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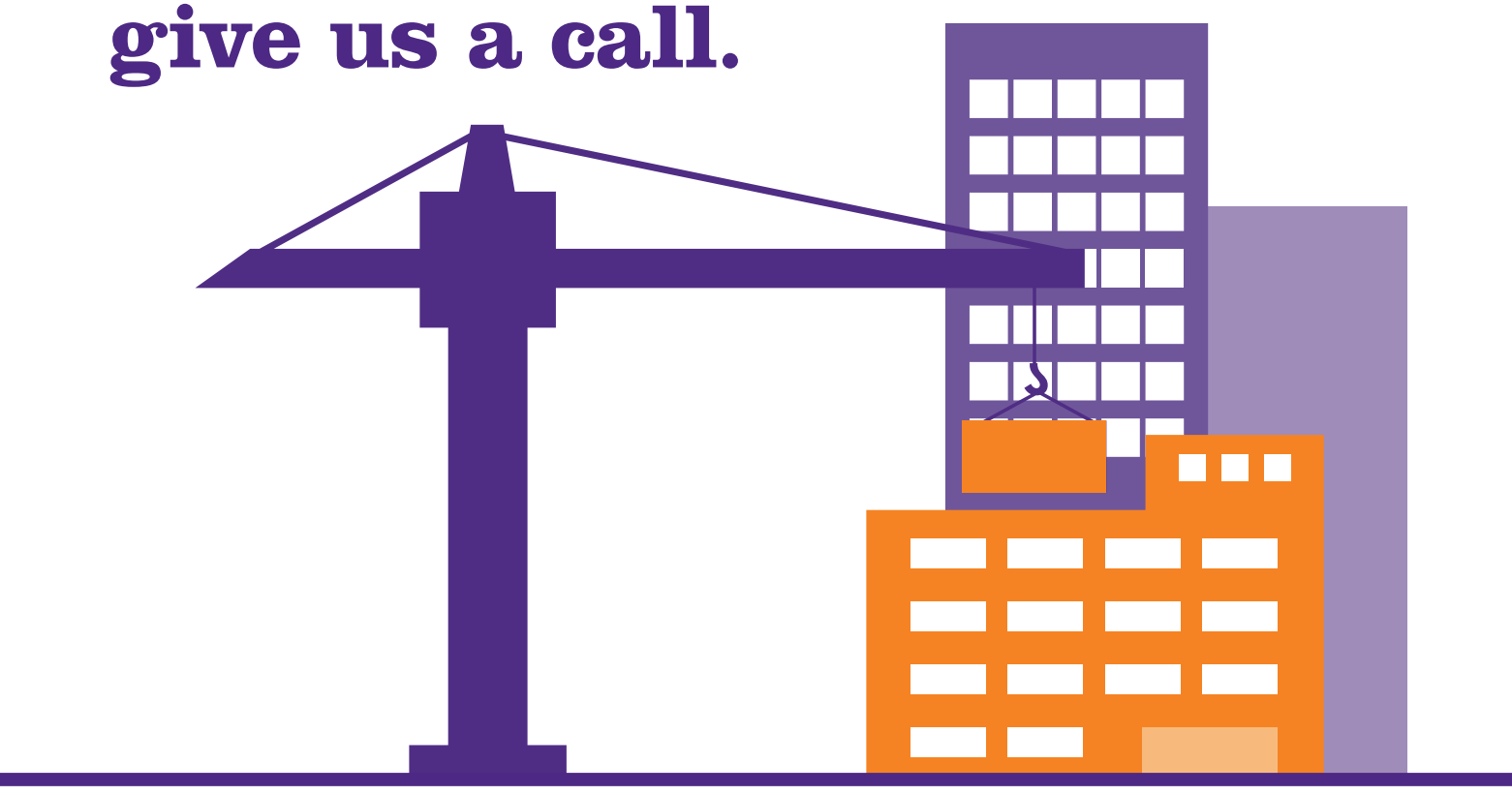

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Cover: Grandview Heights Aquatic Centre, Surrey, B.C., winner of the Schreyer Award. See page 22. Photograph: Ema Peter Photography

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October/November 2016
Volume 57, No. 6

features

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BUSINESS

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Showing that engineering has beauty and a heart

"Why should engineers give themselves awards?" asked Robert W. Lucky in an article posted late this summer online by IEEE. Lucky points out that despite our best efforts to engage the public in the wondrous achievements of engineers, awards fail to elicit much interest outside the industry. No matter how many press releases, tweets, and glittering black tie dinners: "Unless it's a Nobel Prize or an Oscar, the public apparently doesn't care."

