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CANADIAN CONSULTING
Engineer

September/ October 2021

ccemag.com

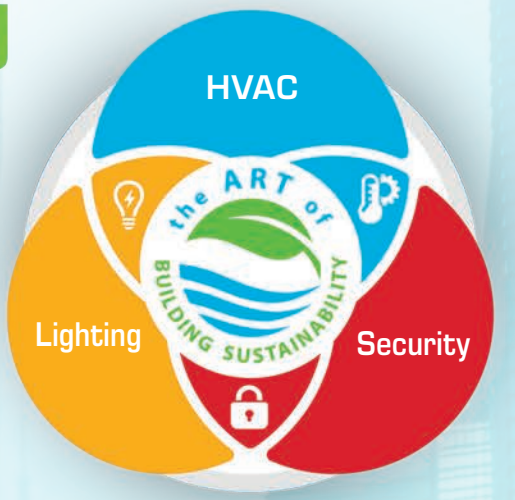
For professional engineers in private practice

2021 Awards

Trans-Canada Highway Avalanche Mitigation wins the Schreyer. P.16

PM40065710

the ART of Building Sustainability



1 CERTIFIED OPEN STANDARDS

Ensure a strong level of interoperability by using open protocols which have third-party listing laboratories to verify adherence to your protocol's form and function.

2 SECURE DATA

Employ a single sign on (SSO) architecture with compliance to scalable credentialing architectures and secure tunneling methodologies such as BACnet virtual private networks (B/VPN).

3 INTEGRATED FAULT DETECTION & DIAGNOSTICS

Specify integrated FDD (IFDD) that delivers real-time fault detection, step-by-step root-cause diagnostics while using all your existing cabling structures, including twisted-pair networks.

4 OWNERSHIP OF ANALYTICS

Insist on timely analytics for all stakeholders with complete control of formatting and scheduling while retaining full ownership of your data and the reports generated.

5 MOBILE-CENTRIC EXPERIENCE

Create better-connected spaces with real-time access to occupancy, lighting, ventilation, and thermal comfort levels, using a holistic mobile-centric experience.

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Select lifecycle-centric manufacturers who minimize the negative impacts of waste with long-term warranty and repair services while adhering to WEEE, R2, RoHS and LEED directives.

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Enjoy the long-term benefits of suppliers who engineer a path forward to new technologies while remaining backward compatible without third-party gateways or hardware replacement.

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Stay on top of regular advances in technology with supplier-certified, multi-lingual online educational videos, technical documentation, software updates, and advanced leader lead training.

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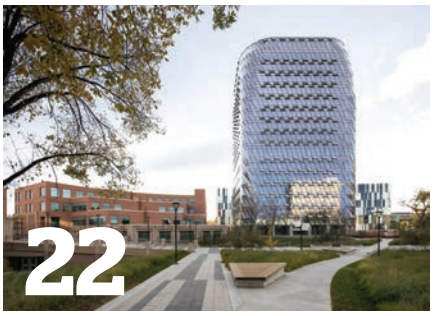

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AWARDS OF EXCELLENCE

ON THE COVER McElhanney wins this year's top honour, the Schreyer Award, with its avalanche mitigation project for Rogers Pass.
See profile on p. 16.
PHOTO COURTESY MCELHANNEY.

Comment

by Peter Saunders

Valuable progress during difficult times

Major infrastructure projects are significant not just physically and economically, but also socially. They can bring us and our nation together—or keep us apart. With today's increasing awareness of social justice issues and their political, moral and ethical implications, we cannot ignore what is going on around us. Rather, we must consider the further potential of engineering to solve the multi-faceted problems that lie ahead.

This need has been illustrated particularly eloquently by many of the entries that were submitted for the 2021 Canadian Consulting Engineering Awards program, which we at *Canadian Consulting Engineer* co-sponsor with the Association of Consulting Engineering Companies – Canada (ACEC-Canada). Such themes as environmental sustainability, Indigenous community outreach, energy efficiency, mentorships, urban enhancement and specialized knowledge transfer came up time and again in the project descriptions (and make no mistake, our judging panel of industry experts took notice).

"I think you'll be both duly impressed and, perhaps, a little surprised by which particular projects shone through this year."

Some of these worthy goals have been all the more difficult for Canadian consulting engineering firms to prioritize and pursue during the global COVID-19 pandemic, to say nothing of getting shovels in the ground while restrictive measures have been in place. Yet, while we received somewhat fewer project submissions for the awards program this year than last, the field of entries was nevertheless still large, broad and diverse and reflected the very best efforts to not let the virus get in the way of valuable progress.

In this issue, we showcase all the winners of the Awards of Excellence and the Special Awards. I think you'll be both duly impressed and, perhaps, a little surprised by which particular projects shone through this year, following what has been such a bizarre time for the engineering profession and the related trades of the construction industry.

Once again, we have highlighted their geographical diversity with a special map, which you'll find on page 13, right before the profiles of all the winning projects. And of course you will soon be able to browse all of the non-winning projects, too, in the Showcase of Entries on our website (ccemag.com).

Speaking of the pandemic, we're not back to normal yet. Our jury had to deliberate over Zoom, rather than meet in person to make the final decisions. And ACEC-Canada handed out the awards on Oct. 28 at a virtual celebration, rather than hosting a gala in Ottawa. (We've tried to make sure this issue reaches you as shortly thereafter as possible!)

Indeed, this fall, many industry events have also taken either a fully virtual or 'hybrid' approach, slowing down the return of large crowds to indoor conference venues.

As Canada slowly recovers from the pandemic, however, the engineering sector is clearly taking the right steps toward a brighter future on all social fronts. **CCE**

Peter Saunders • psaunders@ccemag.com

SCAN CODE TO VISIT CCE'S WEBSITE: Find the latest engineer-related news, stories, blogs and analysis from across Canada.

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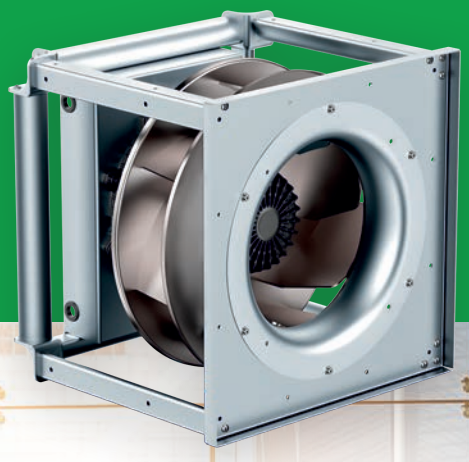

RadiPac centrifugal fans are available for high pressures up to 10 in. wg. Scan here:

ebmpapst

engineering a better life

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There are many situations in which fans have to work at high pressure, including complex air distribution networks or air ducts that have to fit in tight false ceilings and naturally need to have small cross sections. This is also the case for air handling units (AHUs) for hospitals that, in addition to the complex air ducting, have HEPA filtration to maintain their required air quality levels. Steam and droplet separators with many pipe bends cause high pressure losses and call for corresponding performance from the fans used in them.

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David Murray, P.Eng., is Chair of the Board of Directors for the Association of Consulting Engineering Companies – Canada (ACEC-Canada).

Celebrating Excellence In Our Industry

Despite more than a year marked by a global pandemic, consulting engineering firms still completed thousands of projects that addressed complex technical challenges. Through these projects, the industry contributed to the social wellbeing and economic growth of our communities in ways that are often taken for granted—providing safe and healthy cities, connecting people and businesses, helping to build a strong, competitive and sustainable economy and protecting and conserving the environment.

It is important to continue to promote our industry and its services and ensure that we do not become a commodity. Through innovation, firms are advancing the profession and the way we do business. Let's continue to promote science in schools to give our future generations the interest to build Canada and the world of tomorrow.

During these challenging and unprecedented times, we've been able to count on the consulting engineering industry to continue safeguarding our communities and ensuring the wellbeing of Canadians and people across the globe. This industry has played an important role in meeting the challenges of our new shared reality and has made a difference to the lives of Canadians and people around the world. Recognizing and celebrating these accomplishments is critical now more than ever.

This is the reason the Canadian Consulting Engineering Awards, which were recently presented during a virtual celebration, are so important. They showcase ACEC member firms, celebrate the meaningful difference they make to our communities and society as a whole and elevate the image and profile of our industry.

The 20 Awards of Excellence recipients featured in this issue of *Canadian Consulting Engineer* exemplify the best of the consulting engineering industry. From these 20 winners, four were also recognized with Special Achievement Awards for having distinguished themselves for environmental stewardship, impact on the community, showcasing Canadian engineering excellence abroad or overall technical distinction. I invite you to learn more about each project by visiting ACEC-Canada's website, where you can view videos showcasing their achievements. The winning projects and their firms will be further recognized during the *#20DaysofExellence* campaign in November. I encourage you to follow the campaign on ACEC-Canada's social media and share the posts with your own network, to help us further celebrate excellence in Canadian consulting engineering from the past year.

The Canadian Consulting Engineering Awards represent the highest honour in our industry.

The CCE Awards virtual celebration also recognized individuals within our industry who stand out for their contributions to our industry and to their communities. The Beaubien Award—named in honour of the founder of ACEC-Canada, Dr. James de Gaspé Beaubien—is presented annually to an individual for their lifetime contribution to the advancement of their profession and the consulting engineering industry. Recipients are nominated by their peers and selected by ACEC's Past Chairs Council. This year, Bob Gomes, past president and CEO of Stantec, joined the prestigious list of Beaubien Award honorees.

Two rising stars in the consulting engineering industry, Lindsay Bolton and Siobhan Robinson, were also recognized for their exceptional leadership skills and contributions to the industry with the Allen D. Williams Scholarship. For the scholarship committee to have selected two recipients is an indicator of the depth and breadth of talent in the ranks of young professionals in Canada.

Congratulations to all three, who are featured in the following pages, for their achievements. This industry celebration of excellence would not have been possible without the dedicated work of the CCE Awards jurors, the ACEC Past Chairs' Council and the Allen D. Williams Scholarship Board. To all of you, I extend my appreciation and thanks on behalf of the ACEC Board of Directors and our industry. Your contributions were invaluable to the success of this year's celebration. I would be remiss if I did not also recognize all the firms, project partners and clients who participated in this year's awards program.

Finally, congratulations to all the award winners on their outstanding achievements. Félicitations à tous les projets et firmes primées ! Profitez de cette reconnaissance bien méritée et célébrez vos incroyables réalisations !

2021 Beaubien Award presented to Bob Gomes

Bob Gomes, former CEO of Stantec and a current member of its Board, was honoured during the Canadian Consulting Engineering Awards virtual celebration on Oct. 28 with the Beaubien Award, the industry's highest recognition.

Born and raised in Edmonton, Bob earned his degree in civil engineering at the University of Alberta. After joining Stantec in 1988 as an urban land project manager, he held many leadership roles over the course of his nearly 30 years with the company, culminating with his appointment as president and CEO in 2009.

Under his tenure as CEO, Stantec experienced a sustained period of growth with close to 50 acquisitions in eight years. Building on the firm's reputation, Bob oversaw its successful expansion into multiple global markets, including Europe and the Middle East. Under his leadership, Stantec experienced top-line growth of 229%, with gross revenue increasing from $1.5 billion to $4.8 billion.

While the firm now counts more than 22,000 employees in 350 locations across six continents, Bob always believed that growth should be measured in expertise and capability, rather than size, and that consulting engineering firms should strive to be better companies and provide employees with career opportunities. To achieve this vision within Stantec, Bob facilitated a restructuring and refinement of roles and responsibilities to align the growth of the business lines, allowing them to better respond to future opportunities. He also oversaw a company rebranding that challenged the 'why' of the company's strategy and articulated a new purpose and values for the firm.

Bob's professional legacy is his commitment to engineering, the industry and his community.

Perhaps the most visible mark he made on the company and his community is the design of—and securing space and naming rights to—the Stantec Tower, its global headquarters. The tallest building west of Toronto, it consolidated the firm's Edmonton offices and serves as one of the key pillars in the vibrant ICE District. The tower reinforced the company's commitment to the city of Edmonton, where it was founded and solidified its roots.

A tireless advocate for the industry, Bob has been actively involved in professional and industry organizations throughout his career. His long engagement with Consulting Engineers of Alberta (CEA) culminated in his term as president, for which he received the Lieutenant Governor's Award for Distinguished Service. He is also past-chair of the Urban Development Institute and the Edmonton Non-Profit Housing Corporation. His leadership position in the industry meant Bob was often called upon to present his views through speaking engagements with organizations such as ACEC-Canada, CEA and APEGA.

In his final year before his retirement in 2017, he received the CEO of the Year Award from New York-based EFCG, the highest award granted by this organization. In addition to his commitment to his profession and industry, he has consistently volunteered his time and talents in the community through organizations such as Habitat for Humanity, United Way and the Edmonton Economic Development Corporation.

Bob's professional legacy is his commitment to engineering, the industry and his community. As the recipient of this year's Beaubien Award, presented annually in recognition of exceptional service to ACEC and for contributions to the advancement of consulting engineering through professional accomplishments, Bob is recognized by his peers for his exemplary service.

Visit www.acec.ca/beaubienaward to view the Beaubien winner video.

Scholarship Recognizes Young Professionals

The Association of Consulting Engineering Companies-Canada (ACEC-Canada) is pleased to announce that the Allen D. Williams Scholarship Jury has recognized two rising stars from the consulting engineering industry for this year's scholarship. Lindsay Bolton, P. Eng., of CBCL Limited and Siobhan Robinson, M.A.Sc., P.Eng., of Kerr Wood Leidal Associates have both been awarded the 2022 scholarship. They were announced as the recipients during the 2021 Canadian Consulting Engineering Awards virtual celebration on Oct. 28.

While not an unprecedented decision by the board, this is only the second time in the scholarship's 12-year history to have two candidates recognized with the award.

"The calibre of these candidates made it next to impossible to select only one for recognition," stated Dorothy Williams, one of the founders of the ADW Scholarship Foundation. "Lindsay and Siobhan both exemplify the qualities the scholarship was created to recognize. This is why the jury decided selecting one over the other would be a disservice to the consulting engineering industry."

Nominated by ACEC-NB, Lindsay's leadership, technical capability, willingness to help others and aptitude for business development and mentoring are some of the reasons she was selected for recognition by the scholarship jury. Viewed by the leadership at CBCL Group as an employee who consistently outperforms expectations, she rose from junior engineer to the firm's lead for water resources and climate change. Lindsay is an active participant in many professional organizations and involved in regional and national technical working groups to remain informed on rapidly changing climate science innovations and the implications of climate change for engineering design best practices. She also sits on the climate change sub-committee for the federal framework on floodplain mapping hosted by Natural Resources Canada.

Lindsay is also incredibly passionate about advancing diversity and inclusion in the consulting industry. As the chair of ACEC-NB's Diversity and Inclusion Committee, she was instrumental in the completion of its Women in Consulting Engineering Study, one of the only reports on the career experiences of women in consulting engineering.

Lindsay Bolton

Siobhan Robinson

"The calibre of these candidates made it next to impossible for the jury to select only one for recognition."

Siobhan is recognized by the leadership at Kerr Wood Leidal as a dedicated consultant, a tireless and passionate volunteer and a leader who is committed to serving those who follow her into the profession. These qualities made her a standout candidate to the scholarship jury. As a project engineer with a focus on water supply and treatment at Kerr Wood Leidal, her technical and interpersonal skills are best evidenced by the high demand for her participation in projects by clients and internal project managers. She brings an abundance of innovation to her solutions, with refreshing new ways to solve both the hard technical problems and the soft communication components essential in engineering. She encourages those around her to grow personally and professionally and seeks opportunities to positively affect others by engaging in education and outreach activities. A tireless volunteer, she has served in a variety of capacities with ACEC-Canada, ACEC-BC and other industry associations.

The ADW Scholarship commemorates Allen D. Williams, past ACEC chair and founder of Williams Engineering Inc. It provides the recipient with funding to cover registration, airfare and accommodations to attend the annual conference of the International Federation of Consulting Engineers (FIDIC). Visit www.acec.ca/adw-scholarship to view the videos about the 2022 award recipients and learn more.

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The following pages present the Top 20 Awards of Excellence from the 2021 Canadian Consulting Engineering Awards.

CANADIAN CONSULTING Engineer

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2021 CANADIAN CONSULTING ENGINEERING AWARDS / PRIX CANADIENS DU GÉNIE-CONSEIL

This year marks the 53rd annual edition of the Canadian Consulting Engineering Awards, a program produced jointly by Canadian Consulting Engineer magazine and the Association of Consulting Engineering Companies – Canada (ACEC-Canada).

From the top 20 selections, the competition's esteemed jury singled out four for Special Awards.

The awards are the longest-running and most important national mark of recognition for consulting engineers in Canada. The following pages present this year's 20 Award of Excellence winners, selected from more than 60 qualifying entries from across the country.

From these top 20 selections, the competition's esteemed jury singled out four for Special Awards.

The Schreyer Award, the top prize presented to the project that best demonstrates technical excellence and innovation, went to McElhanney for Trans-Canada Highway Avalanche Mitigation at Rogers Pass in British Columbia. The jury called this project unprecedented and leading-edge and, in particular, acknowledged the high degree of difficulty involved in its installation.

