligent, as this severs the liability.)

Construction projects commonly give rise to joint and several liability. Due to the nature of construction, the parties involved are generally considered several, concurrent tortfeasors, *i.e.* their separate acts combine to cause the same damage to the plaintiff. As a result, the named defendants in a claim often include every party involved in the construction project, including the developer, general contractor, project manager, consultants, contractors and sub-contractors.

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**A defendant who is found to be only 1% at fault can be obliged to pay the plaintiff’s entire judgment.**



While consulting engineers generally hold professional liability insurance, developers, general contractors, contractors and sub-contractors are often uninsured, underinsured or lacking in assets.

### The problem for consulting engineers

Consultants generally hold professional liability insurance, as a result of the terms of their retainer, the requirements of the authority having jurisdiction (AHJ) or the conditions of their membership with a professional regulatory association. Conversely, developers, general contractors, contractors and sub-contractors are often uninsured, underinsured or lacking in assets.

Joint and several liability can create unfairness for consultants when a claim relates to faulty workmanship, the liability for which should be apportioned primarily to the construction group. This often becomes evident at mediations.

In this situation, the engineer might have limited liability exposure for negligence in field review of the faulty workmanship; however, if the construction group lacks sufficient insurance or assets to pay the plaintiff's claim, the rule of joint and sev-

eral liability is often raised against the 'deep-pocketed' (*i.e.* insured) engineer to encourage a settlement contribution in an amount disproportionate to the engineer's actual liability exposure. The engineer and/or its insurer may agree to the settlement to avoid incurring trial costs, a potentially unpredictable trial result and the potential for joint and several liability following trial.

The rule can also affect an engineer's insurance premiums and claims history. It encourages plaintiffs to cast a wide net, such that engineers may be named in claims where they are not 'target' defendants, but rather peripheral defendants, included out of an abundance of caution or to provide an additional source of funds for settlement contribution at mediation. While the engineer may have a strong defence, the mere fact of being named as a defendant in an action can result in significantly increased insurance premiums and deductibles.

### Rule reform

The fairness and application of the joint and several liability rule have both been subject to recent debate in Canada.

Saskatchewan's government amended its *Contributory Negligence Act* in 2004 to adopt a modified version of proportionate liability that applies in cases where the plaintiff is contributorily negligent and there is an unfunded liability (*i.e.* no assets or insurance to pay the plaintiff's damages). In these cases, the cost of the unfunded liability is split among the remaining defendants and the plaintiff, in proportion to their fault.

Last year, Ontario's government began consultations with lawyers, insurers and other stakeholders to determine how to make the joint and several liability provisions of its *Negligence Act* more fair as they relate to insurance costs and public services. In its submissions, the Association of Municipalities of Ontario (AMO) recommended the adoption of a full proportionate liability model—*i.e.* limiting the liability of each defendant to the proportion of loss for which they are found responsible.

AMO's submissions were based on the following considerations:

#### **Fairness**

It is unfair for a defendant whose degree of fault is minor when compared to that of other defendants to have to fully compensate a plaintiff should those other defendants be insolvent or unavailable.

#### **Deep pocket syndrome**

Joint and several liability encourages plaintiffs to unfairly target defendants who are known or perceived to be insured or solvent.

#### **Rising costs**

Opponents of joint and several liability are concerned about the rising costs of litigation, insurance and damage awards.



### Provision of services

Application of the joint and several liability rule could cause municipalities to delay or otherwise cut back services to limit exposure to liability.

These factors have clear application to claims involving engineers. Worries about joint and several liability could lead to them either (a) turning down projects for fear of the rule's application or (b) working without professional liability insurance.

### What to do

For engineers, the difficulty with joint and several liability is its general application to most construction projects. Even with a strong defence, when there is a 1% liability risk, an engineer's exposure to the plaintiff's damages could be considerably greater if the co-defendants are uninsured or lack assets.

British Columbia's exception often has limited application because the plaintiff may be a post-construction purchaser or strata corporation that had no role in the construction process and no real potential for contributory negligence.

Opting not to obtain professional liability insurance, so as to avoid becoming a 'deep-pocketed' target, is not a recommended option. Foregoing insurance may constitute a breach of the conditions of professional registration (*i.e.* in jurisdictions where insurance is mandatory) and exposes the engineer to personal liability.

There are limited strategies available to engineers to avoid the application of the rule. In British Columbia, the engineer's defence should include the active pursuit of a contributory negligence argument, if available on the facts of the case.

In other jurisdictions, at the start of projects, engineers could seek a contractual indemnity from their clients regarding potential future payments pursuant to the joint and several liability rule; however, this may be difficult to negotiate. Another step would be to ensure, if possible, all other parties involved in construction—particularly developers and contractors—hold sufficient insurance.