Even in our technologically obsessed culture people take the iconic building, the dramatic bridge, at face value. The beauty and what I'll call the "heart" of a thing is what strikes the public imagination. The site of the CN tower pointing to the sky inspires awe in the onlooker, but most people don't want to hear much about the detailed calculations and engineering that made the structure possible. It has to be said: for much of the public, engineering is just a bore.

The 2016 Canadian Consulting Engineering Awards published in this issue are some of the most complex and innovative projects that have been designed recently by consulting engineers. Some have beauty (Grandview Heights Aquatic Centre, the Mistissini Bridge). Most have "heart" in spades, in the sense of demonstrating a strong social and environmental consciousness (e.g. Whale Cove Arena, Low Level Road). Others are impressive by their sheer scale and power (the Mattagami Hydro and Eleonore Mine projects.)

But the engineering is hidden and behind the scenes. One building, the Westmount arena in Montreal, is even buried underground to avoid creating a bulky presence in an urban park.

And there's an even bigger issue of communication. While certainly the awards are appreciated by the profession and consulting engineering industry, they don't make the national headlines.

In order to assess projects the jurors need to know about their technical details, so the submissions are full of them. But we have to find a way to make that information more accessible to a broad audience. We have to find a way to explain in interesting ways, using plain language.

Some projects are written so well they immediately pop to everyone's attention. But too often that's not the case. Some are given long, technical titles that weary journalists looking for news will pass by. And the descriptions often use convoluted language, are overly detailed, and use terms and acronyms that are only familiar to specialists in that field. I can picture the companies' communications managers urging the project engineers to simplify the verbiage, but meeting resistance because the engineer insists on being precise and accurate.

So we (and I include this magazine) have to trust people's intelligence and find a way to tell our stories in more appealing ways. Then one day the public will sit up and notice that engineers are at the vanguard of efforts to make the world a better place. **Bronwen Parsons**

FOR PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE

CANADIAN CONSULTING engineer

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Royal Alberta Museum, Edmonton.

BUILDINGS

Edmonton boasts two new landmarks

Alberta's capital city is transforming. In late August construction was completed on the Royal Alberta Museum. The 37,100-sq.m complex is north of the city hall and the law courts.

Rogers Place, Edmonton.

From the street the museum appears as a composite of different volumes, including a large horizontal block cantilevered over the low entrance, and natural materials such as limestone. The interior and exterior spaces are woven together "dynamically," and throughout the building are gardens and roof terraces. Along 103A Avenue a pedestrian boulevard is lined with large mosaic panels that were reclaimed from the former post office on the site.

DIALOG Design and Lundholm Associates Architects are part of the Ledcor Design-Build (Alberta) consortium responsible for the $375-million project.

Then in early September the city's new hockey and entertainment venue opened. The 74,320-sq.m, $600-million Rogers Place sits on a 9.5 acre site at 102 Street NW and 104 Avenue. Home to the Edmonton Oilers NHL team, the main arena has 56 suites and 18,600 seats. There is also a smaller community rink of 1,000 seats that will be used for practice and by hockey teams from MacEwan University. The building's main entrance is a grand 3,140 sq.m Winter Garden that can be used for events, and there is an LRT Link and a large parking garage.

Construction began in March 2014. The design was led by HOK, with subconsultants Stantec, MCW Hemisphere, DIALOG, Architecture ATB, Amec, BTY Group, CDML and Bunt & Associates. PCL was construction manager and ICON Venue Group was the project manager.

continued on page 8

PEOPLE

Trial begins over Algo Mall roof collapse

The trial of the former engineer who last inspected the Algo Mall structure in Elliot Lake, Northern Ontario, began in early September. Robert Wood is being tried in the Ontario Superior Court in Sault Ste. Marie on two counts of criminal negligence causing death, and one count of criminal negligence causing bodily harm. The trial relates to the collapse of the parking lot roof structure in August 2012.

EDUCATION

PEI engineering goes green

The University of Prince Edward Island officially opened its 7,000-sq.m School of Sustainable Design Engineering building this summer. Located on the eastern edge of the UPEI campus in Charlottetown, the school offers studies in bioresources, mechatronics and sustainable energy. Previously P.E.I. was the only province in Canada that did not have a full engineering degree program.