The Engineering a Better Canada Award, which honours the project that best showcases how engineering enhances the social, economic or cultural quality of life of Canadians, was presented to gbi for Curé Paquin Primary School in Saint-Eustache, Que. It stood out to the jury as a pioneering example of sustainable development that will help teach the next generation and transfer technologies to other construction projects in the future.

The Tree for Life Award, presented to the project that best demonstrates outstanding environmental stewardship, went to Entuitive for the MacKimmie Tower Redevelopment at the University of Calgary. The jury recognized the challenge of bringing such an old building up to net-zero carbon performance and praised the project's high level of sustainability.

Finally, the Ambassador Award, for the project constructed or executed outside Canada that best showcases Canadian engineering expertise, went to StructureCraft of Abbotsford, B.C., for its work on the Taiyuan Botanical Garden Domes in China. The jury highlighted the project's technical difficulty, envelope-pushing timber fabrication processes and overall beauty.

The 53rd annual Canadian Consulting Engineering Awards were presented at a virtual celebration on October 28. Congratulations to all of our winners! **CCE**

1. Trans-Canada Highway Avalanche Mitigation
Glacier National Park
Rogers Pass, British Columbia

2. Curé-Paquin Primary School
43 rue Saint-Laurent
Saint-Eustache, Québec

3. MacKimmie Tower Redevelopment
2500 University Drive NW
Calgary, Alberta

4. Taiyuan Botanical Garden Domes
Jinsheng Town, Jinyuan District
Taiyuan City, Shanxi, China

5. CIBC Square at 81 Bay Street
81 Bay Street
Toronto, Ontario

6. Peter Lougheed Centre Temporary COVID-19 Treatment Facility
3500 26 Avenue NE
Calgary, Alberta

7. Edmonton Convention Centre Atrium Renovation
9797 Jasper Avenue
Edmonton, Alberta

8. Hôpital Maisonneuve-Rosemont Modular Complex
5415 Boulevard de l'Assomption
Montréal, Québec

9. Hot Pipeline Condition Assessment Study
6301 Silver Dart Drive
Mississauga, Ontario

10. Clayton Community Centre
7155 187A Street
Surrey, British Columbia

11. Mushkegowuk James Bay All-Season Road Feasibility Study
Mushkegowuk Traditional Territory
James Bay Region, Ontario

12. Mill Creek Ravine Pedestrian Bridge Rehabilitation
Mill Creek Ravine
Edmonton, Alberta

13. Whapmagoostui Cree First Nation Drainage Master Plan
P.O. Box 390
Whapmagoostui, Québec

14. West Niagara Secondary School and New Ridgeview Garden Centre
191 Carlton Street
St. Catharines, Ontario

15. The Building Envelope Thermal Bridging Online Database
BC Housing, 4555 Kingsway
Burnaby, British Columbia

16. Lowering the Regional Groundwater Table – Nutashkuan
Route 138
Nutashkuan, Québec

17. Turcot Interchange and Railways Reconstruction Project
Montreal, Québec

18. Southwest Rapid Transitway Stage 2 and Pembina Highway Underpass
315 Chancellor Matheson Road
Winnipeg, Manitoba

19. Major Rehabilitation, Characterization and Treatment of Contaminated Soils
Route Chisasibi/L-2
Chisasibi, Québec

20. Capital Regional District Wastewater Treatment Project
Victoria, B.C.

Portfolios of all this year's and previous years' entries are showcased at www.canadianconsultingengineer.com/awards/showcase-entries/

For more details about the awards program's history and purpose, visit www.canadianconsultingengineer.com/awards/about.

Canadian Consulting Engineering Awards Judging

This year's jury convened online in June to deliberate over the final round of award selections. The following are the esteemed members of our jury.

CHAIR
Jennifer Drake, Ph.D., P.Eng., is an associate professor of civil engineering at the University of Toronto (U of T) and an expert in urban flood management and green infrastructure. Her research group specializes in emerging technologies, including green roofs, rain gardens and permeable pavements.

Erin Bird, P.Eng., is a leader in the City of Calgary's corporate engineering and energy division of corporate analytics and innovation. With the city for 15 years this fall, her past roles have included project delivery and structural oversight of transportation infrastructure projects, infrastructure planning in water resources and capital project strategy. Previously, she worked for a general contractor on bridge projects, for SNC-Lavalin France and for a small consulting firm in Calgary.

Chair's Comments

It was a privilege to serve as chair of the awards committee and see the exceptional work our consulting engineers have produced throughout Canada and abroad. After more than 18 months of lockdowns, restrictions and isolation, I personally found it immensely comforting to know that so many continue to answer the Calling of the Engineer, putting forth their best work even through the most challenging of circumstances.

For the second year in a row, our panel of judges meet virtually to debate and deliberate over this year's winning projects. We greatly missed the joy of seeing familiar faces and old friends in person, but nevertheless are satisfied with our final decisions for this year's winners.

Congratulations to all of the teams and companies that submitted projects this year. Your contributions to our profession are outstanding and the diversity of engineering work and design among the entries was remarkable. Thank you for the time and effort in first completing these works and then showcasing them.

The judges noted this year how many projects directly addressed Canada's net-zero emission goals. As a mother of two children, it brings me inexpressible joy to see how many of our engineering colleagues have risen to this challenge, reimagining through their work our buildings and infrastructure, to ensure our world is safe and liveable for future generations.

Finally, congratulations to the award winners! It was, as always, a difficult task to select projects for the Awards of Excellence. We offer special congratulations to the Special Awards winners and applaud you for your exceptional successes.

— Jennifer Drake, Ph.D., P.Eng., Jury Chair

Guy Bruce, P.Eng., is an electric utility expert with more than 40 years' experience. He retired from SaskPower in 2017 as vice-president (VP) of planning, environment and sustainable development. He has served as chair of the Canadian Electricity Association (CEA's) generation council and on the board of the Energy Council of Canada. Guy is now an independent consultant in Regina, using his extensive knowledge and a collaborative approach to support several clients, including Saskatchewan's First Nations Power Authority (FNPA), and continues to be a member of the Energy Council of Canada, active in helping people understand the industry.

Peter Judd, P.Eng., was general manager (GM) of engineering for the City of Vancouver until he retired in 2015. In that role, he oversaw 1,800 employees and a department

that provided everything from public works planning and design to construction and maintenance. He led many of the city's green initiatives and spearheaded both Olympic and Paralympic operations during the 2010 Winter Games.

Guy Mailhot, Eng., M.Eng., is a McGill graduate (M.Eng. 84), Fellow of the Canadian Society for Civil Engineering (FCSCE) and Fellow of the Engineering Institute of Canada (FEIC). After working for 15 years for consulting firms in Vancouver and Montreal in bridge engineering, he joined the Jacques Cartier and Champlain Bridges in 1999, where he was principal director of engineering. Under a federal government exchange program, he has been on loan to Infrastructure Canada since 2012, acting for the authority as chief engineer for the Samuel De Champlain Bridge Corridor.

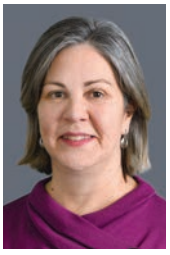
Louise Millette, ing., FIC, Ph.D., has been an associate professor at Polytechnique Montréal since 2002 and served as director of its civil, geological and mining engineering department from 2015 to this year. She previously worked for Bell Canada for 12 years, ending her career there as deputy divisional chief (environment). At Polytechnique, where she first graduated in civil engineering and obtained her Ph.D. in environmental engineering, Louise has integrated sustainable development principles into the training of engineers. She is a long-time partner of the University of Montreal and a Fellow of Engineers Canada and has won awards from Quebec's ministry of education and le Réseau des Femmes d'affaires du Québec (RFAQ).

Stephen Panciuk, P.Eng., is the national engineering professional lead in Marsh Canada's construction practice. Based in Ottawa, he specializes in developing and implementing strategy for large design firms and single project errors and omissions. He also manages Marsh's relationships with several provincial and national engineering associations, speaks at their conferences and annual general meetings (AGMs), is a member of ACEC-Canada's contracts committee and sits on the Consulting Engineers of Ontario (CEO) business resiliency committee.

Anne Poschmann, P.Eng., a Queen's University graduate, began her career as a geotechnical consulting engineer with Golder Associates in 1981. There, she played a leading role in providing geotechnical engineering know-how, value engineering and constructability reviews for the development and improvement of transportation and infrastructure in Canada. She was chair of Consulting Engineers of Ontario (CEO) in 2006 and became the first female chair of ACEC-Canada in 2014. Now retired, Anne unwinds on Gabriola Island, B.C., where gardening and whale watching take up her time.

Harold Retzlaff, P.Eng., FCSCE, is a senior project engineer with Saskatchewan's ministry of highways and infrastructure. He has been with the ministry for more than 35 years and has been involved in the design and construction of several hundred kilometres of highway, guided the planning for numerous highway corridors and developed policies and standards for geometric design and road safety.

Clive Thurston has extensive experience in Ontario's construction industry, having worked as a superintendent, estimator, project manager and owner/operator of a construction company. He served as a bylaw/building official for Brampton and chief building official for Prince Edward County before accepting the position of president of the Ontario General Contractors Association (OGCA). Through OGCA, Clive represented the industry at the Construction and Design Alliance of Ontario (CDAO), a group focused on the renewal of infrastructure and the impact of government regulations. He was also active in the Canadian Construction Association (CCA) ps. A strong believer in consultation over confrontation, Clive promotes policies that are beneficial to all stakeholders within the construction industry.



Judy Wall is president of East Port Properties in Dartmouth, N.S., and has been involved in real estate development for the past 30 years, including many 'firsts' in the industry: the first LEED-certified multi-tenant warehouse in Nova Scotia, the first LEED-certified business park campus in Mount Pearl, N.L., the first LEED Gold and BOMA Best Platinum building in St. John's, N.L., and most recently the first multi-tenant warehouse certified for both design and performance under the Canada Green Building Council's (CaGBC's) new Zero Carbon Building Standard.

Sarah Wells, P.Eng., is executive director of the Transportation Association of Canada (TAC). She has contributed to and led national transportation research projects, managed the development of publications for transportation professionals and been a sessional lecturer for graduate courses in civil engineering at Carleton University. She is also past-president of the Canadian Technical Asphalt Association (CTAA). CCE

Schreyer Award and Award of Excellence

Trans-Canada Highway Avalanche Mitigation

McElhanney

Glacier National Park, located 650 km east of Vancouver, is home to a unique transportation corridor, combining the Trans-Canada Highway, Canadian Pacific Railway and a concentrated cluster of high-frequency avalanche paths. Parks Canada Agency engaged McElhanney to improve the corridor's safety and reliability by implementing industry-leading avalanche mitigation measures.

These solutions, integrated with an existing, complex avalanche control program, have reduced risk for roadway users and the railway and will help keep Canadians moving year-round.

An unprecedented system

Under Parks Canada Agency's oversight, McElhanney—serving as prime consultant—partnered with Dynamic Avalanche Consulting to develop a new avalanche mitigation project along 43.8 km of the Trans-Canada Highway through Glacier National Park. The project began with an analysis of the existing avalanche program and identification of priority mitigations. The process also involved environmental and cultural resource considerations, unique procurement practices and construction management in challenging environments.

McElhanney and its partners planned, designed, prepared the tender for and oversaw the construction of 2 km of snow nets, which mitigate avalanches in three critical paths. There were no applicable North American design standards for these nets, so the team turned to Swiss guidelines.

The netting prevents snow in the start zone from releasing and causing an avalanche, thus removing the need for active control. These nets are now a leading example of how mitigation can be effective in challenging terrain on a large scale.

A remote avalanche control system (RACS) at the east end of the park helps increase the avalanche program's efficiency.

The team also managed the installation of 13 remote avalanche control systems (RACSs), which use explosives to initiate avalanches in five key paths. This arrangement eliminated the need for Parks Canada Agency and the Canadian Armed Forces to conduct artillery control at the park boundaries. Instead, the setup allowed for concurrent control of these paths with artillery control in other areas.

Further, McElhanney managed the design, tender and construction of a 19.5-m high reinforced earthen berm, specifically to reduce the likelihood of glide slab avalanches from reaching the highway and blocking the snow shed portal.

To assist in avalanche forecast decision-making, McElhanney investigated infrasound and Doppler radar technology. Infrasound arrays, which can detect the low-frequency soundwaves produced by avalanches, and

PHOTOS COURTESY MCELHANNEY

This RACS is solar-powered and its explosives are biodegradable.

Doppler radar systems, which can detect avalanches' motion, had been previously used in small-scale installations, but never on the scale necessary for Glacier National Park.

First, McElhanney collaborated with Montana State University (MSU) and industry partners to develop a single infrasound array pilot program, which Parks Canada Agency forecasters confirmed and assisted in control and closure decisions. McElhanney then managed the procurement and calibration of a network of 13 overlapping infrasound arrays, along with four Doppler radar systems, resulting in the largest avalanche detection network (ADN) of its kind anywhere in the world.

This ADN allows forecasters to receive real-time alerts of avalanche activity, which helps them assess avalanche hazard, time road closures and select targets during artillery control. The network has advanced the industry's use of this technology, by proving its capabilities at a scale and level of complexity never achieved before.

"A leading-edge showcase project that stands out for technical excellence and innovation." – Jury

A challenging environment

The sheer number of avalanche paths—135—that affect the roadway and railway through Glacier National Park makes it one of the most challenging transportation corridors in the world to implement and maintain an effective avalanche detection and mitigation program. The team's proposals had to optimize Parks Canada Agency's existing complex program, which involved numerous snow sheds, static defences and traffic ponding areas (*i.e.* to provide safe parking during avalanche control), separate highway and rail closure blocks and avalanche control using two mobile 105-mm Howitzer rifles firing at 270 targets from 16 overlapping gun positions.

The area is famous for its steep terrain and dense forests. The team's access to remote areas to conduct their work was an ongoing challenge. McElhanney engaged certified mountain guides to escort its designers into some of the most exposed sites and field staff was trained in rope access. Some sites had to be searched for unexploded howitzer shells before any ground disturbance could occur.

McElhanney's engineers relied on site reconnaissance and expertise with Light Detection and Ranging (LiDAR) mapping techniques and data during the design process. This was vital in anticipating and preventing measurement errors from the original assumed ground elevations. Construction costs remained within Parks

The 19.5-m high 'Mounds' berm reduces the likelihood of glide slab avalanches from reaching the highway and blocking the snow shed portal.

Nets were installed to prevent snow from releasing in start zones. This eliminated the need for avalanche control in these paths.

Canada Agency's expectations.

McElhanney completed more than 50 comprehensive site inspections during the design phase. The park's very short summer season and extreme weather, coupled with the project's timelines, meant there was no opportunity to recover delayed field work; the only option was to do it once and do it right.

Getting unstuck

'Revelstuck' is the favoured phrase among locals in the Rogers Pass area to describe avalanche-related closures on the highway, as these affect people trying to travel through nearby Revelstoke, B.C. While some of them joke about how being trapped in a beautiful alpine town is a blessing, the economic impact of avalanche-related closures is significant.

McElhanney's analysis concluded that approximately $24 billion worth of freight per year is transported along the highway between Alberta and British Columbia—and this does not include the value of freight passing via the railway, which also has a significant economic impact. Approximately $2.7 million worth of road freight passes through the avalanche corridor each hour. So, every minute of highway closure that can be prevented by the mitigation program represents a considerable economic benefit, while also making this vital link safer for everyone.

In addition to the freight-related benefits of the transportation corridor, it is important to recognize Glacier National Park attracts a large number of tourists to its pristine landscape and the Rogers Pass National Historic Site. They travel along the highway in private vehicles and tour buses and along the railway on-board the Rocky Mountaineer.

The area also attracts hikers, climbers, skiers and mountaineers, who all need a safe and reliable highway.

Protecting the environment

Glacier National Park was established in 1886 and is federally protected. McElhanney worked closely with Parks Canada Agency and various stakeholders to minimize visual impact and any potential disturbance to the natural landscape and wildlife throughout the corridor.

As such, McElhanney adopted the agency's mandate for sustainability when developing its avalanche mitigation measures. In turn, the agency's own environmental team developed environmental impact mitigations based on McElhanney's design. These were further refined through collaboration between the teams as the design was finalized and further considerations were incorporated into construction contracts.

By way of example, McElhanney managed the contracts of 13 RACSs, 13 infrasound arrays and four Doppler radar systems powered by 'green' sources, including methanol fuel cells and solar panels. Further, the explosives denotated with the RACSs are biodegradable, so no long-term waste is introduced into the remote, mountainous environment.

McElhanney's designs reused up to 200,000 m^3 of local materials—

such as landslide debris—as fill materials for the additional traffic ponding areas and the avalanche-stopping berm. The firm also oversaw the expansion of two major diversion berms at the Beaver River site to help protect the area from future landslide activity.

Glacier National Park is home to grizzly bears, wolverines, elk, owls and species-at-risk, such as caribou. McElhanney kept wildlife passages top-of-mind when developing systems. The snow nets, for example, feature regular openings to reduce intrusions into the natural routes along which wildlife may travel.

Saving time

Parks Canada Agency's objectives included improving highway safety, winter highway reliability and avalanche program efficiency.