Ultimately, the best option for engineers who are concerned about unfairness resulting from the rule may be to contribute to the process of legislative reform. **CCE**

*Karen L. Weslowski is a partner in the Vancouver office of Miller Thomson LLP, with an insurance defence practice focusing on professional liability and construction claims.*



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# DEVELOPING EARTHQUAKE RESISTANCE for OFCs

Only recently have codes addressed seismic design of buildings' non-structural systems.

By Effie Bouras

**B**uilding codes ensuring structural integrity during seismic events have been in place in Canada and the U.S. since the early 20<sup>th</sup> century. First came the U.S. publication of provisions for simple lateral design, included as a voluntary appendix in the 1927 Uniform Building Code (UBC). In 1941, the initiation of the National Building Code of Canada (NBCC) also contained seismic provisions, mirroring those of the 1935 UBC.

Later editions expanded the initial scope. The 1953 NBCC, for example, featured seismic zoning maps for the first time. These divided Canada into four major zones, based on historic precedence:

- Northern (the most active, with approximately 59% of Canada's earthquakes).
- Western (approximately 27%).
- Eastern (approximately 14%).
- Central (relatively few reported).

Maps introduced in the 1970s further refined seismic zoning, with numbers on four boundaries indicating accelerations. This approach was changed in the mid-1980s with the adaptation of a point source model.

Meanwhile, the NBCC began to move away from the UBC's approach, starting with its 1965 edition, which

introduced provisions tailored to research being conducted at the time.

## The onus for OFCs

While these codes were mostly preoccupied with creating a safer environment via non-collapse of essential building elements, they were much slower to adopt provisions for seismic design for non-structural systems. Also referred to as operational and functional components (OFCs), these include mechanical, electrical, plumbing and interior architectural finishes, such as suspended ceiling grids.

Historically, the onus for proper bracing design for OFCs was placed on the manufacturers of these elements and on the engineers who prepared drawings and specifications, with seismic testing often completed in conjunction with university research groups or private facilities. Inspections for adherence to the drawings and specifications were not widely conducted.

In Canada, provisions for the design of OFCs were formally introduced in the 1953 edition of the NBCC. At the time, these were mainly limited to architectural components, with a methodology based on simple static analysis. Seismic force requirements were uniformly applied for both structural and non-



Engineers use shake tables at Polytechnique Montréal to simulate seismic effects on building components.

structural components.

## Stricter requirements

The 1965 NBCC introduced separate and stricter lateral force requirements for OFCs. Previously, seismic force requirements had been the same for both structural and non-structural components, but this changed with the treatment of OFCs as a separate article within the 1965 code. It also provided an alternative to simple static analysis, with the introduction of dynamic analysis, but stopped short of defining methods.

Further refinements to guidelines for new buildings appeared in subsequent editions. Meanwhile, the Canadian Standards Association's (CSA's) standard S832-14, *Seismic risk reduction of operational and functional components (OFCs) of buildings*, which was reaffirmed in 2019, presents a risk assessment methodology that covers OFCs for both new and existing buildings.

Specifically, it outlines technical details and responsibilities for the design team, more explicit provisions





Photo courtesy Effie Bouras



Photo courtesy OMA

Beijing's uniquely shaped CCTV Tower was specifically designed to protect against the torsional effect of the primary structure on the operational and functional components (OFCs).

and enhanced categories of elements. For example, its guidelines require a registered professional to identify performance objectives, which includes defining the seismic risk index. A building's seismic risk index is a function of vulnerability, entailing restraint, potential impact, overturning, location, construction and consequence

of failure with respect to life safety.

## Neglected aspects

Even with such developments in code design, the standards are still limited. Canadian codes have neglected certain technical aspects that may affect a building's continued operation after a seismic event, such as the torsional effect of the primary structure on the OFCs, which is most likely to be amplified in irregular structures. (The uniquely shaped CCTV Tower in Beijing, China, for example, was specifically designed for protection against this effect.)

Further, Canadian building codes do not thoroughly address the urban-scale interdependencies between building supply/outlet interfaces, such as water, telecommunications and electric power, which need to be available for immediate post-earthquake occupancy and functionality. Hospitals, especially, are establishments of civic protection and, as such, according to the CSA standard, must provide continuity of care while ensuring the safety of patients.

This is a particularly worrisome issue, considering many such facilities

were built prior to the establishment of modern-day codes that effectively address seismic hazards.

## A shared responsibility

With this in mind, a survey was conducted of Montreal-area building professionals in 2015 in an effort to understand the role of current code provisions—and any insufficiencies—in promoting the post-earthquake functionality of hospitals.