PUBLIC RELATIONS

#AnEngineerWasHere

On September 20 staff from the Ontario Society of Professional Engineers (OSPE) handed out printed tags, coffee, and doughnuts at Bloor and Church Streets in downtown Toronto. The event was part of OSPE's #AnEngineerWasHere campaign in which they asked people to photograph the yellow tag against a structure like the CN Tower or an iconic product like the iPhone, and then share it on social media.

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continued from page 6

Ontario Min. Transportation

Nipigon Bridge concept, northern Ontario.

CRD

Artist's rendering of McLoughlin Point wastewater treatment plant, Esquimalt, B.C.

BRIDGES

Causes of Nipigon bridge failure named

On September 22 the Ontario government issued a long awaited update about what happened to cause the Nipigon River Bridge deck to lift during a cold snap in January.

The bridge is under construction on the Trans-Canada, Highway 11 near Greenstone, 250 kilometres east of Thunder Bay. The $106-million project is Ontario's first cable-stayed structure. Part of the bridge was already completed and open to traffic when the deck lifted almost 60 centimetres during high winds and cold weather. Traffic on the Trans-Canada was forced to detour for days through Sault Ste. Marie and the United States.

In their update, the Minister of Transportation and Minister of Northern Development and Mines said the investigations had found three main factors were responsible for the lifted deck: "[F]irst was the design of the shoe plate and its flexibility; second was a lack of rotation in the bearing that was constructed; and third was improperly tightened bolts attaching the girder to the shoe plate. When combined, these three factors produced the malfunction. Neither cold temperatures nor wind contributed to the closure."

The design for a retrofit to address the problems is being reviewed by Associated Engineering and ministry engineers. They are also reviewing sections of the bridge that are still being constructed.

The repairs are expected to cost between $8 and $12 million.

The organization Professional Engineers Government of Ontario (PEGO) said it was disappointed with the government's findings because the investigation had not looked into the deeper causes of the failure which had to do with the need for more project oversight.

WASTEWATER TREATMENT

Victoria area sewage plans move forward

The Capital Regional District of Victoria, B.C. (CRD) has moved a step nearer in how to deal with its sewage. The CRD represents 13 municipalities and three electoral areas on southern Vancouver Island and the Gulf Islands in B.C.

The problem of what to do with its sewage has been facing the CRD for over 30 years. Currently the

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continued from page 8

wastewater is screened (removing items 6 mm or larger) before it is dispatched into the Juan da Fuca strait. The Federal Department of Oceans and Fisheries requires that the sewage undergo at least secondary treatment by 2020.

Faced with ongoing disputes over where to locate a treatment plant and a looming federal deadline, the province appointed an independent panel to study the issue. That panel, the Core Area Wastewater Treatment Project Board (CAWTPB), recommendations were accepted by the CRD board in September.

The panel recommended building a 108 megalitre/day plant at McLoughlin Point in Esquimalt to treat wastewater. Earlier plans have been redesigned to accommodate some of the concerns of the people of Esquimalt and to recognize the picturesque site by setting the building farther back from the shoreline. Another plant to treat and temporarily store the biosolids will be built at the Hartland landfill in Saanich. The waste from McLaughlin will be transported to Saanich through a conveyance system.

Jane Bird, chair of the independent panel, pointed out that at $765-milllion the revised plans are "significantly less expensive than previous plans."

MAILBOX

Biomass is big in the east as well

Catching up on my backlog of magazines I read with interest the May issue of CCE. I appreciated the collection of articles around the themes of green buildings and renewable energy.

I was disappointed in the limited coverage of "Biomass Energy Evolves" (page 35). Billed as a cross-Canada review, this otherwise excellent and interesting article limited its scope to projects from Ontario to B.C. This was unfortunate as it omitted developments in the five eastern provinces.

I am quite familiar with the topic of biomass energy, having worked at ADI for most of my career. Since the 1970s my colleagues at ADI have been pioneers in the use of wood wastes for energy, energy conservation and, most notably, the development of anaerobic wastewater treatment for warm, strong, organic wastes such as those from food processing, breweries, pharmaceutical wastes, etc.

Working with UNB-Fredericton, the team has developed, patented and commercialized several wastewater treatment technologies and have become a global leader. ADI-designed systems are found around the world from Ukraine to Colombia to Australia to China, in the U.S. and seven Canadian provinces. The client list is over 260 companies in 35 countries — a successful outgrowth from a regional Canadian consulting engineering company.

A review of Canadian biomass energy without ADI Systems is comparable to a review of Canadian engineering publications without CCE. A quick Google search under "anaerobic wastewater treatment Canadian" yields ADI Systems among the first few entries. A true cross-Canada review would have caught this omission.

Otherwise an excellent issue.