To ensure all of these objectives were met, team members assessed, ranked and recommended specific mitigation options, before managing and undertaking planning, design, tender package preparation, construction supervision and contract management for the prioritized options.

The resulting suite of implemented solutions reduced the area's avalanche hazard index by an estimated 21%, the average annual winter Trans-Canada Highway closure time by approximately seven hours and the average annual mobilization time for avalanche control by an estimated 14 hours.

The RACSs installed near Glacier National Park's boundaries eliminated the need for artillery control in these areas, resulting in reductions to mobilization time and cost. (By way of explanation, these areas are now controlled with RACSs, concurrent to artillery control in other areas of the park.)

Further, the RACSs eliminated the need to close the highway to control some avalanches that only affect the railway, thus reducing overall closure time and the related impact on freight movement. The snow nets and stopping berm eliminate the need for avalanche control and cleanup within their paths. And finally, the ADN improves the timing and control of closures along the highway by increasing support for the forecasters' decision-making process. **CCE**

Trans-Canada Highway Avalanche Mitigation, Rogers Pass National Historic Site, B.C.

Award-winning firm (prime consultant): McElhanney, Calgary (Naginder Jabbal, P.Eng., C.Eng., PMP; Alvin Hemmingson, C. Tech, RSIS; Jaime Sanderson, EIT; Richard Singer, P.Eng., PMP; Scott McTavish, CET; Jenny Lines, P.Eng.).
Owner: Parks Canada Agency.
Other key players: Dynamic Avalanche Consulting (avalanche modelling and design).

Engineering A Better Canada Award and Award of Excellence

Curé-Paquin Primary School

gbi

Curé-Paquin is the first project in Quebec—and the first school in Canada—to earn the Canada Green Building Council's (CaGBC's) Zero Carbon Building (ZCB) Certification. Montreal-based gbi designed its mechanical and electrical systems for energy savings and comfort.

Energy-saving features

Curé-Paquin was built in Saint-Eustache, Que., to meet Leadership in Energy and Environmental Design (LEED) Gold standards. As such, it incorporates features to reduce energy consumption and environmental impact, including:

- A geothermal system for heating and air conditioning.
- An electric heat accumulator.
- Radiant flooring.
- Advanced building controls.
- An integrated LED lighting system controlled by proximity and natural light sensors.
- Roof-mounted solar panels.

In addition to energy efficiency, the school was designed to maximize comfort.

"This is really a project that speaks to sustainable development and what we expect buildings should be in the future." – Jury

Engineers at gbi worked closely with Montreal-based Leclerc Architectes to design the building envelope to minimize its energy consumption. No fossil fuels are used; all of the school's energy needs are met by electricity.

The site's 36 geothermal wells, each 300 feet deep, are coupled with an 80-kW energy storage accumulator. The wells meet all of the school's heating requirements, while the accumulator manages peak electricity consumption.

A very high-efficiency energy recovery system recaptures heat from exhaust air and uses it to preheat incoming fresh air. And the PV solar panels, with a capacity of 27 kW, meet 10% of the school's energy needs.

In addition to being highly efficient, a ZCB produces its own energy and/or uses carbon-free, renewable energy sources. For Curé-Paquin, the annual reduction in greenhouse gas (GHG) emissions is estimated at 2,800 t of CO_2. The

PHOTOS COURTESY GBI

roof-mounted solar panels produce 38,400 kWh per year, equivalent to the annual energy requirements of two single-family homes.

A complex goal

When CaGBC issued a call for proposals for ZCB pilot projects, gbi seized the opportunity to work with the Centre de services scolaire de la Seigneurie-des-Mille-Îles (CSSMI). The Curé-Paquin school was chosen as one of 16 Canadian projects that participated in the pilot program.

ZCB certification was still under development and unfamiliar to most of the Canadian industry. A project must meet all requirements of the thermal energy demand intensity (TEDI) program, for example, but this performance indicator was little-known in Quebec.

Close collaboration was needed between gbi and Leclerc Architectes to promote passive heating. After devising about 10 energy models, they achieved an energy consumption rate of 34 kWh/m^2.

As part of the effort toward a zero-carbon goal, gbi's engineers performed a life cycle analysis, calculating the amount of CO_2 emitted by the manufacturing, transformation and installation of construction materials. The team spent some 100 hours in research and development (R&D) to develop the calculations required to perform this analysis.

By specifying durable heating, ventilation and air conditioning (HVAC) systems, which should last between 30 and 50 years, gbi increased the life cycle compared to traditional systems that last around 20 years. Calculations show these same systems will substantially reduce the school's energy costs by an average of $45,000 per year.

Other environmental benefits

The engineers also opted for refrigerants with a low impact on the ozone layer and low GHG emissions, mercury-free lighting systems and low-flow toilets that reduce water consumption by 42%.

In the end, Curé-Paquin met CSSMI's budget and functional requirements. It also surpassed CaGBC's ZCB requirements to obtain LEED Gold certification.

The school will consume 60% less energy than a building designed according to theNational Energy Code of Canada for Buildings (NECB 2011). It is certainly the most energy-efficient building for CSSMI, which represents more than 100 schools. **CCE**

Curé-Paquin Primary School, Saint-Eustache, Que.

Award-winning firm (prime consultant): gbi, Montreal (Maxime Boisclair, P.Eng.; Pascale Lépine, P.Eng.; Guillaume Gigoux-Théorêt, P.Eng.; Minh Nguyen, P.Eng.; Jean-Michel St-Georges, P.Eng.; Mathieu Laflamme, P.Eng.; Antoine Fortier, P.Eng.; Geneviève Belleau, Tech.; Denis Lachance, Tech.; Sébastien Gravel, Tech.).

Owner: Centre de services scolaire de la Seigneurie-des-Mille-Îles.

Other key players: Leclerc Architectes, Construction SOCAM (general contractor), Sega Qc Electrique (electrical), Puits Bernier (geothermal), Regulvar (automatic controls), MC Ventilation (ventilation), Les gicleurs FF (fire protection), STR Mécanique (plumbing), Akonovia (enhanced commissioning).

Tree for Life Award and Award of Excellence

MacKimmie Tower Redevelopment

Entuitive

As part of its strategic vision for a carbon-neutral campus by 2050, the University of Calgary (U of C) commissioned a retrofit of the MacKimmie Tower—built in 1970—to transform it into a leading-edge, high-performance, net-zero carbon building.

The tower is now 85% more energy-efficient and is the first building in Alberta to be certified to the Canada Green Building Council's (CaGBC's) Zero Carbon Building (ZCB) Design Standard. It serves as a model of what can be done to existing, aging building stock. In fact, at press time, the 40,000-m² MacKimmie Tower is the largest net-zero carbon building project anywhere in Canada.

The retrofit, requested by Alberta's provincial government, has turned a 50-year-old library building into commercial space, where much of the university's administration now works in one centralized location, freeing up space in several other buildings for future research facilities or classrooms.

Efficient features

One point of interest is the double-skinned façade, which greatly improves thermal performance. It features active shading systems and fully automated operable windows, both at the inner and exterior glazing line (the automation can be overridden by individuals for comfort).

This system takes advantage of Calgary's extreme diurnal temperature fluctuations and performs nighttime flushes/purges after warmer days. It has also provided a comparably safer work environment during the COVID-19 pandemic, with a less risky fresh air distribution system compared to more traditional mechanical systems.

Immediately after the existing precast panels and asbestos were removed, the interior glazing line was installed, to ensure the building was enclosed as quickly as possible. This enabled work on the interior finishes to advance in parallel with the installation of the exterior glazing skin.

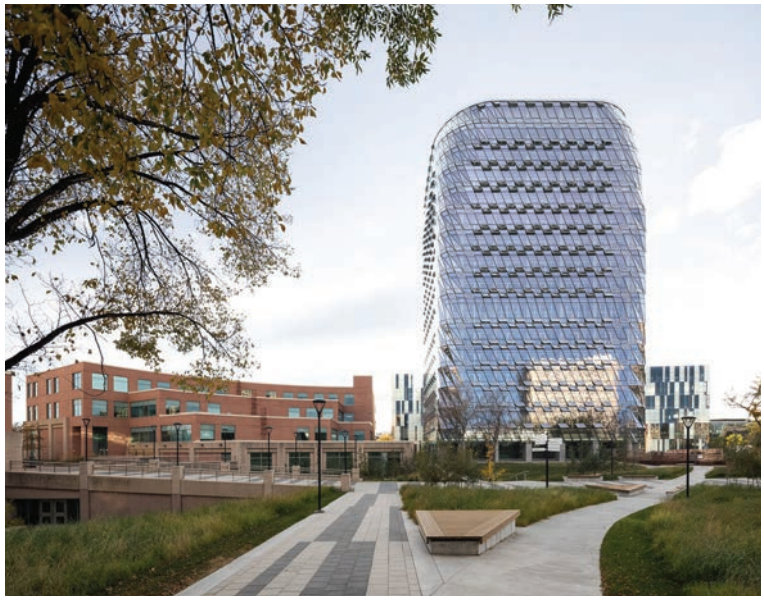


PHOTO COURTESY ENTUITIVE

The tower will be connected to the rest of the university by a series of outdoor spaces and promenades.

As a result, the trades were able to work on the interior and exterior façade in tandem, rapidly reducing the construction schedule. The university used a phased approach to gradually allow staff to move in and the building was half-occupied by U of C staff while exterior work continued.

Reuse of the 50-year-old structural skeleton was another opportunity for innovation. Removing the weight of the heavy precast cladding—and the library books—made it possible to add two more floors, taking the tower from a 12 to 14 storeys. More efficient elevators were installed in the existing shafts, allowing the

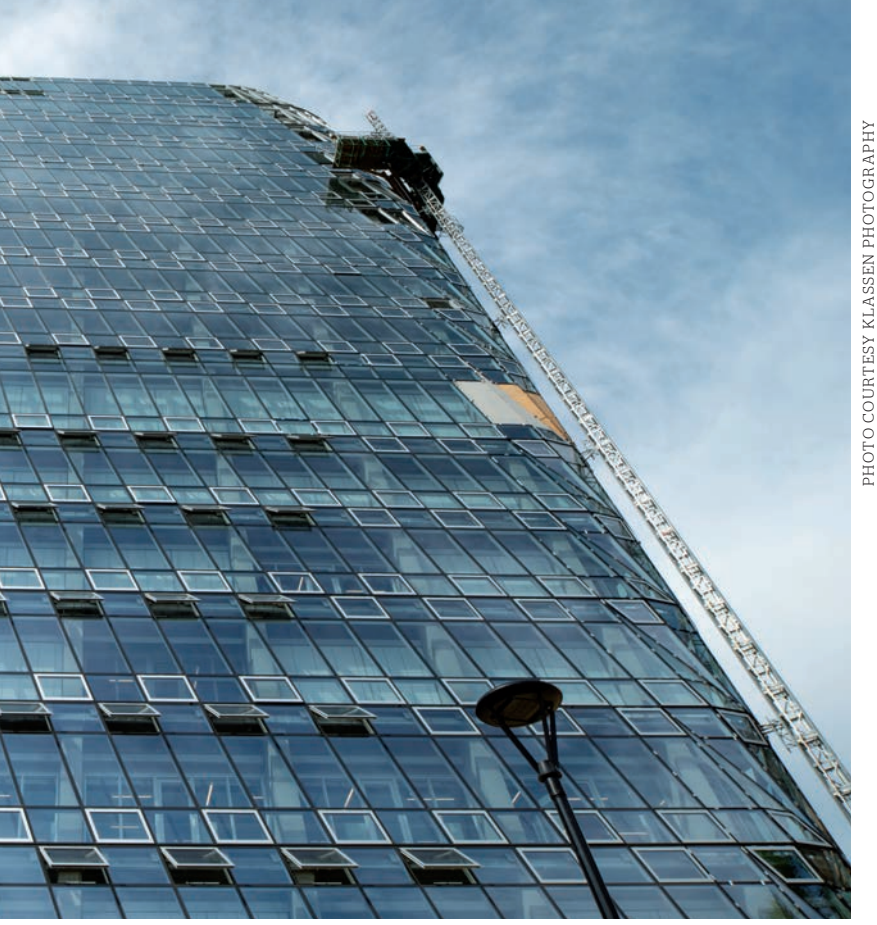


PHOTO COURTESY KLASSEN PHOTOGRAPHY

Two storeys were added to the existing structure.

design team to reduce the elevator count by one, freeing up a shaft for natural stack effect ventilation.

With more efficient mechanical systems and natural ventilation, 80% of the existing mechanical floor on the seventh level was freed up, allowing for common boardrooms with tall ceilings at 16 ft clear, which added the equivalent of yet another floor.

Passive design controls were also used to achieve net-zero while minimizing energy use and optimizing interior comfort. Other sustainable features include active and passive natural ventilation, high thermal mass construction, daylighting, connections with the university's district energy systems and renewable energy generation, as photovoltaic (PV) solar panels will be installed at roof level and PV glazing will be integrated within the façade's glazing at locations with maximum sun exposure.

Rethinking the structure

An extensive study was conducted to determine how best to add two new floors without any modifications to the existing columns and lateral load resisting shear wall system. The study found removing the heavy library loads, using live load reduction allowed by the current code and removing the heavy precast panels could accomplish this.

Not only did the extra floors add space, but they also aided in creating the tower's new esthetic, with its distinctive curved and faceted façade. Many passersby assume a completely new tower was constructed, not realizing it is an existing building that was reclad!

Eight two-storey columns added at the corners were sloped about a vertical axis to provide a wider curvature of the glass. This assisted with the crowning of the building.

The existing concrete waffle slab posed challenges to route new mechanical, electrical and data systems within the structural floor depth. Placing the slab underneath would have resulted in undesirable finishes and would not have maximized the thermal mass properties of concrete.

The solution was to add a raised access floor at every level to integrate electrical, mechanical and sprinklers within the interstitial space, to expose the existing concrete waffle slab and enable its inherent thermal mass properties to facilitate more efficient heating and cooling. Each floor serves the space below it.

PHOTO COURTESY KLASSEN PHOTOGRAPHY

The university used a phased approach to gradually allow staff to move in while exterior work continued.

"This is the largest net-zero carbon building in Canada—and it is incredibly difficult to get to net-zero in an existing build." – Jury

The bigger picture

The MacKimmie Tower is part of a larger redevelopment, which will also include the construction of a new building with the same double-skinned façade and energy-efficient mechanical systems. The tower will be connected to the rest of the university by a series of outdoor spaces and promenades, providing places to congregate.

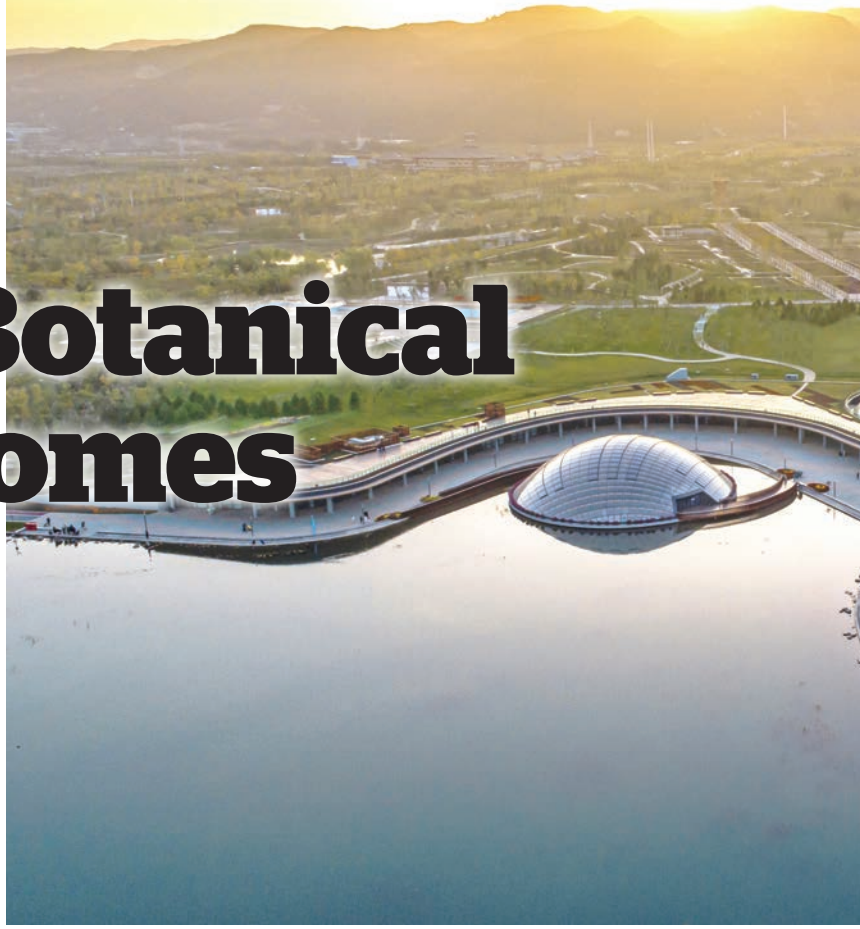
When the entire project is completed, it will offer benefits for students, faculty and staff alike, as well set a new standard for the city of Calgary, Alberta Infrastructure and other post-secondary institutions, as they come to understand the long-term cost savings that larger upfront capital investments in sustainable refurbishments can provide. **CCE**

University of Calgary MacKimmie Tower Redevelopment, Calgary, Alta.