Participants included structural engineers, project managers and architects. From the interviews, it was clear the legal and professional framework of design with respect to OFCs was challenged by the nature of their shared responsibility among these professionals, which cause logistical confusion.

Unaware of any legal oversight, other than following the NBCC, some building professionals assumed their lack of technical knowledge in the field of seismic design abdicated them of any responsibility. In fact, architects and subcontractors are legally responsible for the accuracy of their installations. They would be considered legal entities for enforcement purposes.

## What's next

Past credible failures of OFCs under seismic duress have laid the groundwork for both (a) increasing awareness of the importance of proper seismic bracing and (b) clarifying the legal framework outlining professionals' responsibilities.

Further developments will need to focus on effective implementation of safety measures during all phases of design and construction, which continues to be a challenge. Some core aspects of responsibility, enforcement and oversight will need to be refined and streamlined to alleviate perceived procedural bottlenecks.

**CCE**

*Effie Bouras, PhD, completed a postdoctoral fellowship in the department of civil engineering and applied mechanics at Montreal's McGill University. Her advisor for this piece was Ghyslaine McClure, P.Eng.*



# Langley's RAILWAY CROSSING INFORMATION SYSTEM

A mix of technologies was required for the first project of its kind in North America.

By PBX Engineering

To mitigate the effects of trains blocking at-grade road crossings along the Roberts Bank Rail Corridor (RBRC) in Langley, B.C., the provincial ministry of transportation and infrastructure recently launched an intelligent transportation system (ITS) project, called the Railway Crossing Information System (RCIS). It integrates sensors, predictive algorithm software and dynamic messaging to update motorists on the status of en-route rail crossings, allowing them to avoid delays by detouring to nearby overpasses or unimpeded at-grade crossings.

The objective is to optimize the use of existing infrastructure—as an alternative to building new overpasses or other routes—to reduce traffic congestion and its associated economic and social impact. Vancouver-based PBX Engineering was engaged to plan, design and implement the system, managing a multidisciplinary team that included traffic modelling, structural, civil and geotechnical engineering.

## An innovative ITS

During a rail event, major crossings currently typically remained occupied anywhere from two to five minutes. To support increased international trade through the Port of Vancouver, however, these events are predicted to increase in both length and frequency in the coming years, resulting in longer and more frequent crossing closures.

On average, every minute of blockage results in roughly five minutes of traffic congestion. By reducing this unnecessary idling, the RCIS would facilitate significant reductions in greenhouse gas (GHG) emissions and noise pollution. PBX's team undertook extensive modelling of travel time savings to validate the cost-related and environmental benefits of the system.

As the project was the first of its kind in North America, however, there was no reference for the design process. An array of detection methods were researched and analyzed. A six-month pilot test was undertaken

to evaluate these technologies and determine which iteration offered the greatest performance, reliability and accuracy in gathering the necessary metrics.

Widely varying train configurations, numbers of cars, height profiles and speeds all introduced considerable challenges. The selection of suitable detection technology was pivotal in obtaining and displaying information on motorist advisory signs (MASs), but standard options were insufficient.

The hardware would need to resist inclement weather and vandalism. Posing further complexity, all of the infrastructure was required to be installed outside of the RBRC's right of way (ROW) and independent of any rail equipment.

Based on the pilot test results, a combination of three different types of detection technologies was determined to provide the best performance and reliability, including an infrared (IR) sensor and two types of radar.





Based on pilot test results, a combination of three different types of detection technologies was determined to provide the best performance and reliability.

### Sharing data

The RCIS uses strategically placed checkpoints to detect trains entering the 'Langley's' area of the RBRC. Each detector is a suite of integrated sensors and field controllers that measure and

track various train metrics. The information is processed using custom-developed adaptive algorithms within a sophisticated Advanced Traffic Management System (ATMS) and relayed to six MASs positioned along major arterial routes.

The data gathered by the RCIS has never been available before. It will be shared with other agencies in the region.

PBX also developed the messaging strategy, which combines static and dynamic graphical elements on the full-colour LED digital signs. This process involved human factor interface studies to determine the most effective way of displaying information to the public. The results showed comprehension was highest when the trains' crossing status and direction were displayed with simple, multi-coloured text and icons.

### From start to finish

PBX developed a preliminary design report, tested different technologies, completed the full electrical and systems design, co-ordinated the interdisciplinary design process, oversaw construction, programmed and configured the system and undertook complete performance testing. Several

effective value engineering solutions—such as minimizing the number of detector sites and using standard industrial control components wherever possible—reduced the implementation costs for the stakeholders.

The firm drew on experience in systems integration from the ITS, security and industrial process control application sectors to create operational models, adaptive detection algorithms and exception processing capabilities for the RCIS. The installation of the MASs also involved civil and structural engineering and construction in dense urban environments. A helical pile design was used to minimize foundation size and reduce construction time for the large signs.