Andrew Steeves, P.Eng.
Fredericton, N.B.

CHAIR'S MESSAGE

Telling our stories

Every year consulting engineers and their firms complete thousands of projects across Canada and internationally. Some of these projects are small, some are large. Some firms are niche businesses while others are large corporate entities. The one thing that is common in all these projects is the hard work, dedication and innovation delivered by consulting engineers. These projects — past, present and future — mark the importance of our industry in building and maintaining our nation's infrastructure.

The vast majority of projects go from concept to completion with little or no attention paid to the consulting engineer, nor the firm. This is the reason the Canadian Consulting Engineering Awards, presented jointly by ACEC and *Canadian Consulting Engineer*, are of such importance. They celebrate 20 outstanding projects from firms across Canada and acknowledge the accomplishments of the consulting engineers that made them happen. The CCE Awards, as well as the various provincial awards programs that take place throughout the year, provide us an opportunity to tell our stories, stories that need to be told more often and louder!

Congratulations to those projects that were recognized at the CCE Awards gala. Thank you to all the firms that participated in this year's awards program. I also wish to thank *Canadian Consulting Engineer* and the jury members for the hours they dedicated to reviewing the project submissions.

I am continuously impressed with the pride that consulting engineers show when their projects are acknowledged and profiled. Consider highlighting your next high profile project and help us tell our story.

RICHARD TILLER, M.ENG., P.ENG., FEC
CHAIR, ACEC BOARD OF DIRECTORS

MESSAGE DU PRÉSIDENT DU CONSEIL

Racontons notre histoire

Chaque année, des ingénieurs-conseils et des firmes de génie-conseil réalisent des milliers de projets d'un bout à l'autre du Canada et à l'étranger. Ces projets sont de petite ou grande envergure. Ces firmes œuvrent dans des créneaux particuliers ou sont de grandes sociétés. Mais tous ces projets ont ceci en commun : le travail acharné, le dévouement et l'innovation dont font preuve les ingénieurs-conseils. Ces projets — passés, présents et futurs — soulignent le fait que notre industrie joue un rôle de premier plan pour ce qui est de construire et d'entretenir notre infrastructure nationale.

De la conception de ces projets jusqu'à leur achèvement, on accorde peu d'attention à l'ingénieur-conseil ou à la firme. C'est pour cette raison que les Prix canadiens du génie-conseil, qui sont présentés conjointement par l'AFIC et la revue *Canadian Consulting Engineer*, sont si importants. Ils célèbrent vingt projets remarquables réalisés par des firmes à travers le pays et reconnaissent le travail des ingénieurs-conseils qui les ont concrétisés. Les Prix canadiens du génie-conseil, ainsi que les programmes de reconnaissance provinciaux qui ont lieu au cours de l'année, nous permettent de raconter nos histoires, des histoires qui devraient être racontées plus souvent et être plus largement entendues!

Je tiens à féliciter les ingénieurs-conseils à l'origine des projets auxquels nous avons rendu hommage lors du gala de remise des prix. Je tiens à remercier toutes les firmes qui ont soumis leurs projets dans le cadre des prix annuels de 2016. J'aimerais aussi remercier *Canadian Consulting Engineer* et les membres du jury, qui ont donné de leur temps pour passer en revue les projets en lice.

Je suis sans cesse impressionné par la fierté que les ingénieurs-conseils manifestent quand leurs projets sont reconnus et mis en valeur. Pensez à nous faire part des projets de haut niveau que vous réaliserez et aidez-nous à raconter notre histoire.

RICHARD TILLER, M.ING., ING. P., FIC
PRÉSIDENT DU CONSEIL D'ADMINISTRATION

Réjean Breton wins 2016 ACEC Beaubien Award

On October 25, outstanding achievements in consulting engineering were showcased at the Canadian Consulting Engineering Awards gala, an annual event co-sponsored by ACEC and *Canadian Consulting Engineer.* Twenty projects were selected for recognition with an Award of Excellence, and of these, five projects were selected for Special Achievement Awards.

Réjean Breton, Eng., was honoured that evening as recipient of ACEC's prestigious Beaubien Award. Presented annually, the Beaubien Award recognizes individuals for exceptional service to ACEC and for contributions to the advancement of consulting engineering through professional accomplishments.

Réjean has always been — and continues to be — an exceptional ambassador of the consulting engineering profession. Gifted with a capacity for wonder and an ability to convey it to others, Réjean has always encouraged the recruitment of young engineers and promoted women in engineering. A passionate and visionary man, he is known for his straightforward manner and for ardently defending what are often very original ideas.