Award-winning firm (structural engineering consultant): Entuitive, Calgary (Ian Washbrook, P.Eng; Brock Schroeder, P.Eng.; Zia Khan, M.Tech, P.Eng.; Kristofer Dahl, EIT; Brock Schroeder, P. Eng.; Blaine Jansen, C.Tech.).
Owner: University of Calgary
Other key players: DIALOG (client, architect, mechanical, landscape), Stuart Olson (construction manager), DukeEvans (project manager), SMP (electrical), Urban Systems (civil), Tetra Tech (geotechnical), TransSolar Energietechnik (energy modelling).

Ambassador Award and Award of Excellence

Taiyuan Botanical Garden Domes



StructureCraft

The city of Taiyuan wanted to create a world-class botanical garden under three long-span gridshell domes. Rather than steel, the domes would be constructed using wood, a more sustainable and esthetically pleasing material.

Canadian firm StructureCraft supplied structural engineering for a unique paraboloid scheme. With the largest dome at 88 m, it stands as the longest clear-span, non-triangulated timber gridshell in the world.

Complex geometry

The site features three paraboloid domes, ranging from 43 to 88 m in diameter and 12 to 30 m in height. The gridshells comprise light, doubly curved glulam beams, arranged in two or three crossing layers. Timber was chosen due to its adaptability to the project's geometric demands, as well as its inherent fire resistance, structural flexibility, natural esthetic and environmental sustainability.

Working with Austria's Delugan Meissl Associated Architects (DMAA), StructureCraft's engineers developed an optimized geometry while considering daylighting, structural performance, shipping, fabrication and preassembly, all of which were meticulously described with digital files and kit-of-parts erection and sequencing drawings for site crews.

Domes are usually constructed for efficiency using triangulation in their surface. For architectural and sunshading reasons, this project's architect and client wished to create a more tightly spaced grid on one side and more open fan on the other. This resulted in a 'seashell' shape, with each glulam member unique and many of them doubly curved.

Further, domes are usually spherical, leading to more repetitive patterns in their surface. The client and architect were insistent on a unique paraboloid, if it could be built economically and its structural efficiency could be enhanced, given its less stable, non-triangulated surface.

The glulam lattice panels were prefabricated with half-lap scarf joints.

One part of the solution was a geodesic design. Custom scripts were written in the latest computational geometry software to optimize the precise shape of the paraboloid. This would minimize waste in the doubly curved glulam pieces, while ensuring structural efficiency.

To prevent buckling resulting from the non-triangulated surface, a light grid of cable diagonal bracing was engineered and installed below the gridshell surface.

Of course, the structure needed to be constructible. Building piece-by-piece up to 30 m in the air, expecting it all to fit with structural forces properly transferred, would be impossible. The solution lay in precisely prefabricating a pattern of roughly 10 x 12-m modules that could be placed on shoring towers and stitched together using simple, custom-designed scarf joints.

PHOTOS COURTESY STRUCTURECRAFT.

Given the parabolic shape, each beam has a variable radius in the strong axis, with double curvature adding a sweep in the weak axis direction.

Problem-solving

Gridshells are not new, but traditionally, a non-triangulated gridshell would be constructed by fitting wooden laths together on-site. This was extremely labour-intensive and not very precise, but it was the only practical way to address the geometrical complexity.

With this project, the complex geometry was solved in advance. Each unique piece was prefabricated with confidence it would fit on-site. The software rationalized the two-way curvature necessary in each piece, minimizing computer numerical control (CNC) cutting time and the volume of waste.

A major challenge lay in how to tension the cable net, given it had to connect numerous nodes in a two-way pattern. Single adjustable pieces between nodes would have been prohibitively expensive and labour-intensive. And with long lengths of cable continuous through the nodes, tensioning at the extreme ends would be impossible, due to friction at each node.

The problem was neatly solved by devising a special casting for each node, with separate pieces joined with an adjusting bolt which could essentially 'pull' tension into the cable.

"A beautiful and technically difficult structure that pushed the envelope with a very large span of timber, high quality control and leading-edge fabrication." – Jury

An international effort

Specialized engineering and construction planning were performed in Canada. The timber was sourced from Europe, while the steel castings and cables were sourced locally in China.

Construction techniques were developed with local labour in mind. Only a few StructureCraft engineers and project managers were present on-site to oversee construction, passing skills along to more than 100 local carpenters. Some of these construction methods led to a much more safety-conscious site, reflected also in longer-term training.

A dramatic journey

StructureCraft first met with the Taiyuan government in 2017 to answer questions about the use of timber for the botanical garden project, part of a broader 'greening' plan for the industrial city. At that point, the architect had designed the concept, but did not know if it could be engineered and built, so the Canadian engineers needed to show the material could be used in unique, long-span structures.

Thus began a journey that involved not only deep engineering and computational geometry explorations, but also much drama, including wavering political support, unfamiliar general contractors and local design institutes (LDIs) that needed convincing about unique timber structures. The architect was only engaged for the concept and relied on StructureCraft to ensure this concept was turned into reality.

While much fortitude and persuasion were required along the way, the formation of relationships and building of trust, based on the communication of sound engineering principles, finally led to warm acceptance on everyone's part. The result is a unique series of long-span timber structures, created through co-operation of team members on three different continents, delivering on Taiyuan's desire for a world-class attraction. **CCE**

Taiyuan Botanical Garden Domes, Taiyuan City, China.

Award-winning firm (structural engineer, erection engineer, construction manager): StructureCraft, Abbotsford, B.C. (Gerald Epp Sr., P.Eng.; Lucas Epp, P.Eng.; Brandon Sullivan, PE).
Owner: Taiyuan Botanical Garden
Other key players: Delugan Meissl Associated Architects (design architect), Greenland Construction (general contractor), SKF Construction (timber contractor), Institute of Shanghai Architectural Design & Research (local design institute).

Award of Excellence

CIBC Square at 81 Bay Street

RJC Engineers

CIBC Square at 81 Bay Street is a commercial office development in downtown Toronto's financial district, just north of the Gardiner Expressway and adjacent to Union Station, the Path and Scotiabank Arena. With its many connections, it is one of the most complex and advanced towers ever constructed in Canada.

Rising 54 storeys, it offers 1.5 million sf for office space, restaurants, retail stores, a terraced park platform and a new GO bus terminal. RJC Engineers provided structural engineering, along with CSA S413 waterproofing consulting for vehicular traffic surfaces, for this complex development.

Working within constraints

The tower features unique floor plates to support its folded glazed façade, sloped building columns, a reinforced concrete core and a structural steel floor slab system. All floors are identical, except for varying edges to support the unique architectural appearance. Large corner cantilevers in the range of 4.5 m, which meet the architectural form, were checked by RJC for vibration with time-history analysis.

Slender, 24-m tall columns in the main lobby, supporting the whole tower and bracing a 24-m cable wall, were made of 700 x 750-mm solid structural steel square sections. Many of these highly loaded structural steel columns were tilted to avoid the architectural services below.

"A huge building in a very tight space, over one of the busiest travel hubs in Canada. Not an easy site to work on." - Jury

A seven-storey podium implements an intricate stacked-occupancy scheme, including securities trading floors, amenity spaces (restaurants, retail, conference facilities) and a mechanical and electrical level just above the new two-level bus terminal. The geometric constraints required creative designs using structural steel beams and full-height transfer trusses, reinforced concrete and post-tensioned concrete systems. The tower and podium were structurally hardened beyond CSA standards.

A 900-mm deep post-tensioned slab supports the upper bus level and spans 24 m over the lower bus level. The shallow depth of this slab was critical in accommodating appropriate floor elevations dictated by path access and bus ramp slope criteria.

The 1.5-acre elevated park connects the development to the north side of the rail land, creating a new public realm and setting a new precedent for future developments over the 16-track rail corridor. Its geometry required long-span steel trusses for strategically located columns for future train tracks. All tracks were opened during construction, which made field operations complex.

Another key element is the 40-m long Bay Street Bridge, with a full-height glass wall on the south side (no structure), spanning Bay Street. The 'open C channel' structure required complex analytical modelling to optimize stresses for a cost-effective design that carefully considered accelerations due to walking vibrations.

Excavation and construction of a

PHOTO COURTESY RJC ENGINEERS.

three-level underground parking garage and the base of the structure came with considerable challenges along the north property line, which required a contiguous caisson wall transitioning into a reinforced concrete crash wall above the rail corridor and supporting the skypark. The hybrid crash wall, integrating shoring and structural systems, was designed to American Railway Engineering and Maintenance-of-Way Association (AREMA) standards to sustain impact forces from train derailment. This design required a permanent rock anchor system to ensure durability over the building's life cycle.

Coping with change

RJC Engineers met and exceeded the client's goals and expectations in delivering a complicated structure in an efficient and cost-effective manner—and had to prepare a complete set of tender documents for a spec building without a tenant.

During construction, CIBC became a tenant, which led to significant reworking to tailor the building to the bank's needs. RJC had to prioritize and schedule the redesign work in co-operation with its clients and their subconsultants to prevent on-site stoppage.

Indeed, timely focus on site issues and changes was crucial for overall project success. In another example, due to the need for heavy equipment and the presence of critical underground infrastructure, the Bay Street Bridge could only be craned from the Bay Street Viaduct at rail level. RJC successfully conducted a condition assessment and proved to transit agency Metrolinx that this 100-year-old viaduct could support the loads and deflections could be monitored, all on the busiest sections of track anywhere in Canada. **CCE**

The 24-m tall steel columns in the main lobby support the tower and brace a cable wall.

PHOTO COURTESY ELLISDON CONSTRUCTION.

CIBC Square at 81 Bay Street, Toronto, Ont.

Award-winning firm (structural engineer): RJC Engineers, Toronto. (Tibor Kokai, P.Eng.; Benoit Boulanger, P.Eng.; David Ruggiero, P.Eng.; Andrew Voth, P.Eng.; Joseph Dukovcic, P.Eng.; Tom Kasparik, P.Eng.; Craig Dunham, P.Eng.; Brian Couture; Bob Dziegielewski; Kelly Jimmo.)

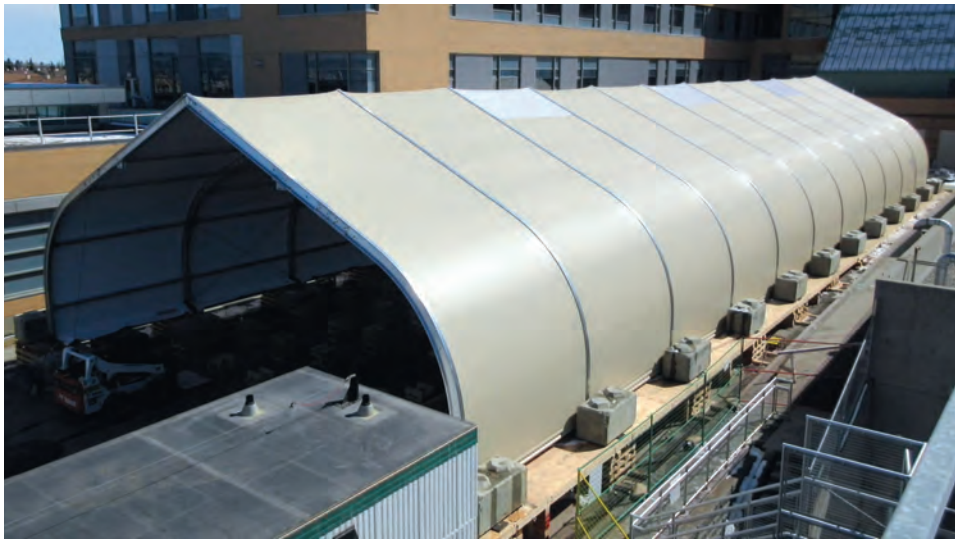
Owner: Hines and Ivanhoé Cambridge.

Other key players: EllisDon Construction (builder), WilkinsonEyre Architects (design architect), Adamson Associates Architects (production architect and architect of record), The Mitchell Partnership (mechanical), Mulvey and Banani International (electrical), WSP Canada (geotechnical), Walters Group (structural steel supply and installation).

Award of Excellence

Peter Lougheed Centre Temporary COVID-19 Treatment Facility

Stantec



In March 2020, Calgary accounted for 63% of Alberta's confirmed cases of COVID-19. Stantec, Alberta Health Services (AHS), Sprung Structures, Faulkbuilt and CANA Construction worked together to build a temporary treatment facility at the Peter Lougheed Centre (PLC) to accommodate the predicted pandemic peak in May 2020.

Communication and co-ordination between all disciplines, physicians and nurses were critical. The more than 750-m² pandemic response unit (PRU) was designed and entirely constructed in less than three weeks, providing an additional 70 treatment spaces for patients.

This project was a first for Stantec, AHS and the provincial government, due to its urgency. While it is a temporary structure, it operates much like a fully functioning hospital. And unlike other alternate care facilities (ACFs) built in convention centres during this pandemic, which only provide bed space, this project provided a fully functioning hospital unit, including medical gases, proper air exchange rates, nurse call and a direct connection to PLC's emergency department.

"The team was able to rise to the occasion under difficult circumstances and a very short timeline." - Jury

Those building the structure wore N95 respiratory masks at all times and maintained physical distancing whenever possible.

Responding to immediate needs

Stantec designed the ventilation system with airborne transmission of COVID-19 in mind, configuring the airflow to travel from clean to dirty, with fresh air supplied near health-care workers and exhaust grilles near patients. The system was configured as a 100% outside-air system, with no recirculation, and used an upblast exhaust fan and high-plume stack to prevent entrapment of gases in the building.

The facility was designed to limit the spread of the virus within the hospital and to the surrounding community. Although physically connected to the main hospital, the

PHOTOS COURTESY STANTEC.

PRU was negatively pressurized to prevent contaminated airflow from entering that structure.

Government predictive modelling projected the first wave would peak and then begin declining within three months, so the building was intended for very short-term use, but it could be easily winterized with insulation and heat tracing of all drains and water lines susceptible to freezing and air handling units with sufficient heat to operate in the winter.

As the pandemic proceeded and the facility was in fact required during the following winter, the structure was retrofitted with insulation to complete the winterization process.

Pandemic challenges

By April 2020, the entire province was in lockdown, with everything except essential services shut down. Nearly all construction projects were affected, with many put on hold.

Safe work protocols were still in development. Nobody knew which type of mask would best protect those physically involved in the project. There was a shortage of medical-grade N95 masks, but fabric masks could not be purchased in bulk. The decision was made for those building the structure to wear N95 respiratory masks (as used in dusty conditions) at all times and to maintain physical distancing whenever possible.

The project also ran into material supply challenges. Where possible, Stantec worked closely with contractors and suppliers to specify materials that were already in stock locally. Fortunately, all of these entities expedited their work to meet schedules. A local air handling unit manufacturer, for example, emptied its production line and was able to supply units in eight days, much faster than the typical 16 weeks.

Future use

The main benefit of a temporary facility such as this is it can be reused or repurposed for a variety of circumstances.

In the future, for example, PLC will renovate its emergency department. Stantec designed the temporary facility to be attached to this department for convenience of treatment, but also because it can be used as a decanting space when the renovations are underway.

After the facility is eventually dismantled, it can be redeployed at other AHS sites as decanting spaces or emergency shelters. Many components were specified for flexibility and reuse, including the air handling units, medical gas alarm systems and outlets, lights, medical equipment and movable partitions. **CCE**

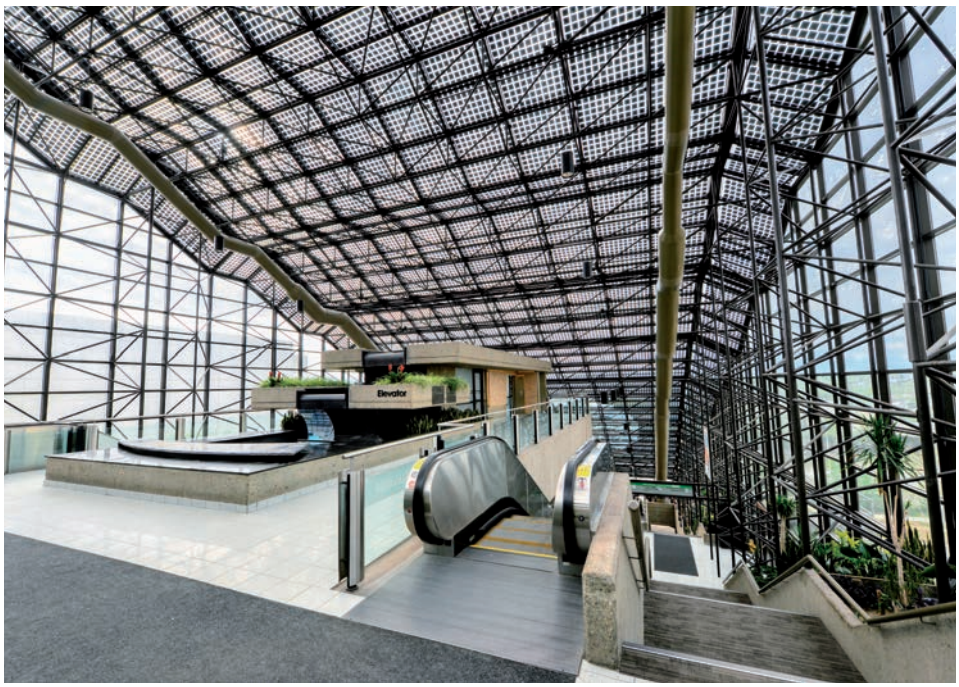
Peter Lougheed Centre Temporary Covid-19 Treatment Facility, Calgary, Alta.