PBX collaborated closely with neighbouring municipalities to identify any planned projects or requirements that could affect the design of the RCIS and supported the provincial ministry through negotiations and co-ordination with rail companies. Any challenges that emerged during the construction process were addressed rapidly to ensure adherence to the project's timeline. As a result, the project proceeded on schedule and on budget and is scheduled to go live this spring. **CCE**

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# SMART WATER TECHNOLOGY

The Internet of Things (IoT) offers many benefits for water management.

By Paul Laughton, P.Eng.

Water is, without question, our most precious natural resource. It is essential to life and we cannot function without it. In Canada, many of us are lucky enough to have access to clean water that has been treated for public consumption, thanks to environmental engineering, biology, chemistry, microbiology and public policy.

Water and wastewater treatment facilities are critically important for our communities. They help ensure people thrive in good health and prosperity and our economy runs smoothly.

Today, these facilities can benefit from the Internet of Things (IoT) by using sensors to serve as ‘eyes on everything.’ These devices can extract valuable data, which is then read and analyzed with a connected software platform, for the purpose of

detecting patterns and anomalies, making recommendations and alerting users to potential situations before they happen.

## Turning water into smart water

For water and wastewater treatment plants, IoT sensors can collect real-time data on water quality, temperature, flow and storage levels, air quality, equipment temperature, humidity, biogas distribution and energy output.

Water meters and intelligent sensors can work together to gather information about total dissolved solids (TDSs), bacteria, chlorine and electrical conductivity. Other strategically placed sensors can detect temperature changes, pressure levels and leakage incidents, sending the information back to a main server, so engineers are alerted and can resolve any issues.

IoT sensors can also monitor water

quality through each stage of disinfection treatment, such as chemical levels during chlorination or, when water is being treated with ultraviolet (UV) rays, using flow and UV transmittance data to help optimize output.

The same technology can even help conserve water. Predictive analytics can estimate the amount of water a given city is going to use within a given day, based on historical data, weather and other factors. By knowing what level of consumption is expected, engineers can maintain levels in reservoirs and tanks throughout the day, pumping water into overhead tanks as required.

‘Smart water’ technology is already being used to provide safe and clean water to Indigenous communities in Canada where boil-water advisories had been in place for decades. By improving levels of automation, the



use of IoT sensors has reduced human error in communities where water and wastewater overflow events in the past had resulted in costly clean-up and remediation efforts.

### Streamlining operations and protecting equipment

IoT sensors can improve efficiency, reduce operational costs and extend the life of a facility's equipment. Thermal cameras, for example, can detect when equipment is overheating and requires repair, allowing staff to shut it off to prevent a breakdown or dangerous incident from occurring.

By combining collected data with machine learning technologies, an IoT platform can also help predict the maintenance needs of pumps, distribution networks and storage cisterns. Another specific application in wastewater treatment plans is monitoring the flow rate of sludge in grit chambers, which can otherwise strain machinery elsewhere in the process and damage the pumps.

And again, multiple sites can be monitored from a central location.

### Network surveillance

The resilience of public water and wastewater facilities calls for intelligent, flexible, reliable and customizable surveillance technology. This may include Internet Protocol-based (IP-based) visual and thermal cameras, radar, door stations and audio equipment.

Such equipment can integrate with other IP-based systems. The technology is scalable and updatable, allowing users to manage multiple sites from a central location, for example, and to futureproof their network.

Network cameras can protect premises without constant staff presence by using intelligent features to analyze monitored situations and then alert users as necessary with direct notifications. An alarm can be raised when, for

example, an unauthorized intruder crosses a predefined boundary.

Thermal cameras and radar can detect people, objects, incidents and temperature fluctuations in complete darkness or other challenging conditions. Hardware variations include pan-tilt-zoom (PTZ), fixed-box, dome,

modular and even purpose-built explosion-protected cameras for hazardous areas.

Related audio equipment can include two-way and horn speakers that are triggered in response to intruders. The same systems can be used for live or scheduled announce-

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ments in different zones.

## Protecting workers

Preventing intrusion and possible contamination of water contributes to public safety, but internal safety is another area where IoT-based sensors can play a role.

By way of example, new analytics technologies are now being designed to detect whether or not employees are wearing the proper safety gear. If they are not, an IoT connection can allow a trigger alarm to prevent them from entering a certain area.

Cameras can also trigger alarms for events like chlorine leaks to help prevent workers from coming into contact with toxic substances.

## Customizing the system

When considering IoT-based 'smart



Networked technologies can help protect on-site engineers.

water' technologies for a facility, it is important to consider local factors, including geographic location. Each plant will entail its own unique key

assets, vulnerabilities and threats, so each is a unique project. What is the likelihood of something happening, what is the possible impact and are there any existing mitigation strategies?