Award-winning firm (prime consultant, structural engineer, mechanical engineer, electrical engineer): Stantec, Calgary (Jeff Rent, P.Eng.; Rory Smith, P.Eng.; Ronald Bonnett, C.E.T.).
Owner: Alberta Health Services.
Other key players: Stantec Architecture (architect), CANA Construction (contractor), Sprung Structures (fabricator).

Award of Excellence

Edmonton Convention Centre Atrium Renovation

DIALOG



The revitalization of the Edmonton Convention Centre's (ECC's) multi-level atrium along the slope of the river valley was an opportunity to do more than just replace its 35-year-old glazing. DIALOG added a higher-performance building envelope, modern lighting and electrical systems, structural upgrades and Canada's largest building-integrated photovoltaic (PV) system. The renovation allows the ECC to showcase its ambitious sustainability goals, while also helping to achieve them.

Harnessing the energy of the sun

The installation of the solar PV system is the most visible and ambitious update. As the 35-year-old glazing was leaking and had poor thermal performance, given the atrium's expansive area and southern exposure, there was an opportunity to integrate solar PV glass. Insulated glazing units (IGUs) were manufactured, with monocrystalline cells sandwiched between the panes, custom-sized to fit within the existing framing system.

The 170-kW solar PV system uses a string inverter topology. Instead of hiding the inverters, they are prominently mounted in plain sight among the atrium's indoor foliage.

"A great example of what's possible in terms of bringing existing buildings into the future." - Jury

This location showcases the components necessary to harness energy from the sun and provides an educational opportunity for visitors.

The selection of the glazing was an intensive, iterative process that included six different options. There were many factors to be considered, including U-value, visual transmittance, shading co-efficient, colour and system weight.

The overall cooling load for the space had to be equal to or lower than the existing load, so as to avoid costly mechanical system upgrades. Another significant factor was retaining enough light quality for the atrium's plant collection; this required a full daylight illuminance study. The process led to the selection of a double-paned assembly, since triple glazing could not be structurally supported.

Due to the new glazing's reduced heat loss, a study of the anticipated snow loading was commissioned. The study considered building massing effects, prevalent wind direction, snow melt through the roof and current climatic data to determine if any reduction in snow loading was permitted below the values prescribed by the codes.

A structural analysis model was developed to assess the effects of the increased loading on the atrium space frame. This included analysis of both the existing frame and the

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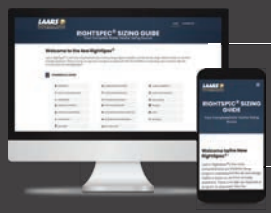

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The ECC atrium follows the slope of the river valley. The south-facing roof provides a strong opportunity to harness energy from the sun.

The renovation strengthened the existing structure and integrated it with a new electrical system.

steel 'jacketing' designed to reinforce the existing structure. The jacketing, placed around the round, hollow steel truss section, was carefully detailed to tie in neatly with the existing structure.

The wireway design for the DC cabling that connects each PV panel into the electrical distribution network was carefully co-ordinated with the glazing structure. Electrical inspectors were consulted early in the design phase to determine the safest way to run the high-voltage cabling through the glazing system and the structure.

Enhanced safety measures were taken, such as arc-fault protection, ground-fault protection, additional bonding and grommeted wireways. These measures will mitigate the risk of electrifying the glazing frame in the event of a fault.

Advancing sustainability

As for lighting, antiquated 400-W high-pressure sodium fixtures were replaced with efficient LED downlights. These fixtures are located above escalators and stairs, making maintenance access difficult, so the new lights use remote driver systems, allowing for maintenance from ground level.

The renovated building envelope's performance was analyzed with respect to energy, water management and thermal comfort. An early-stage energy model helped evaluate the impact of various glazing options, the value of embodied energy in the original aluminum frame and net greenhouse gas (GHG) reductions.

In addition, the existing natural ventilation operable windows were refurbished with modern, remote power operators, allowing the building's operators to more easily bring in fresh air.

Balancing energy and economics

Following the renovation, the ECC benefits from lower operating costs, due to the high-performance envelope and active electricity generation. It is estimated the envelope upgrades alone reduce its heating and cooling costs by about 10%.

The atrium is brighter than ever. The older glazing was significantly tinted to reduce heat gains, with a visible light transmittance of only 18%, whereas the new glazing can selectively control the infrared (IR) spectrum without dark tinting. The new glazing units bring the visible light transmittance up to 25%, even with opaque PV cells covering approximately half of their surface.

Operationally, the solar PV array generates approximately 200 MW-hours of electricity per year, reducing annual costs by approximately $20,000. When that is combined with the improved thermal performance of the envelope and the efficiency of the LED lighting, the overall renovation is expected to reduce the ECC's overall energy consumption by 20%.

"Not only does the installation help position Edmonton as an attractive destination for sustainable events," says Melissa Radu, ECC sustainability manager, "but it has also encouraged us, our clients and our guests to set loftier goals to support the future of our environment." **CCE**

Edmonton Convention Centre Atrium Renovation, Edmonton, Alta.

Award-winning firm (prime consultant, structural engineer, mechanical engineer, electrical engineer, architect): DIALOG, Edmonton (Blair Bisson, P.Eng.; Josh Bornia, P.Eng.; Donna Clare, Arch.; Greg Freer, Arch.; Chris Idenouye; Grant Kidd, P.Eng.; Justin Phill, P.Eng.; Ed Pon, P.Eng.; Rob Swart, Arch.).

Owner: City of Edmonton.

Other key players: Howell-Mayhew Engineering (solar PV engineer), Morrison Hershfield (building science engineer), Bird Construction (construction manager), Kuby Renewable Energy (solar PV installer), Flynn (glazing installer), River City Electric (electrical contractor).

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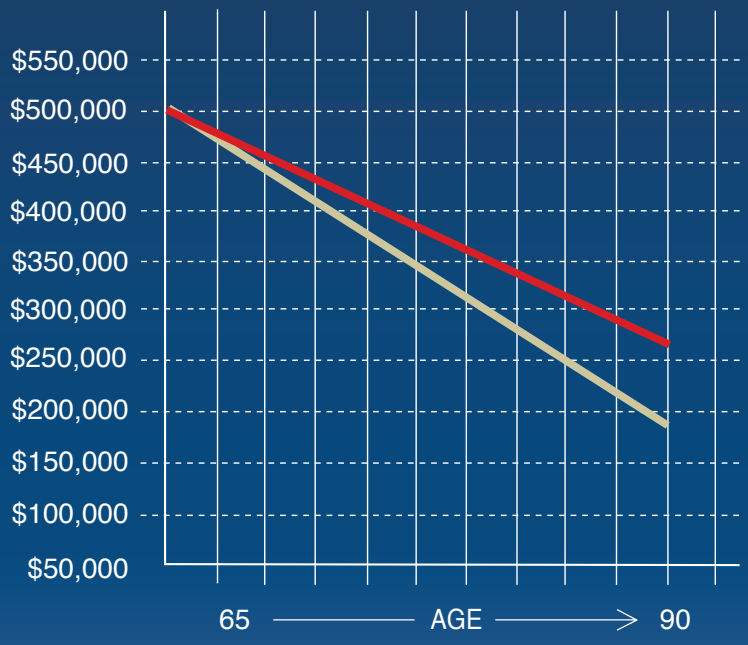

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Award of Excellence

Hôpital Maisonneuve-Rosemont Modular Complex

WSP Canada

When the COVID-19 pandemic was declared in early 2020, the government of Quebec declared a state of emergency and activated preventive measures. As part of this response, Montreal's Hôpital Maisonneuve-Rosemont (HMR) requested a modular complex to be built rapidly, so it could accommodate the increased patient load, but could also be used to accommodate the longer-term needs of the hospital's oncology program, serving cancer patients.

HMR engaged WSP Canada, alongside architectural partner Architecture49, to provide all mechanical, electrical, telecommunications, structural and civil engineering services for the project. WSP also provided environmental, geotechnical, surveying and laboratory studies and commissioned the project on time, in a fast-paced environment.

A non-traditional approach

To meet an aggressive timeline and increased demand for rooms due to the pandemic, the project was designed to accommodate a modular construction process. Energy-efficient mechanical and electrical systems were designed and specified to accommodate 'plug and play' modules that were shipped to the HMR site from an off-site construction facility. MECART, the modular constructor, was engaged throughout the design process to help streamline it.

The engineering systems were designed to accommodate HMR's specific health-care needs, the modular construction techniques and a clinical change of use following the pandemic. So, they were not typical of traditional health-care facility design.

For the patient rooms, for example, mechanical systems and controls designed to provide negative pressure during COVID-19 can be switched to positive pressure in the future for immune-compromised cancer patients, with minimal intervention. Detachable wall panels allow the facility's wall-mounted electrical and communication services to be easily reconfigured with changes in patient care.

"It stands out as an example of thinking about long-term uses, not just short-term benefits."- Jury

High-efficiency particulate air (HEPA) filters were installed in the ventilation systems. Full redundancy for heating, ventilation and air conditioning (HVAC) and electrical power was provided by an emergency backup generator and distribution system for power interruption events. Corrosion-resistant flooring was specified for ease of maintenance.

Setting a precedent

The successful design and construction of the two-storey HMR modular complex has helped set a precedent for rapid construction to support future crisis-management strategies. The project is now a model for other hospitals. And once the COVID-19 crisis has passed, its 36 patient rooms will be repurposed to fit the needs of the hospital for at least another decade. **CCE**

Hôpital Maisonneuve-Rosemont Modular Complex, Montreal, Que.

Award-winning firm (prime consultant, quantity surveying, land surveying, urban planning, lab services, commissioning, architecture, building science and geotechnical, civil, structural, mechanical, electrical and telecommunication engineering): WSP Canada, Montreal (Louis Boissonneault, ing.; Benoit Lemire, ing.; Pierre Rodrigue, ing.; Joël Boudreau, Tech.; François Patry, ing.; Martin Villemure, ing.; Stéphane Éthier, ing.; Mario Bouchard, ing.; Catherine Jolin-Duhamel, ing.; Juan Gamarra, Arch.).
Owner: Centre intégré universitaire de santé et de services sociaux de l'Est-de-l'Île-de-Montréal (CIUSSS-EMTL).
Other key players: Société Québécoise des infrastructures (SQI) (client), Architecture49 (architect), Mecart (modular rooms), Pomerleau (construction manager), Consultants Expertise en Ascenseurs (CEA) (elevators).

PHOTO COURTESY WSP CANADA.


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Award of Excellence

Hot Pipeline Condition Assessment Study

CIMA+

The Greater Toronto Airports Authority (GTAA) owns and operates hot-water closed-loop pipeline network, with carbon steel pipes operating at high temperatures to ensure continuity for Toronto Pearson International Airport. The GTAA engaged CIMA+ to develop a conditional assessment for these pipelines, based on its own inspection standards, and thus avoid unnecessary shutdowns and/or using invasive tools.

Based on the findings of CIMA+'s study, this year the GTAA has completed an inspection of the entire population of hot-water pipes at Canada's largest airport, while they are in service and fully operational.

Environmental significance

Hot water systems convey not only water, but also chemicals designed to allow the water to run at high temperatures and to provide a corrosion barrier for the internal surface of the pipeline.

The water is in a closed-loop pipe system; any drainage is conducted within that system, using storage in boilers. So, any unexpected failures and main breaks would lead to hot water spills that could present a health and safety hazard, due to high temperatures and the chemicals that could reach major watercourses and/or combined sewer systems around the airport.

"The acoustic monitoring technique they used to assess the wall of the pipes was ingenious. They adapted geophysics to something that's not in the ground, which is quite unusual." - Jury

The spilled water could eventually reach treatment plants and cause significant issues to the treatment process, due to the highly concentrated chemicals in the water.

A novel approach to acoustics

GTAA needed to develop an assessment method for challenging pipeline systems where the carrier is inside a conduct, given the limitations and constraints resulting from system operating conditions (*i.e.* high temperatures) and their limited tolerance for inspection risks, with preference given to external, non-invasive tools.

Acoustics is a well-known technology for inspecting potable watermains and buried pipelines, but it is limited to those installed in a compacted backfill, not in a void like GTAA's hot pipeline setup. When an acoustic stress wave is introduced on a pipe's external wall surface (*i.e.* by tapping with a rubber hammer on the external surface), it will vibrate at a macroscopic level, causing radial displacements that affect the sound wave velocity inside the hot water body. When a pipe is not compacted in backfill, the boundary conditions for equilibrium are not

PHOTOS COURTESY CIMA+.

the pipe wall, but rather the void surrounding the carrier pipe.

To address this issue, CIMA+ chose to introduce the acoustic sound wave in two forms simultaneously. The first form introduces the sound wave outside the pipe, similar to regular acoustic technology, but using a constant frequency of tapping on the pipe's external wall surface.

The second form uses a high-amplitude sonar wave to measure deformations from inside the pipe.

With these two waves, acoustic measurements can be compared to a point where the frequencies correlate, providing a conclusive result for wave velocity. Once the velocity is determined, the pipe's remaining wall thickness can also be calculated, using a transient wave velocity formula.

This concept enabled the use of modified acoustic technology to assess the hot-water pipes while they were in-service, with no operational changes. And when the system is offline in the summer, GTAA can address repairs and replacement needs identified during an assessment that was conducted at the beginning of the year. Indeed, the study allowed the client to develop a seasonal maintenance cycle of assessment and renewal (as needed) during each year, increasing the reliability of its hot water pipeline system.

A multi-stage plan

The project presented two major challenges: (a) securing funds to conduct a trial and validation of the proposed idea and (b) turning the idea of constant external noise into reality by building a sensor.

To address these challenges, CIMA+ developed a multi-stage plan. The first step included a presentation of the proposed acoustic modification, supported by simulation modelling and a detailed budget, to get GTAA's buy-in.

Once that budget was approved, the second step was to engage an acoustic technology vendor to design and build the equipment. The proposed solution was a 'shaker' sensor that would vibrate at a wide range of frequencies that could correlate with sonar waves introduced inside the pipes.

The third stage included choosing a 'testbed' pipe and performing actual field measurements, using the newly developed tools. Once results were provided with a range of accuracy, the fourth and last step was to validate the results and their accuracy by collecting a sample of the inspected pipe and conducting pit depth measurements at a third-party specialized lab.

The results came back with an average of 6% accuracy, exceeding the original expectation of 10%—and this could be increased by assessing the air inside the pipe, since trapped air inside a water body impacts the wave velocity being measured. **CCE**

GTAA needed a way to inspect the entire population of hot-water pipes at Canada's largest airport, while they are in service and fully operational.

Hot Pipeline Condition Assessment Study, Mississauga, Ont.
Award-winning firm (prime consultant): CIMA+, Mississauga, Ont. (Rabia Mady, P.Eng.).
Owner: Greater Toronto Airports Authority (GTAA).
Other key players: Kenaidan Contracting.

Award of Excellence

Clayton Community Centre

RJC Engineers

Clayton Community Centre is a 78,000-sf, two-storey building that provides a gathering place and social hub for the fast-growing community of Clayton Heights in Surrey, B.C. The centre combines various services under one roof, such as a library branch, gymnasium, fitness centre, child care and art spaces.

A new iteration of ancient technology

The project team had a strong desire to use wood as a primary material, but the required spans and architectural intent led RJC Engineers to develop the concept of a two-way wood system, composed of three-member reciprocating wood modules that are repeated and expanded to create a complete roof system.

Connecting discrete wood members with shear connections in such a way is not new; this technology was implemented in ancient China, using members with limited length to build structures with significant span. This general idea was modified and built upon to arrive at the two-way interlocking system.

The basic module comprises three wood members placed in three different directions, creating a minimalistic pinwheel element. The triangular form can engage neighbouring, identical pinwheel elements, interlocking and combining to form a genuine two-way system. The advantages are similar to those of concrete flat plate construction.

The form of the two-way system posed many technical challenges. The architectural vision led to a system where all wood members are of the same width and depth. To improve the system's efficiency, key members were reinforced for moment and/or shear to minimize the overall system's typical member size.

The member reinforcing was achieved with a combination of diagonally installed self-tapping wood screws and steel plates. This type of reinforcement for glulam members is not codified in Canada, so reinforced beams were proof-tested at the University of British Columbia (UBC).

The two-way system's reciprocating nature led the team to investigate system redundancy and measures to carefully prevent progressive collapse. The solution included the introduction of continuous steel 'integrity plates,' strapped to the top of the structure and spanning to critical lines of support.

Construction-wise, there were several challenges in implementing the pinwheel system on a large scale. The engineering team worked closely with supplier Western Archrib and erector Seagate Structures to develop feasible and cost-effective methods. The system's reciprocating nature meant temporary shoring of at least the leading edge of the erected structure was needed.

A platform was created adjacent to the building, where three-member pinwheel modules were prefabricated on the ground, labelled and stacked. A crane then lifted the modules into place.

"A clever use of wood modules for an efficient structural system."
- Jury

Targeting PH certification

Targeting Passive House (PH) certification provided a guide early on for the centre's design and layout, including building massing, materials selection, consideration of solar orientation and shading and attention to key details. At press time, Clayton Community Centre is on track to be the first community centre to be PH certified in North America—and Canada's largest PH facility to date. **CCE**

Clayton Community Centre, Surrey, B.C.

Award-winning firm (structural engineer): RJC Engineers, Vancouver, B.C. (C.C. Yao, Ph.D., P.Eng.; Meredith Anderson, P.Eng.; Tom Tong, P.Eng.; Robert Koller).
Owner: City of Surrey.
Other key players: HCMA Architecture + Design (client, architect), EllisDon (contractor), Integral (mechanical), AES Engineering (electrical), GHL Consultants (code), Aplin Martin (civil), Morrison Hershfield (building enclosure), Hapa Collaborative (landscape architect), EnerSys Analytics (energy modelling).

PHOTO BY MICHAEL SHERMAN, COURTESY RJC ENGINEERS.

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Award of Excellence

Mushkegowuk James Bay All-Season Road Feasibility Study

Morrison Hershfield

The Mushkegowuk Council retained Morrison Hershfield to assess the feasibility of a new all-season road (ASR) connecting four communities in Ontario's James Bay Region to each other and the provincial highway network to the south.

Complexities—including a vast 150,000-km² study area, challenging geotechnical conditions and diverging community views—were overcome through extensive community engagement, multi-factor quantitative and qualitative assessments and innovative design methodologies.

A collaborative partnership

The James Bay ASR Feasibility Study was a collaborative partnership between Morrison Hershfield, the Mushkegowuk Council and the coastal James Bay communities of Attawapiskat, Kashechewan, Fort Albany and Moose Factory, which currently rely on winter roads, rail and air to transport people and goods into, out of and within the region. Care was taken to build trust and community consensus at each key stage in the study.

The primary objectives were to investigate, refine and assess the potential for an ASR to connect the coastal communities. The project involved a dynamic, interactive engagement program, technical studies, socio-economic and environmental studies to assess potential impacts of new transportation infrastructure, a functional design and a cost estimate for the recommended route.

"The social benefits of a travel route that would reduce the cost of living to residents in a large area, while addressing technical challenges, were impressive." - Jury

The recommended route

The selection of recommended route relied on a multi-factor approach to assess the relative merits of each corridor alternative. The evaluation used 44 criteria with associated indicators and metrics. The affected communities provided input on the methodology.

The recommended ASR is 525 km of gravel-surface public highway, with a design width of 9.5 m, a design speed of 100 km/h and a posted speed of 80 km/h. The design includes 70 bridges and 100 additional medium- and large-diameter culverts to span watercourses and muskeg conditions.

Two primary sections comprise the recommended route. The recommended inland route runs 192 km, starting at Fraserdale, heading northeast, relatively parallel to an existing railway, hydroelectric and telecommunications infrastructure corridor, and ending in Moosonee adjacent to Moose Factory. The 333-km recommended coastal route begins at Moosonee and generally heads northwest, some 10 to 30 km inland and parallel to the coast, connecting to Fort Al-

PHOTOS COURTESY MORRISON HERSHFIELD

bany, Kashechewan and Attawapiskat.

Overcoming geotechnical challenges

Difficult geotechnical conditions typically represent a considerable obstacle for construction of transportation infrastructure in Ontario's Far North, where underlying soil conditions are typically muskeg and unable to support heavy loads. Non-conventional methodologies are required to provide a stable foundation and prevent deformation of the embankment and pavement structure.

Morrison Hershfield developed conceptual designs for structures to mitigate the varying and poor subsoil conditions and proposed methodologies to allow construction of roadways capable of supporting up to 36,000 kg (maximum truck weight) of dynamic loads at speeds up to 100 km/h.

These designs included the proposed use of composite layers of geosynthetic pavement structure to mitigate concerns of differential settlement, thus enabling uniform distribution of loads over a wider footprint.

The concept allows for a floating pavement design over the organic mat (muskeg) where peat depth is greater than 2 m. The proposed solution for these conditions includes a granular surface layer over geocells filled with earth borrow between geogrid and geotextile layers.

Socio-economic benefits

If constructed, the James Bay ASR will allow year-round ground travel between the western coastal James Bay First Nations communities and the provincial highway network. It has the potential to provide significant benefits and opportunities for the affected communities and their members, if implemented in a manner that protects the environment, traditional land use and the long-term socio-economic interests of the affected Mushkegowuk peoples.

A detailed socio-economic evaluation determined the ASR's potential benefits:

- A reliable alternative to the increasingly unreliable winter road network.
- A lower cost of living, through reduced transportation costs for goods and services.
- Improved overall community mobility and linkages among communities.
- Enhanced access to friends and family in other northern communities and emergency, health, social services and educational opportunities.
- Increased employment and economic opportunities, including significant regional construction employment opportunities (up to 1,800 direct, indirect and induced jobs per year, over seven years).
- Enhanced opportunities for local sustainable economic development initiatives.

A positive conclusion

The project's objectives, as defined at the outset by the Mushkegowuk Council, were met and documented in the feasibility study's report, including the assessment of corridor and alignment alternatives for the coastal and inland sections of the ASR, the selection and functional design of a recommended route, a preliminary cost estimate and recommended next steps. The final report was delivered within the originally contracted budget.

The study concluded, despite challenging conditions, the design, construction and operation of the ASR are feasible—and if built, it has the potential to transform the lives of those living in the remote Mushkegowuk James Bay communities. CCE

The ASR would transform lives in communities like Moose Factory and Moosonee.

Mushkegowuk James Bay All-Season Road Feasibility Study, James Bay Region, Ont.

Award-winning firm (prime consultant): Morrison Hershfield, Ottawa, Ont. (Andrew Harkness, P.Eng.; Joelle Doubrough, EP; Deven Bhatla, P.Eng.; Andrew Eagen, EIT; Bruce Biglow, P.Eng.; Kaitlyn York, BES; Tom Howson, CAN-CISEC; Andrew Ritchie, M.PL.; Mustafa Sasal, Ph.D., P.Eng.; Ben McMaster, P.Eng.).
Owner: The Mushkegowuk Council.
Other key players: CreeGeo (geospatial analysis), Golder Associates (geotechnical), Shared Value Solutions (social impact assessment), McLeod Wood Associates (workshop facilitation), Keir (economic analysis).

Award of Excellence

Mill Creek Ravine Pedestrian Bridge Rehabilitation

ISL Engineering and Land Services

The City of Edmonton wanted to maintain the functionality of the Mill Creek Ravine trail system by extending the service life of its pedestrian bridges. Built in 1902, three of the bridges were originally part of the Edmonton, Yukon and Pacific Railway (EY&PR). The trestle bridges were converted for pedestrian use in the 1970s.

Community engagement sessions emphasized the importance of preserving the heritage value of the structures. Thus, retaining part of the original 'building fabric' in the final construction was a key objective of the design process. To achieve this goal, the bridges were completely dismantled and each piece of timber was carefully graded and catalogued. This step added a significant challenge to the construction process and required a high level of co-ordination between ISL and the project's prime contractor, Alberco Construction.

A timber resistograph microdrill was used to determine which timbers could be salvaged. In the end, approximately 20% of the original timbers were salvaged and included in the final bridge construction.

Additionally, ISL had to consider safety improvements to meet current requirements. This included widening the bridge decks to meet current design standards for multi-use trails. New handrails were also designed to meet current safety standards for pedestrians and cyclists, but also to match the architectural style of the timber bridges. In these ways, ISL was able to maintain the original character of the bridges.

Reducing repairs

Timber rotting issues had been an ongoing maintenance challenge for the city. The existing timber pier columns were consistently rotted just below ground level and piers in the creek were in even worse condition.

All foundations were converted to a concrete pile-and-cap design that elevated the timber just above grade. The team also removed the timber pier columns from the creek and replaced them with a timber truss span designed to maintain the authenticity of the historic bridge appearance.

"They preserved the heritage of the structure and maintained its regional character. A great example of collaboration with a local neighbourhood." - Jury

Bridge decking had also been a maintenance concern for the city. The underlying problem was sandwiched layers of timber placed over the historic rail ties, which trapped moisture and promoted rotting. Addressing this concern, ISL designed a free-draining bridge decking solution, with large timbers connected from below the deck using galvanized hardware.

Minimizing disturbance

Trail closures were necessary to complete bridge construction. A

PHOTO COURTESY ISL

pedestrian accommodation plan and construction staging were crucial to ensure logical connectivity of the trail system. Clear signage with multiple detour options was essential. Much of the construction work was consolidated over a winter season to reduce the impact on the public.

Construction roads were lined with rig mats to reduce damage and provide access to laydown areas closer to the bridge locations. Off-site fabrication of timber trusses was efficient and allowed erection of the bridge spans using cranes from the top of the ravine.

Slope stability had become an issue on the steep south bank of one of the trestle bridges, threatening its long-term structural integrity. Conventional methods for installing a concrete pile stability wall were not possible, due to restricted access for large equipment on the steep slope. The design team addressed this access problem by designing micropile foundations that could be installed with smaller and lighter equipment.

Site cleanup

Tree removal was required adjacent to the bridges for structural concerns, where trees had become entangled with the existing trestle piers. Modest tree clearing would also promote good air flow around the bridges, aiding in the drying process and improving the long-term health of the timber structures.

The project team worked with the city's urban forestry group to document and provide compensation for the tree removals. The areas around the bridges were restored with low-height naturalization planting.

The original trestle bridge piers were removed from the waterways and replaced with timber truss spans. The new clear spans improved the structural durability and hydraulic performance of the bridges, which were previously susceptible to debris jams.

Many years of railway operation through the Mill Creek Ravine had contributed to accumulation of hydrocarbons in the soil adjacent to the trestle bridge. Soil remediation was included in this project to clean up the slopes.

ISL and Alberco worked through the winter months to minimize impact to the popular trails and ensure the public could enjoy the newly rehabilitated bridges throughout the following summer. They are now expected to last 50 years with regular maintenance before needing another upgrade. **CCE**

Mill Creek Ravine Pedestrian Bridge Rehabilitation, Edmonton, Alta.

Award-winning firm (prime consultant): ISL Engineering and Land Services, Edmonton, Alta. (Troy Letwin, P.Eng.; James Chapman, P.Eng.; Scott Murray, P.Eng.).

Owner: City of Edmonton.

Other key players: Thurber Engineering (geotechnical), Golder Associates (hydrotechnical), Spencer Environmental Management Services (environmental), Twenty/20 Communications (public engagement), Alberco Construction (prime contractor).

Award of Excellence

Whapmagoostui Cree First Nation Drainage Master Plan

CIMA+

The Whapmagoostui Cree First Nation is exposed to extreme meteorological and climatic events. In this isolated community of approximately 980 inhabitants, the increasing frequency of heavy rains in the fall and spring, combined with snow melt, causes a substantial accumulation of runoff water in certain areas, which impedes pedestrian and vehicle traffic, in addition to accelerating the deterioration of gravel roads and causing damage to foundations and infrastructure already subject to freeze-thaw conditions.

Retention chambers were installed to collect sediments and replenish the groundwater table.

PHOTO COURTESY CIMA+

The Cree Nation Government (CNG) commissioned CIMA+ to create a drainage master plan for this community, with the work to be carried out by the members of the Cree Nation. This project is the first of its kind in Nunavik, north of the 55th parallel, accessible only by plane or boat.

The solution was developed through a six-stage master plan, phased from 2016 to 2022. The 2018, 2019, 2020 stages have been completed and are already operational.

Specifying local infrastructure

The project's success to date demonstrates the relevance of combining drainage methods adapted to local northern conditions with state-of-the-art hydraulic simulations, taking into account climate change in calculating requirements.

Infrastructure was designed according to the versatility of locally available materials, their weight, their durability and the capacity of local equipment to manipulate the drainage system's components.

By way of example, rain outlets with dissipation manholes were specified along the Great Whale River's shore. These needed sufficient capacity to carry water away and withstand tides and ice movements, but since there was no adequate equipment to lift the manholes, CIMA+'s simulations led to reducing their diameter before installing them using local equipment.

"An example of smart design and engineering, with the right technology to meet the community's needs." - Jury

Design and engineering work had to consider the budgetary constraints associated with short seasons, construction methods, materials and transportation costs by boat billed according to weight and volume.

The local geology, characterized by an appreciable thickness of loose, sandy soil, allowed for a design that would replenish the groundwater table. To limit the transport of sediments toward the rain outfalls, retention chambers were added to the

design to collect sediments accordingly.

The use of these chambers allowed certain sections of the sewer system to be shortened, which reduced the weight of materials. This design reduced construction costs, as well as carbon emissions associated with the transportation of materials.

The chosen design combines traditional drainage with polyethylene high-density (PEHD) pipes to minimize weight and facilitate handling by locally available workers and equipment. This had a direct positive effect on transportation fuel costs. Components, such as manhole covers, were selected based on their toughness and durability in a severe northern environment. All material quantities were calculated to avoid accumulating surplus materials.

Optimizing productivity

Construction was carried out by a team of Cree workers using available on-site equipment, to avoid the cost of mobilizing heavy equipment from southern regions, installing work camps and hiring specialized workers from away. This was a major challenge in terms of logistics and co-ordination.

The Cree workers' production capacity was optimized through constant support from and supervision by CIMA+'s technicians and engineers. Each phase was carefully planned before implementation and the construction supervision team transferred knowledge to the workers.

A project of such complexity is usually managed by a contractor, but in this case, CIMA+ implemented the conditions required to perform the work through internal management, inclusive and respectful of the Cree team's culture.

CIMA+ was also responsible for managing time for workers and equipment use. The 2018-2020 phases, during which more than 20 members of the community were involved, represented approximately 72 weeks at a rate of an average of 65 hours/week, for an investment of more than $8 million in the community. The local economic benefits were in the order of $2 million in salaries and $2 million in equipment costs.

The benefits arising from the use of local equipment were reinvested to purchase new and better-performing equipment. The trained local workers also contributed to other projects carried out in parallel by other contractors seeking local manpower. This all fit in with the project's objective to promote a local and independent economy to benefit the quality of life for this First Nation's population. **CCE**

Whapmagoostui Cree First Nation Drainage Master Plan, Whapmagoostui, Que.

Award-winning firm (prime consultant): CIMA+, Quebec City, Que. (Yves Durand, P.Eng.; Laurie Juneau-Paradis, P.Eng.; Andréanne Dumont, P.Eng.; Denis Lévesque, Sr. Tech.; Keven Roussel, Sr. Tech.; Boris Karl Houssouvou, P.Eng.).
Owner: Cree Nation Government.
Other key players: Whapmagoostui First Nation.

Award of Excellence

West Niagara Secondary School and New Ridgeview Garden Centre

WSP

In 2017, the District School Board of Niagara (DSBN) purchased half of the family-owned and operated Ridgeview Garden Centre's land to build a new secondary school.

The property was formerly a shale quarry and brickworks, dating back to 1875. When the brickworks was demolished, its remnants were buried on-site. Subsequently, the shale quarry was illegally infilled with approximately 140,000 m³ of construction and demolition (C&D) waste. This left the land burdened with poor soil quality, most of which was geotechnically unsuitable for future use of the site.

DSBN retained WSP to complete an updated Phase One and Two Environmental Site Assessment (ESA), including the filing of a Record of Site Condition (RSC). The results of the ESAs showed a complex, contaminated site with multiple challenges.

WSP then provided remediation options, including removal of waste to licensed landfill, diversion of impacted soil to a reuse site and sequestration and risk management of impacted soil beneath the site—all while keeping Ridgeview open and operating throughout the remedial efforts.

PHOTOS COURTESY WSP

A complex site

Estimates based on historical documentation suggested the site housed 73,000 tonnes of C&D waste. On the east side of the quarry, however, unanticipated ribbons of waste were discovered, leading to a secondary, deep area of waste. The final volume of C&D waste was approximately 170% of the original estimate.

The soil originally used to cap the waste was also impacted with polycyclic aromatic hydrocarbons (PAHs). Ontario's Ministry of the Environment, Conservation and Parks (MECP) had previously documented the cap material to be environmentally non-impacted, having been sourced on-site from outside the former quarry area. This added an unexpected 73,000 m³ of soil requiring risk management.

"The project team worked within a tight timeline while dealing with complex challenges in a highly visible area." – Jury

Rather than landfilling the cap material and the existing quarry fill that was determined not to be suitable on-site, an off-site receiving facility accepted and reused approximately 100,000 m³ of the soil.

While additional effort was needed in soil characterization, processing and tracking, this was a sustainable solution that diverted soil from landfills.

There were 2,000 tonnes of slag present on-site, mixed with about 10,000 tonnes of soil and concrete. This stockpile was screened and crushed appropriately for reuse.