Insurance is another factor to consider, as underwriters will take everything into consideration when assessing a treatment facility. If the likelihood of having to file a claim is lower, that can work in the plant's favour, helping to justify an investment in enhancements.

As always, consulting engineers should get involved as early as possible, to provide input the owner may not otherwise consider and to ensure a plant's specific systems will perform optimally. There is also the opportunity to consider interdependency. If lighting is not appropriately positioned, for example, some cameras may not work as effectively as they should. By getting involved at the beginning of a new build, engineers can help determine such interdependencies and make the process more cost-effective.

**CCE**

*Paul Laughton, PEng., is architect and engineering manager for Axis Communications, where he supports both internal employees and external customers in designing smarter security systems. For more information, visit [www.axis.com](http://www.axis.com).*

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1 Canada Life and Health Insurance Association, "A guide to disability insurance," January 2016.

2 Parachute, "The Cost of Injury in Canada," 2015.

3 www.disabled-world.com, "Disability Insurance: Benefits, News and Claims," 2017.

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To give you an idea, have a look at the total annual cost to Canadians who suffer disabilities caused by different injuries, when you factor in health care costs plus the costs of reduced productivity and other issues:<sup>2</sup>

Description	Total cost (\$ Million)
Transport incidents	4,289
Falls	8,680
Fire/burns	366
Unintentional poisoning	1,264
Struck by/against sports equipment	187
Other unintentional injuries	7,127
Violence	1,142
Undetermined intent/other	598



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# Rethinking Liability Insurance

Does your firm need a new approach?

By Mark Urwin

In the marketplace for professional liability (PL) insurance, how do you determine which program is right for your team? Ever engineering firm faces this question, as they seek to bring a high level of consistency and quality to making a decision that will affect their business year after year.

As the former financial controller of a building code consulting firm and having been tasked with purchasing its own PL coverage, I learned to focus on value first, followed by the insurer's coverage options, experience, capabilities and, finally, cost. I found this approach largely insulated the firm

from the uncertainty and volatility of the insurance marketplace.

In talking to my colleagues, however, I realize many engineering firms find the PL market increasingly challenging to navigate. With that in mind, the following are my thoughts on this subject.

## Defining value

Focusing on the value of PL insurance means considering the benefits your firm will derive both now and in the long run, even if you do not file a claim. For me, this involves thinking of insurance not as a business expense

like renting office space, but as an investment.

Over a long period, I have learned there is a difference between the cost of insurance and the cost of risk. While you have relatively little control over the cost of insurance, you can influence your exposure to risk. So, I recommend looking for a carrier that can help you by supporting your firm's risk management goals.

I liken this decision-making model to qualifications-based selection (QBS). Just as your clients may select your firm based on your experience, skill and knowledge, so too should you



use the same criteria when choosing your professional liability insurer. Indeed, I believe the same criteria apply regardless of the size of the firm or the insurance carrier.

It is a given the insurer must be a financially stable, well-capitalized entity, with consistently high credit agency ratings. It is also critically important for the insurer to have both the desire and the ability to manage insurance cycles, so it can offer predictable coverage terms and ongoing support, regardless of your claims experience.

I wanted an insurer that was willing to work with my company to ensure our coverage was broad and flexible enough to meet our needs, offering the limits, deductibles and options we required. It was also crucial to us to work with a PL insurer that specialized in serving our profession, with a legacy of experience in the architecture and engineering (A/E) industry.

These days, you have to know where to look to find these companies. Your agent or broker should be able to help.

Some of the best A/E insurers have gone on to be acquired by new financial parent companies. While their programs have been around for years,

run by specialists in A/E risk, I would want to know if their new parent companies are committed to such programs, investing in them and keeping on key personnel.

### It only takes one claim

To me, great claims handling is a deal-maker. You only need to be involved in a single claim to understand how significant this is.

As mentioned, I wanted to work with claims specialists who understood our business and, hence, our types of disputes. I didn't want to have to explain what we do in our profession to someone who also works on, say, life insurance claims.

How experienced is the insurers' claims staff? Are they licensed attorneys? Do they specialize in A/E defence? Or are they simply general adjusters? Also, are they located in my time zone?

With these issues in mind, I looked for a claims department that would help us resolve our problems before they could become full-blown claims. I wanted them to step forward if a claim were justified, but not simply roll over and pay unnecessarily just to settle a case. I also looked for an insurer that

would try to find ways to cover claims, rather than run away from them, and would help control our legal expenses, provide personalized service and communicate with us promptly and frequently.

### A partner in education

We also found PL insurance carriers with true value offered first-rate training and risk management education programs.