Fine-grained particles from the stockpile were screened out and treated as contaminated soil and managed accordingly, while larger slag and crushed concrete were used as a prescribed aggregate base for a new coverall building behind the new Ridgeview Garden Centre.

DDE was found in shallow soil in a former orchard area, where alternative options needed to be explored to satisfy environmental and geotechnical requirements for a future sports field. Since an orchard can be classified as agricultural land use, it was surveyed separately from the school and Ridgeview.

New buildings

The new, centrally located, 60-classroom West Niagara Secondary School (WNSS) will accommodate more than 1,500 students from the towns of Grimsby, Beamsville and Smithville, Ont. It will combine specialized programs from two current facilities: Beamsville District Secondary School and Grimsby Secondary School. Its 8-hectare lot will provide enough space for the athletic field, a running track and parking. WNSS is scheduled to open in September 2022.

The revitalized Ridgeview Garden Centre, meanwhile, will reopen in a new location, having shifted only a few hundred metres along King Street, to maintain ease of access for its patrons.

Environmental benefits

In redeveloping this former industrial site, DSBN has reduced urban sprawl (*i.e.* building a new school in a more central location), resolved a longstanding MECP order (*i.e.* to remove waste from the site to licensed landfill), sequestered 205,000 m^3 of impacted soil under the new Ridgeview Garden Centre, reused 100,000 m^3 of impacted soil offsite for subgrade application, appropriately managed 16,000 m^3 of orchard soil in-place, reused 2,000 m^3 of slag and crushed concrete on-site as aggregate and allowed a stream on the east side of the property to return to more natural function.

The site is surrounded by commercial farm and residential land.

This motivated proponent has worked with Ontario's Ministry of Education, Ridgeview Garden Centre and the MECP District Officer to enable the site's redevelopment to move forward successfully in a tight timeline, significantly enhancing the use of the land.

A strong partnership between the stakeholders and WSP maintained the project schedule, overcame challenges along the way and achieved a positive outcome.

Further, as a multidisciplinary consulting firm, WSP was also able to accommodate additional client requests with respect to assessments of noise, vibration, air quality and land use compatibility for the WNSS. **CCE**

West Niagara Secondary School and New Ridgeview Garden Centre, St. Catharines, Ont.

Award-winning firm (environmental engineers for site remediation): WSP, Hamilton, Ont. (Karen Bailey, B.A.Sc.; Amy Chiang, P.Eng., PMP; Grace Coveney; Anya Krywy-Janzen, G.I.T., M.Sc.; Sean Morris, C.Tech.; Najla Nureddin, BES; Bailey Walters, M.Sc., P.Geo.; Freesia Waxman, P.Eng.).
Owner: District School Board of Niagara.
Other key players: Budget Demolition (remediation and hauling contractor), Ridgeview Garden Centre (tenant, neighbour and reuse site), Ministry of the Environment, Conservation and Parks (compliance), Town of Lincoln (community partner), Town of Grimsby (community partner).

Award of Excellence

The Building Envelope Thermal Bridging Online Database

Morrison Hershfield

Morrison Hershfield, in partnership with BC Housing and project sponsors, expanded the Building Envelope Thermal Bridging (BETB) Guide to include details applicable to all Canadian climates and energy codes and developed a first-of-its-kind online database.

ThermalEnvelope.ca was developed for users to easily search for building envelope details, compare approaches to mitigate thermal bridges and calculate the overall thermal transmittance of opaque wall assemblies, roofs and floors. These tools can play an important supporting role in achieving net-zero design and implementation within the Canadian construction industry.

An expanded resource

The industry is now undergoing significant changes to improve the overall energy performance of buildings. The National Energy Code for Buildings (NECB) aims to achieve net-zero energy consumption for all new buildings in Canada by 2030. To reach this ambitious goal, the industry requires new tools to affordably design and build such high-performance buildings.

Prior to the launch of the BETB Guide in 2014, the impact of thermal bridges was largely overlooked in practice, energy standards and energy calculations. Their impact is now clearer and comprehensive thermal bridging calculations are becoming a requirement in codes and standards across the country—including NECB 2017, BC Energy Step Code, Vancouver Building Bylaw (VBBL) and Toronto Green Standard (TGS) Version 3—as well as internationally. The BETB Guide has become an important resource for thermal bridging calculations.

The expanded BETB Guide and new online database aim to transform the building market by facilitating the design and construction of more thermally efficient building envelopes. Migrating the expanded guide to a web-based platform has minimized the need for project-specific thermal simulations, making calculations less onerous in practice.

"Making all this data public will help a lot of people start at the right place and reduce the energy impact of a lot of buildings in Canada." – Jury

The database at ThermalEnvelope.ca provides a streamlined, automated process to find more than 500 common building envelope assemblies and interface details, perform and review calculations, provide compliance documentation and collaborate with design teams. Users can search for and compare details using such criteria as construction type, insulation characteristics, proprietary systems and desired performance level.

This new and expanded resource moves beyond climate and construction practice in British Columbia and is now applicable to all energy standards and climates in Canada. It also provides details applicable for net-zero or Passive House (PH) design, all of which is timely and necessary, given new and contemplated changes to energy efficiency requirements across the country, along with federal, provincial and territorial government commitments to reducing greenhouse gases (GHGs) under the Pan-Canadian Framework on Clean Growth and Climate Change.

A global and national issue

Buildings consume large amounts of electricity and natural gas. Designing and constructing energy-efficient buildings and improving conservation in existing buildings can lead to large reductions in energy consumption and related GHG emissions.

PHOTO COURTESY MORRISON HERSHFIELD

In Canada, space heating is a particularly significant source of energy consumption and GHG emissions for commercial, institutional and residential buildings. Building envelope thermal performance is a critical consideration for reducing space heating loads.

According to the World Green Building Council (WorldGBC), the building sector has the greatest potential to significantly reduce GHG emissions, compared to other major emitting sectors; the total savings could be as much as 84 gigatonnes of CO_2 by 2050, through such direct measures as energy efficiency, fuel switching and renewable energy.

The building sector has the potential to achieve energy savings of 50% or more by 2050.

Collaborative process

When designing the online database, the challenge was to not simply replicate the Portable Document Format (PDF) version of the BETB Guide on a website, but rather to create an enhanced, intuitive user experience that includes all the features one would expect when calculating the thermal performance of a building envelope.

The expansion of the BETB Guide, identification of details and development of the web application were collaborative processes, seeking to meet the needs of stakeholders across the industry and the country to ensure the tool would be as inclusive and effective as possible.

The result is an intuitive database that consolidates vast amounts of technically sophisticated and complex information, a catalogue of more than 500 common building envelope assemblies and interface details, along with their associated thermal performance data, into an accessible, practical and easily understandable tool that allows practitioners to make informed design decisions. It is applicable to all energy standards and climates in Canada, with the potential for future expansion.

Timely delivery

New buildings designed and built to higher standards of energy efficiency benefit the industry, building owners and occupants and society in general. The timing of this online database is ideal in the context of new regulations that require detailed thermal transmittance calculations to minimize thermal bridging and the demand from industry for objective and consistent information regarding building envelope thermal performance.

This project supports policy already in place in several provinces and provides a cornerstone for developing model energy codes and adopting net-zero energy-ready codes by NECB by 2030. CCE

The Building Envelope Thermal Bridging Online Database, Burnaby, B.C.

Award-winning firm (prime consultant): Morrison Hershfield, Burnaby, B.C. (Ruth McClung, EIT; Ivan Lee, P.Eng.; Felipe Merino Gordo, MASc.; Fabio Almeida, EIT; Barilelo Nghana, M.Eng.; Neil Norris, P.Eng.; Katie Hay, P.Eng.).
Owner: British Columbia Housing Management Commission (BC Housing).
Other key players: Evoke (technical lead and project manager), Open Technologies (web developer).

Award of Excellence

Lowering the Regional Groundwater Table – Nutashkuan

WSP

Due to its location along the Gulf of St. Lawrence and its low elevation above sea level, the Nutashkuan Innu First Nation—a community of 1,077 residents—had been subjected for several years to recurring problems with flooding during the annual spring thaw. The issue became particularly severe in 2017, when approximately 60 homes were flooded, resulting in $4 million worth of damages.

After the 2017 spring floods, WSP was commissioned to quickly develop a solution to protect the community through a controlled lowering of the regional groundwater table.

Considering solutions

Nutashkuan is located on the shores of the St. Lawrence River at Pointe Parent, where the estuary and the Gulf of Natashquan meet. Relatively flat, the region is characterized by vast and very permeable sandy deposits, which have a direct effect on the level of the groundwater table.

WSP's engineering team had to find a way to control the rise of groundwater in the affected area. Traditional solutions included raising homes, installing pumping stations in several locations or installing pumps in each of the affected homes. Even if technically feasible, these solutions would have required major investments, trained operators and maintenance for further upkeep, which made them unattractive to the Band Council.

An innovative solution was proposed and studied, which included creating a tunnel upstream of the community to intercept and reroute underground waters away from the affected homes, therefore lowering the water table all along the affected community. Difficulties included avoiding any pumping systems, the lack of terrain slopes, nearby Gulf high tides and future climate variations.

Developing a new application

The project's complexity was amplified by the community's remoteness and its specific location along the shores of the Natashquan River. All of the community's homes were built without footing drains, since no stormwater network had enough slopes to carry these waters away by gravity.

"This is a cool, interesting project that will have a valuable impact on its community." - Jury

The frustration of flooded residents and the urgency of preventing further events the next spring added to the difficult conditions under which the team had to work. Within six months, the designers worked with hydrogeology experts to implement a groundwater monitoring program and *in situ* permeability tests and to generate a computer model to reproduce the hydraulic behaviour of the groundwater table, based on knowledge of the area's terrain acquired over several years of collab-

PHOTOS COURTESY WSP.

The team installed underground catchment chambers.

The drainage system carries large volumes of groundwater to the gulf despite the absence of adequate sloping.

oration and confirmed by subsequent investigations.

Since water catchment had to be very efficient over a considerable distance in a flat area, WSP's team developed a new application by installing underground infiltration chambers, which are traditionally used to hold rainwater under paved surfaces.

A total of 830 m of catchment chambers were built—each 1.5 m wide, 0.9 m high and 3 m deep—along Route 138. These chambers were completed with 540 m of 750-mm diameter pipes, creating an underground stream that bypasses the community.

The installation of piezometric probes at several locations, validation of tide levels and analyses of soil were carried out quickly and simultaneously, along with funding applications and environmental authorizations.

As per the hydrogeological study, the solution was a highly efficient deep drainage system capable of intercepting large volumes of groundwater and carrying it to the gulf despite the absence of an adequate slope. The system also had to withstand the action of iron ochre present in the soil, which could quickly obstruct the holes in conventional perforated pipes.

A passive system

Climate change will likely have an increasing impact on variations in the region's groundwater table. The new system will provide long-term and durable protection.

Particular attention was given to the potential impacts lowering the groundwater level could have on coastal ecosystems and surrounding hydric and hydrogeological regimes. To limit disruptions, the drainage system only lowers the groundwater level during flood events. To achieve this, a system of gates was installed downstream of the new drainage system.

The system requires no electrical power and its operation and maintenance costs are minimal. The locations of the drainage chambers along Route 138 were strategically selected to avoid excavation work in the community's residential area and unnecessary deforestation, since vegetation growth is very slow in the region. The use of trench boxes, instead of conventional excavation methods, also minimized tree felling.

The system was built in late 2019 at a cost of only $1.8 million and proved efficient in protecting entire community against flooding, as confirmed by piezometric measurements from 2019 to 2021.

Additional benefits

The project also had indirect social benefits for the community. The hiring and training of local workers and the use of local resources contributed to stimulating the economy.

As the catchment system ensured the efficient drainage of surface water, a storm drainage system based on the same general principle was built in 2020 to lower water levels and redirect stormwater to the river. In the short term, surface water drainage will allow the community's roads, which are mainly made of gravel, to be paved. **CCE**

Lowering the Regional Groundwater Table, Nutashkuan, Que.

Award-winning firm (prime consultant, engineering design, construction supervision): WSP, Quebec City, Que. (Soheil Nakhostin, ing.; Vincent Bélanger, ing; Samuel Bottier; Marc Antoine Lebel, CPI; Arnaud Coté Leclerc, ing.; Denis Lopez, Tech.; Nathalie Bélanger, Tech.).
Owner: Nutashkuan Innu First Nation.
Other key players: Services aux Autochtones Canada (funding), Groupe Michel Leclerc (general contractor), Québésec (dewatering contractor).

Award of Excellence

Turcot Interchange and Railways Reconstruction Project

AECOM

A consortium formed by AECOM and Tetra Tech acted as the owner's engineer in the Turcot Interchange project for the last 12 years, as part of an integrated team with Ministère des Transports du Québec (MTQ). A combination of alternative and traditional delivery methods made the implementation and integration of this project possible in an urban setting, while keeping Canada's busiest road sector active.

PHOTO COURTESY AECOM AND TETRA TECH.

Rethinking a place

The Turcot Interchange had reached the end of its service life. Its rebuilding was an opportunity to modernize a key junction, rethink its place within the urban fabric and reclassify the land on which a previously decommissioned railyard was located.

Much more extensive than the interchange itself, the project consists of rebuilding four interchanges and three highway sections (15, 20 and 720), moving the transcontinental railway and adding new municipal connections in anticipation of future development and to improve existing infrastructure. The project location spans a dense and diverse metropolitan area. With a budget of $3.67 billion, it is the largest highway construction project in Quebec history.

The project team co-ordinated with multiple stakeholders, whose interests sometimes differed, to achieve consensus on proposed project elements. These stakeholders included the cities of Montreal West and Westmount, five boroughs, Canadian National Railway (CN), Canada Pacific Railway (CP), Réseau de transport métropolitain (RTM), Société de transport de Montréal (STM) and Parks Canada.

The integrated project team established a work breakdown, whereby 35 simultaneous work packages would be delivered under a traditional project delivery model, while one other major contract would deliver another portion of the project under a design-build model. Undertaken simultaneously, they required extensive planning and co-ordination to effectively deliver the broad scope of work.

"Connecting spans of bridge during the night minimized the pain. You wouldn't recognize it the next day!" - Jury

Separate and dedicated teams were set up to manage the two models and prevent any schedule delays. Railroad displacement, which falls under federal jurisdiction, added to the complexity of standards, access sharing and uninterrupted functionality.

The main challenge was rebuilding in constrained spaces below or

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The project included three signature bridges.

near existing infrastructure where more than 300,000 vehicles travel daily, while limiting closures to prevent excess traffic in neighbouring areas. In collaboration with MTQ, the consortium drafted technical requirements to enable uninterrupted road and rail travel and to leave room for creativity through a request for contractor bids.

A flagship project

MTQ wanted to make Turcot a flagship project in terms of project management and environmental approaches. The project will create lasting positive impacts to the surrounding areas in terms of land use, public and active transportation, environment, road geometry, bridges and structures, drainage and public services. The consortium looked back at previous projects to define with MTQ the best-case scenario for future generations.

The consortium participated in the development of the objectives of the project's charter, which include maintaining functionality, limiting impacts on the community, promoting urban integration, improving public transit and ensuring mobility during the works, while respecting the established budget and schedule. To ensure accountability in project management, the consortium designed and implemented custom monitoring and control tools.

To reduce negative impacts on traffic and mobility, several measures to promote public transit were implemented, including reserved lanes, express bus lines and the relocation of a bus terminal and a commuter train station. The integrated team collaborated on these measures, monitored their impact on mobility and helped develop communications to keep nearby communities informed on the progress of the works and to promote alternative transportation.

The consortium prepared contaminated land restoration plans, which included using soils from other regional construction sites to limit the amount of borrowed native raw materials, reusing contaminated soils on-site under certain conditions and revalorizing compressible soils.

The project requirements included a target to reuse or recycle 80% of the materials remaining after the dismantling of existing buildings and structures. This was achieved by incorporating these materials into the new earthworks.

In 2013, the consortium established a team to monitor environmental quality and track impacts such as noise, dust and vibrations on neighbouring communities, 24-7. The team used data available from temporary noise monitoring stations and recommended adjustments as needed during construction, with the location of the stations changing to follow the progress of the works.

Four air quality monitoring stations were established. At the end of the works, one will remain operational under the City of Montreal's monitoring network.

Carbon-neutral

MTQ had also set the objective of making Turcot its first carbon-neutral project. The consortium made this commitment a reality through elements within the design-build contract and by developing a methodology to calculate greenhouse gases (GHGs) emitted by construction activities, transportation of materials to and from construction sites and off-site elimination of waste.

Methods for reducing GHGs included the use of hybrid vehicles on the construction site, compensation in the form of carbon credit purchases and the planting of trees inside and outside the project's boundaries. The consortium also conducted studies that led to a reduction in heat islands by quantifying the impact of the increased greenery of areas compared to the conventional final coverage method in infrastructure projects. **CCE**

Turcot Interchange and Railways Reconstruction Project, Montreal, Que.

Award-winning firms (owner's engineer): AECOM and Tetra Tech (consortium), Montreal, Que. (François Labelle, ing.; Mathieu Ashby, ing.; Dorine Noujaim, ing.; Bart Mossor, ing.; Marie-Claude Wilson, ing.; Boris Tzakov, M.Sc.; Paul Laberge, ing.; France Doucet, Tech.; Yvan Côté, ing.; Paul-André Fournier).
Owner: Ministère des Transports du Québec (MTQ).
Other key players: n/a.

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2 Statistics Canada, "Household spending, Canada, regions and provinces," November 25, 2019.
3 CMHC, "Mortgage and Consumer Credit Trends National Report – Q4 2019," December 2019.

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Award of Excellence

Southwest Rapid Transitway Stage 2 and Pembina Highway Underpass

Dillon Consulting

The City of Winnipeg identified the need for rapid transit to support long-term growth and connecting the rapidly growing southwest quadrant (which includes the University of Manitoba) with the downtown area. Dillon Consulting provided services to deliver the project under a public-private partnership (P3) model.

This is the largest capital infrastructure project undertaken by the city to date. Riders can now travel on an exclusive, bus-only right-of-way, providing frequent, reliable and high-speed service.

Achieving value for money

The City of Winnipeg retained Dillon as subject matter experts (SMEs) and representatives throughout three project stages: (1) project planning, including the functional design report, P3 business case and value for money (VFM) assessment; (2) contract development and procurement; and (3) owner's advocate during design and construction.

With an initial budget of $587 million, SWT2 includes 7.6 km of transitway, nine stations, nine other structures, a Canadian National Rail (CN) underpass, the widening of the Pembina Highway Underpass and active transportation facilities.

A comprehensive VFM assessment by sub-consultant Deloitte TTL compared the net present value of the risk-adjusted costs of different procurement options. It found a P3 delivery model would provide positive VFM through appropriate risk transfer to a private partner.

The $90-million Pembina Highway Underpass project was bundled with SWT2 to benefit from economies of scale, attract larger international consortiums and mitigate many of the risks had these two projects proceeded independently.

Some of the key project delivery challenges included:

- extensive relocation of power and gas utility infrastructure.
- construction of a new underpass, associated rail bridges and extensive infrastructure immediately adjacent to—and while maintaining—CN Rail operations.
- widening of a major arterial underpass without impacting

PHOTOS COURTESY DILLON CONSULTING.

Despite an in-service date coinciding with COVID-19, the project has met key objectives in increasing local use of public transit.

traffic.
- accelerating completion of Stadium Station for use during the 2017 Canada Summer Games.

Extensive stakeholder management was required for 300-plus public and private entities and interest groups. A three-tiered approach for the management of stakeholders was established by sub-consultant Landmark Planning & Design, with a two-way approach to ensure stakeholders' interests were understood and addressed while effectively communicating project objectives and limitations. Proactive engagement was critical in mitigating scope creep and the associated cost and schedule impacts.

Scope, cost and schedule management were critical to project delivery, not only because of organizational and political oversight requirements, but also because the P3 funding agreements were subject to established schedule milestones. Any significant changes to these critical elements would significantly impact the project and transit operations of the corridor.

Through innovative project delivery and competitive procurement methods, the project realized VFM savings, reducing the initial $587-million budget to $467 million, and finding further savings during construction, for a total cost of $418 million at construction completion.

The project team met or exceeded schedule milestones, including the Stadium Station completion, turnover for training and commissioning and in-service date. The magnitude of financial savings and schedule achievements is a rarity for projects of this scale, complexity and public scrutiny.

Ready for the future

This transformative project was designed to move residents from a dependency on cars to alternative, more environmentally sustainable transportation options, including the new BLUE rapid transit line and active transportation. This mode shift would reduce congestion on major routes between downtown and the southwest quadrant, including Pembina Highway.

Ensuring access to amenities for riders was an essential part of planning and design. BLUE's amenities include conveniently located stations, real-time passenger information, heated shelters, public art, bike lockers, park-and-ride and kiss-and-ride opportunities.

The project followed a rigorous methodology to protect the environment. An inventory of all vegetation—*e.g.* trees, shrubs, bushes and grasslands—was taken for the pre-construction lands and then used to identify required protection, re-establishment and enhancement.

Winnipeg's southwest quadrant is projected to grow by more than 40% in 20 years. SWT2 will support this continued growth, link downtown with major destinations in the southwest and enable direct access to intermediate neighbourhoods and efficient service for those living, working and studying in the area.

Amenities include public art.

Despite COVID-19 coinciding with the project's in-service date, key objectives have been met. Stadium Station increased safety and reduced the time to clear riders after events by 50% to 60%. University of Manitoba Station increased transit ridership by between 5% and 15%. BLUE provides frequent, reliable, high-speed service, reducing traffic congestion and improving travel times.

The long-range objectives include transit-oriented development, local economic impact, revitalization of downtown and environmental sustainability. The municipal government is already receiving development proposals, demonstrating private-sector endorsement of these objectives. **CCE**

"The P3 model allowed this project to enjoy economies of scale and it came in under budget, which was significant." - Jury

Southwest Rapid Transitway - Stage 2 and Pembina Highway Underpass (SWT2) Project, Winnipeg, Man.

Award-winning firm (owner's advocate/engineer): Dillon Consulting, Winnipeg, Man. (Taran J. Peters, P.Eng.; Robert Taylor, P.Eng.; Crystal Cooper, PMP; Ali Campbell, P.Eng.; Kristen Parmer; Tina Sontag, CET; Kevin Breukelman, CET; Caleb Olfert, P.Eng.; Katrine Levesque, P.Eng.; Drew Monnier, P.Eng.).
Owner: City of Winnipeg.
Other key players: Landmark Planning & Design (communications and public engagement), Deloitte (finance).

Award of Excellence

Major Rehabilitation, Characterization and Treatment of Contaminated Soils

Englobe

PHOTO COURTESY ENGLOBE.

Hydro-Québec. retained Englobe in 2015 to manage the large-scale environmental remediation of Block D, a parcel of land in the Cree community of Chisasibi, Que. The former petroleum depot had been active during the construction of Phase 1 of the La Grande complex from 1973 to 1984. It was dismantled in 1996, but its historic activities had left the land contaminated by petroleum hydrocarbons, with more than 1,000 barrels buried on-site.

Addressing challenges

Chisasibi is on the eastern shore of James Bay and the southern shore of La Grande River. Projects in this region encounter challenges with cold climates, remote locations, lack of infrastructure/resources, short summers for soil treatment, challenging and variable ground conditions and limited access to a qualified workforce. These can cause issues for transportation, material handling, scheduling, equipment design and maintenance.

To regularly liaise with stakeholders and keep the project on schedule, a non-traditional project management and monitoring committee (PROM) was established, with representatives from all groups. The PROM maintained open lines of communication, making sure everyone understood priorities, objectives and desired outcomes. This team approach ensured work was completed to the expectations of all parties.

Englobe participated as an active member of the PROM, helping to facilitate discussions and share an understanding of the work to be done based on a scientific approach. For the duration of the five-year project, the team regularly co-ordinated further opportunities to seek input from stakeholders.

"With impressive mentorship, training, safety and jobs, they did a very good job for the community." - Jury

Englobe's team also helped establish a strong occupational health and safety (OHS) culture, providing support for the contractor to prepare an updated program with the provision of personal protective equipment (PPE) and training for all contractor employees, job safety analysis for tasks and daily safety meetings.

Englobe's team proactively managed community concerns surrounding potential residual odours from treated soils. A subcommittee was established to investigate meth-

ods for mitigation of these odours, investigate qualitative and quantitative characterization methods for them, investigate ambient air sampling methods and develop a scenting protocol to compare mitigation methods.

Mentorship

Englobe's team took the initiative to provide in-person training workshops for local workers involved in the project. These helped to build trust and confidence by allowing the workers to learn more about the project's milestones, what was being done with the collected samples and how the resulting data was being used.

Skills developed for this project are transferable to various industries, contributing to greater regional prosperity.

Remediating the environment

The handling of fuel associated with accidental spills during the Block D depot's operations had significant environmental impacts on the land, leaving it contaminated. The site, under provincial jurisdiction, corresponded to an enclave within the reserved lands of the CNC, but due to the on-site contamination, the retrocession of the land to the community could not proceed.

Between 2015 and 2020, the project team oversaw the complete remediation of the site, leaving the soil and groundwater restored and meeting applicable criteria. During the remediation, measures were taken to minimize further environmental impacts.

One aspect of the project, for example, was to decommission the remaining structures of a wharf from the depot's active period. All work to remove this wharf, located along the sensitive shoreline of La Grande River, needed to be completed during a specific time frame to ensure minimal impacts to aquatic habitat and spawning fish species. Once the wharf's scrap metal was carefully removed from the shoreline, it was transported off-site and 100% recycled. The area was then redeveloped to blend in with its surroundings.

Further environmental measures included the application of soil treatment technology requiring only renewable energy, transporting and disposing of all project waste off-site in authorized facilities, recycling all other metal discovered on-site, reusing project materials (turbine, chimney, tarps, etc.) and managing the revegetation of the entire site.

The final stages of the project were impacted by the COVID-19 pandemic, which forced the team to postpone finishing the site from 2020 to 2021. Following the full remediation of the site, the retrocession process for this parcel of land was able to be initiated by those concerned. With the site fully restored, the CNC will be able to enjoy this beautiful space. CCE

Major Rehabilitation, Characterization and Treatment of Contaminated Soils, Chisasibi, Que.

Award-winning firm (prime consultant): Englobe, Quebec City, Que. (Luc Daigle, Tech.; Etienne Rousseau, P.Eng.; Robert Desjardins, Tech.; Katheryne Budd, B.A.Geo; Joliane Hardy, Tech.; Jacques-Samuel Moreau-Gougeon, Tech.; Alexandre Caza, Tech.; Patrick Beaubien, Tech.; Pierre Légaré, Tech.; Cindy Gagné).
Owner: Hydro-Québec.
Other key players: Chee Bee Cree Construction (contractor).

Award of Excellence

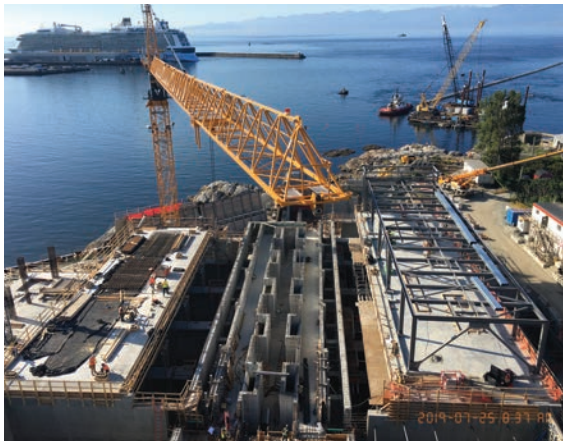
Capital Regional District Wastewater Treatment Project

Stantec

When British Columbia's Capital Regional District (CRD) embarked on an ambitious effort to plan, construct and commission a new 108-ML/d tertiary treatment facility to serve Greater Victoria, one of Canada's fastest-growing communities, it engaged Stantec to provide technical and owner's engineer services.

In preparing to deliver nine major capital projects under the program, the largest in CRD's history, Stantec served as the owner's engineer for the procurement, construction management and commissioning of the new facilities. Its team completed the project definition report for the new wastewater treatment plant and undertook an extensive value engineering and economic review of options to reduce the project's capital cost.

Stantec's design resulted in cost savings of $425 million over previously developed concepts. The options evaluation process included triple bottom line evaluations, financial evaluations, extensive consultation with stakeholders and numerous workshops with CRD staff and politicians.



Achieving goals

CRD had three key goals for the wastewater treatment program:

- To comply with federal regulations for secondary treatment by December 31, 2020, to protect the marine environment.
- To minimize capital and lifecycle costs to CRD residents and businesses and enhance local communities with an efficient system.
- To optimize resource recovery from the water treatment process and minimize greenhouse gas (GHG) emissions.

The project protects the sensitive marine environment adjacent to Victoria, which is home to orca, salmon, sea lions and other diverse life.

As for the second goal, the facilities were delivered for $775 million, in line with the estimated budget prepared by Stantec and, as mentioned, $425 million lower than earlier concepts prepared by others.

"Notable for innovation, delivery and resource recovery—and the hybrid delivery model delivered the best value, saving $425 million!" - Jury

And regarding the third goal, the project produces a high-quality effluent suitable for reuse, including irrigation; heat recovery from effluent at the plant can enable district heating; and the aforementioned biosolids are used as cement kiln fuel.

From high-rate treatment processes that take little space, to pumping and lifting residuals up 150 m to the Hartland biosolids facility, to drilling a major forcemain sewer horizontally under Victoria harbour, the project team devised innovative solutions to reduce program costs.

CRD's wastewater rates are amongst the lowest in Canada. This project contributes to a more sustainable process and improves the quality of life for more than 300,000 residents, leaving a legacy that will serve Greater Victoria for the next 100 years. **CCE**

Capital Regional District Wastewater Treatment Project, Victoria, B.C.

Award-winning firm (project manager/owner's engineer): Stantec, Surrey, B.C. (Reno Fiorante, P.Eng.; Bob Dawson, P.Eng.; Rob Simm, P.Eng.; Stan Spencer, P.Eng.; Andrew Buchner, P.Eng.; Jon Bell, P. Eng.; Al Ghanam, P.Eng.; Jeff Ball, P. Eng.; Sean Lockhart, P.Eng.; Uthaya Uthayakumar, P.Eng.; Enrico Dimzon; David Harding, AIBC; Margaret Huggan).
Owner: Capital Regional District.
Other key players: n/a.

PHOTO COURTESY STANTEC

Literature review

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Set to SOAR

Dillon Consulting recently launched SOAR Professional Services, a planning, engineering, environmental science and management consulting firm dedicated to supporting First Nations, Inuit and Métis communities and organizations across Canada. Based in Kingsclear First Nation, N.B., the new business is owned, led and staffed by Indigenous professionals—including its president, Ryan Dunbar, who first joined Dillon in 2005.

During your career with Dillon, how were you able to shift greater focus onto Indigenous clients?

About 10 years ago, I completed training in client relationship management (CRM), which included a marketing budget to pursue high-priority clients we were not extensively supporting. The list didn't include any Indigenous clients. I proposed to use my training and budget to work with my own community, Kingsclear First Nation, on a water treatment system feasibility study. We developed an implementation strategy for the entire community's water, waste and distribution systems. Since then, we have supported the community in securing funding for and completing every project on that list. Using a similar model and knowledge gained from these projects, we have expanded delivery of Indigenous services work substantially across Canada.

When and how did the concept for SOAR arise?

Canada was slowly advancing efforts to address substantial funding gaps for Indigenous community infrastructure. At the same time, Dillon was advancing a strategy to substantially grow its staff resources. Then-president (now CEO) Sean Hanlon provided the opportunity for me to present the SOAR concept to our board of directors, who provided the resources to create the new firm.

The board officially gave approval to operationalize SOAR a few weeks before pandemic restrictions came into effect in March 2020. Dillon provided capital investment and resources—*i.e.* for accounting, legal, human resources (HR), web development and marketing—as well as investments in my leadership potential. Each of these resources was critical to a complex limited partnership model that met the objectives outlined by our board.

I am still learning every day, as well as identifying challenges I had never anticipated, but the experience has been truly rewarding.

"The results are real, impactful and happening at a much more rapid pace than has been seen across Canada historically."

Tell us about Two-Eyed Seeing.

Two-Eyed Seeing is a concept developed in 2004 by Mi'kmaw Elder Albert Marshall. He described it as "learning to see from one eye with the strengths of Indigenous knowledge and ways of knowing and from the other eye with the strengths of mainstream knowledge and Western ways of knowing and learning to use both together to produce more fulsome and sustainable solutions for the benefit of all."

By way of example, our team was completing a climate change project for a First Nation using the Public Infrastructure Engineering Vulnerability Committee (PIEVC) protocol, which isn't perfectly suited to Indigenous community infrastructure. We modified the approach to look at community service impact resulting from engineered failures, with extensive engagement with Elders, Youth, Leadership, Directors, Land Knowledge Holders, etc. We integrated climate change impacts they had observed. The outcomes of this study led to significant community adaptations that would in all likelihood have fallen through the cracks had we not modified standard engineering guidance to more closely align with Indigenous ways of knowing.

What will be key in ensuring SOAR's longevity in the industry?

It's easy to get excited about the work. The results are real, impactful and happening at a much more rapid pace than has been seen across Canada historically. We have supported economic development projects that have changed communities, from the way people are employed to investments in historically underfunded social systems to opportunities to reconnect culturally. I am not sure it would be possible to find more rewarding ways to build a career!

Our continued success and longevity will be driven by our ability to recruit like-minded individuals who are passionate about supporting others. Our established relationship with Dillon can help provide capacity as we grow and will give us the ability to expand our knowledge and understanding. Our goal is to support similar progress to a growing network of communities that could benefit from our approach to their future projects. **CCE**

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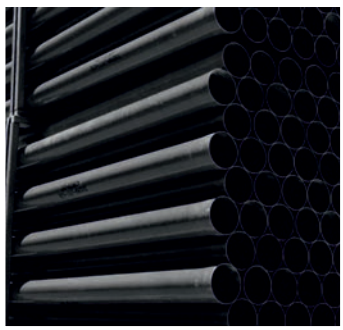

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