Our firm really relied on and benefited from these programs, the significance of which cannot be overstated. I also expect an insurance company to provide a strong degree of service and advice to help us with our professional services agreements (PSAs).

### The role of your broker

Our insurance broker never let us down. We expected them to recommend a program, rather than a price. So, they would run through a qualitative vetting process and show us how each carrier would support our risk management efforts, educate our staff and treat our time and deductible as if it was their own.

As design professionals, we have to stand by the recommendations we make to our clients. As licensed professionals, we do not shy away from this responsibility. I would always expect the same from our broker.

### Value vs. cost

There is always someone who will offer you a PL insurance policy for less money, but just as we constantly explained to our own clients, the first cost is not always the lowest cost or the best value.

In the end, I would want an insurance company to be there for the long term, to work hard to reduce our losses and to be willing to go to bat for me and my profession. That is the carrier that offers the best value. **CCE**

*Mark Urwin is a chartered professional accountant (CPA) who recently retired from Vancouver-based LMDG Building Code Consultants ([www.lmdg.com](http://www.lmdg.com)).*



Your agent or broker should be able to help you find an insurer with experience in the architecture and engineering (A/E) industry.



# REVIEWING IKEA'S GEOTHERMAL CHILLER

An innovative system provides nine years of flawless operations.

By Antonino Lagana, P.Eng., M.Eng.

In 2011, furniture retailer Ikea commissioned and implemented a frictionless magnetic levitation (maglev) centrifugal chiller to heat and air-condition a major distribution centre in Brossard, Que., by means of geothermal energy. The system achieved unprecedented energy efficiency for the facility, reduced its carbon footprint significantly and provided low-maintenance, highly reliable, silent operation.

The distribution centre comprises a 79,750-m<sup>2</sup> warehouse and 1,641-m<sup>2</sup> single-story office complex. In the warehouse, where the roof height varies from 10 to 15 m, the geothermal heating and cooling system is particularly important in ensuring occupant comfort and air quality, while also saving energy and reducing the facility's carbon footprint.

In 2012, the project was featured in this magazine (see *Canadian Consulting Engineer*, May 2012) as a case study and won first place in ASHRAE's international technology awards for existing commercial buildings.

Since then, it has been operating seamlessly. And as an industry first, *i.e.* pioneering the adaptation of a chiller with maglev bearings to serve as a heat pump for heating and cooling applications, it has served as something of a demonstration project for geothermal energy performance.

## Innovative features and results

During the heating season (*i.e.* winter), the maglev chiller serves as a heat pump, drawing heat from a ground heat exchanger (GHX) to an indoor hydronic loop to produce hot water. Inversely, during the air-conditioning season (*i.e.*



summer), it draws heat from the hydronic circuit to produce chilled water, dissipating it to the GHX.

As a heat pump, the maglev chiller does not feature reversible refrigerant circuits and a change-over valve, since it was designed to be a chiller only. Consequently, the hydronic loop is a giant circuit, connecting the ground to the indoor loop. Three-way valves send groundwater into the evaporator and indoor water into the condenser during heating mode. And the same valves divert groundwater into the condenser and indoor water into the evaporator during cooling mode. It is therefore possible to 'free cool' with groundwater by shutting off and bypassing the heat pump during the mid-season, saving additional energy.

The GHX comprises 46 vertical boreholes, each 183 m deep, using single U-tube piping. The supply and return manifolds for the pipes going into and coming out of the GHX were installed in an accessible underground vault. Groundwater circulates between the manifold and the heat pump through an underground supply and return pipe.

### Efficient displacement ventilation

The indoor water loop serves the offices' fan coils and the warehouse's custom air handling units (AHUs), which provide heating or cooling by means of displacement ventilation, ensuring high levels of air quality. They blow hot or cool air through supply grills at floor level.

Displacement ventilation is particularly effective at cooling the high-ceiling warehouse because the cool air remains at floor level, due to its higher density compared to hotter summer air. As it does not rise naturally toward the ceiling, heat losses are minimized.

In heating mode, meanwhile, the custom AHUs diffuse warm air over the warehouse floor at a relatively high speed, so it also stays 'attached' to the floor, by means of the Coandă effect, *i.e.* the tendency of a fluid jet to stay attached



The system heats and air-conditions a distribution centre in Brossard, Que.

to a convex surface. There are also ceiling-mounted unit heaters to provide additional warmth in the warehouse as needed for comfort.

### Actual performance and balanced geo-exchange

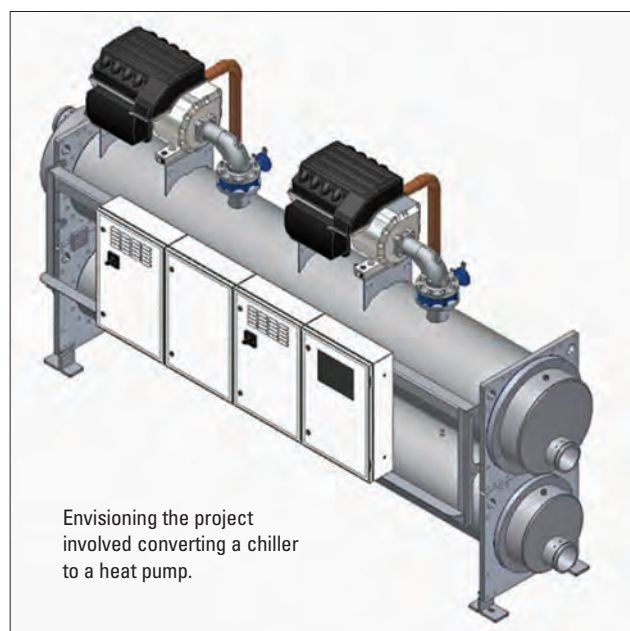
The facility also features natural gas-fired rooftop AHUs. While these have not been removed yet, they are used only when point heating demand increases beyond the capacity of the geothermal system.

The maglev chiller is the principal source of heat. Indeed, the geothermal system can supply all of the needed heating energy for the facility more than 80% of the time, surpassing initial estimates. There is an electric boiler for backup purposes and the gas-fired AHUs come on less than 20% of the time.

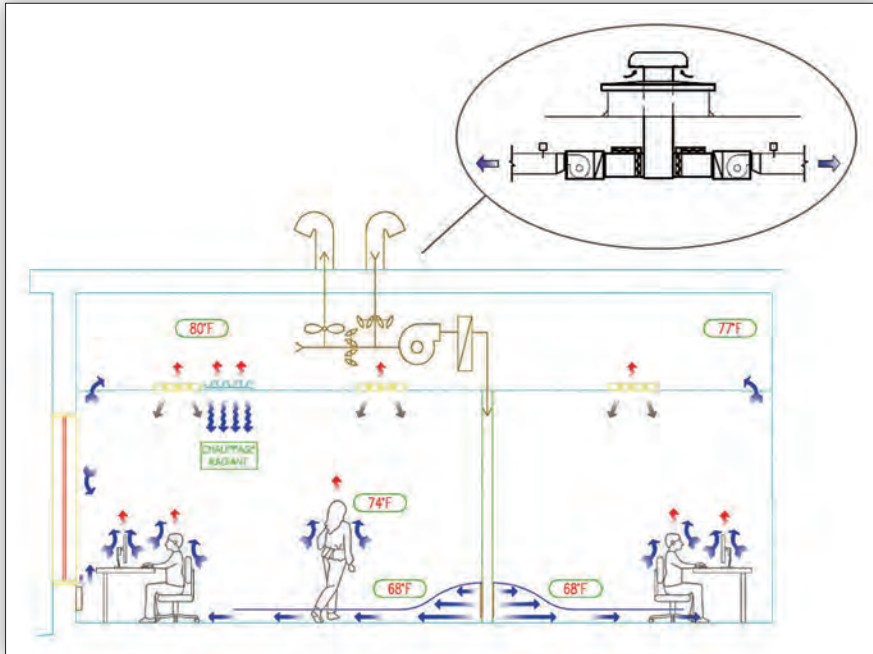
In cooling mode, the geothermal heat pump adequately air-conditions the offices and the warehouse. Specifically, during hot summer days, at maximum capacity, it can temper the warehouse air to approximately 27 C, much to the satisfaction of its occupants. Prior to this installation, the warehouse was not cooled at all, so workers often contended with heat-wave discomfort.

The geothermal heat pump and GHX were sized to meet 33% of the building's peak heating load, supplemented by other heating sources (*i.e.* the aforementioned electric boilers and gas-fired AHUs), and 100% of its required cooling load. With this hybrid configuration, the system returns to the ground in summer about as much heat as it draws from it all winter, effectively avoiding long-term ground thermal depletion. In fact, measurements confirm the ground shows no sign of thermal depletion and remains a consistently reliable heat source and sink, during all seasons, from year to year.

At its maximum heating capacity in winter, the heat



Envisioning the project involved converting a chiller to a heat pump.



This schematic demonstrates the principles of displacement ventilation for the facility's offices.

At peak cooling load, the heat pump provides cold water to the indoor loop at approximately 8 C and warm water to the ground at 24 C. So, full air conditioning is achieved with a temperature lift of only 16 C, leveraging the maglev chiller's extremely high efficiency at part loads. The pump's cooling COP is 10. The newly provided comfort in the air-conditioned warehouse comes with almost no additional electricity and nearly zero extra cost.

## Electrical and other savings

A high-efficiency lighting retrofit and variable frequency drives (VFDs) on the pump motors deliver further electrical savings. Also, the water in the loop uses a low-viscosity antifreeze solution, developed specifically for this project to

minimize electrical pumping power requirements.

Laboratory testing results indicate this solution is functioning as intended. It contains only 8% propylene glycol and effectively inhibits any biological growth or corrosion. Common antifreeze normally contains 25% propylene glycol for use with chilled water in geothermal ground-heat exchangers.

Yearly savings include approximately 80% and 30% reductions in natural gas and electricity consumption, respectively. (It is worth noting electricity in Quebec is generated by clean, hydroelectric power, producing no greenhouse gas (GHG) emissions.)

Installation and life-cycle costs were also reduced thanks to (a) the hybrid geothermal configuration, which considerably minimizes GHX and heat pump capacity, (b) the silent characteristics of the heat pump, which sidestepped expensive soundproofing measures, and (c) low maintenance requirements, due to the maglev heat pump's frictionless operation. And finally, the project's costs were further minimized by incentives from Hydro-Quebec and the federal government's office of energy efficiency, which provided a quick, simple payback.

In all of these ways, Ikea's geothermal chiller demonstrates how innovative technology can provide thermal comfort and improved air quality to occupants with minimal energy consumption.

**CCE**

*Antonino Lagana, P.Eng., M.Eng., is principal mechanical engineer in building energy performance for Stantec in Montreal and served as engineer of record for the Ikea maglev chiller. For more information, visit [stantec.com](http://stantec.com).*



This underground vault houses the geothermal pipe groundwater manifolds.

pump provides hot water to the indoor loop at approximately 43 C and chilled water to the ground at approximately -1 C. It maintains this constant temperature lift of 44 C between indoor and groundwater and a heating co-efficient of performance (COP) of 4.

Aggressively low set points were originally intended for the warehouse to guarantee maximum savings, but these targets were quickly relaxed and raised in favour of thermal comfort. Notwithstanding, the required savings are being delivered. At part load, the hot water temperature is modulated according to actual demand, but the hybrid geothermal configuration ensures the heat pump most often operates at its maximum capacity.



# Specifier's Literature Review



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## ELECTRICAL



Radica Software has released Electra Cloud, reportedly the world's first fully browser-based electrical computer-aided design (CAD) software, which allows engineers to create, edit and share electrical, pneumatic and hydraulic schematic drawings with team members. The platform is compatible with Microsoft, Linux and Apple operating systems (OSs), smartphones and other mobile devices. Teams can collaboratively edit drawings in real time from around the world or revert to earlier revisions without losing any of their work. As founder and CEO Thomas Yip puts it, "Users no longer need to have software installed on their computer to access electrical drawings." Radica also plans to release an entirely offline version of the software for users concerned about privacy.

**radicasoftware.com**

## SENSORS

NewTek Sensor Solutions now offers an online library of three-dimensional (3-D) models of its linear variable differential transformer (LVDT) position sensors to help ensure the right fit to integrate with a new or existing application. The models cover a range of miniature, high-temperature, hermetically sealed right-angle and spring-loaded LVDTs for the power generation, factory automation, oil and gas exploration, aerospace, military, chemical processing and automotive testing industries, among others. They are offered in .stp and .igs formats for nearly universal acceptance in computer-aided design (CAD) programs, so users can visualize spatial requirements for positioning sensors for different systems and plants.

**newteksensors.com**



## HVAC

Annexair, based in Drummondville, Que., recently unveiled what it calls the first-ever biocomposite ventilation unit for the HVAC



market, built using a fire-resistant resin from recycled plastic water bottles, to help promote more sustainable air conditioning. The central air unit is available in different sizes (examples pictured) for commercial buildings. As the casing requires not metal components, it is fully corrosion- and rust-resistant, weighs 50% to 60% less than conventional units and should last upward of 60 years if well-maintained. The new units are scheduled for availability in August 2020 and the company—which is a member of the United Nations (UN) Global Compact—plans to halt production of its conventional steel HVAC units in 2021.

**annexair.com**

## INDUSTRIAL

Festo Canada, based in Mississauga, Ont., says the new DPDM Multimount compact cylinder is its smallest, lightest, easiest-to-mount and most economical so far in its class. As its name suggests, it can be fastened in place at the front or rear, vertically or horizontally, for applications such as stopping or stabilizing small work pieces or platforms in light manufacturing. Single- and double-acting versions are available, with or without protection against rotation, in a variety of diameters and stroke lengths. Options include heat protection up to 120 C and a magnetic piston for position sensing.

**festo.com**



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