Réjean believes that true success is found off the beaten path. This philosophy is what drove him in 1980 to co-found the firm that would later become Breton, Banville et Associés, or BBA. By 1986, with over 35 employees and growing exponentially, the firm relocated from Beloeil to the small town of Mont-Saint-Hilaire. Moving to a suburban area instead of Montreal was a risk; however, Réjean was forward-thinking. He foresaw

that IT advances would eliminate the issue of distance for clients and recognized that suburban quality of life would help attract top young talent. By 1998, the BBA building was constructed, complete with a host of innovate characteristics that earned the new head office several accolades. Almost 20 years later, the building is still at the cutting-edge of technology.

Under his leadership, the firm continued to grow, expanding into the international market to deliver projects in France, Haiti, Peru and several African countries. The refurbishment project the firm undertook in Rwanda immediately after the civil war, really a humanitarian endeavour, was an incredibly intense experience that remains a vivid memory for Réjean. He remained president of BBA until his retirement in 2006. To this day, his legacy of strong, deep-rooted business culture continues to drive the organization which now has over 600 employees.

From the time BBA was founded, Réjean strongly encouraged the firm's partners to support social causes and recognized the company's social responsibility. The list of initiatives he led is long and some are highly original, such as the BBA Arts Day. Since 2007, Réjean has chaired the Fonds de la relève Théodore-Wildi, a scholarship for engineering students at Laval University. In retirement, he remains as passionate as ever and continues to give back by sitting on several boards in the areas of arts and culture, science and education, and business.

In the same spirit, Réjean has been passionate in supporting the profession. In 2002, he joined ACEC's Board of Directors, holding various positions including Board Chair in 2006-2007. During his tenure, Réjean initiated the ACEC Tree for Life Award, presented to a firm whose project best demonstrates outstanding environmental stewardship. Although his official duties with ACEC ended in 2008, Réjean continues to support the world of engineering by regularly attending national conferences and award galas, and by representing ACEC on the Engineering Change Lab sponsored by Engineers Canada. Réjean was selected for this award by his industry peers for his exemplary service to the association and his contribution to the consulting engineering industry and the profession.

Tijana Smiljanic wins the 2017 Allen D. Williams Scholarship

The Association of Consulting Engineering Companies-Canada (ACEC) is pleased to announce that the 2017 Allen D. Williams Scholarship has been awarded to Tijana Smiljanic of McElhanney Consulting Services Ltd. Ms. Smiljanic was presented with her award at the Canadian Consulting Engineering Awards Gala in Ottawa.

Left to right: Tim Stanley of ACEC-BC; TijanaSmiljanic of McElhanney, receiving the ACEC-BC Young Professional Award for her extraordinary accomplishments in the first 10 years of her engineering career; Keith Sashaw of ACEC-BC.

The Allen D. Williams Scholarship is presented annually to a young professional, employed by an ACEC member firm, who demonstrates a commitment to the consulting engineering industry in their province or territory.

Tijana Smiljanic, P.Eng., is a transportation engineer at McElhanney. As a fast-rising star within the firm, she has demonstrated a great aptitude for the business of consulting engineering, a desire to learn, and an eagerness to take responsibility. Her passion, drive, technical knowledge, client understanding and leadership skills make her a successful project leader. From the beginning of her career at McElhanney, Tijana has worked on larger assignments, specializing in major transportation/design and P3 projects, such as the Port Mann/Highway 1 upgrading and the Power Street overpass in Vancouver. She is currently the design coordinator for the firm's portion of the $200-million design-build interchanges project in Winnipeg.

In addition to her demanding role, Tijana is an active young leader at McElhanney, co-leading the development of the YP rotational program which promotes challenging, rewarding and long-standing careers with the firm.

In 2014, Tijana was elected Chair of the ACEC-BC Young Professionals Group. During her term, she worked to have the ACEC-BC Board approve a budget increase that permitted the YPG to host outreach activities, sponsor university events, and fundraise for various school programs. Tijana also initiated the development of a three-year plan that provides a long-term, clear vision for the network and ensures initiatives spanning multiple committee terms are executed. In her role as Chair of the YPG, she also held a seat on the ACEC-BC Board of Directors and represented the province on the ACEC Young Professional Network. Her contributions in the first 10 years of her engineering career were recognized in the spring of 2016 when she was awarded the ACEC-BC Young Professional award.

Her involvement as a volunteer goes beyond her professional association. Tijana is active in her community at large, acting as a mentor volunteer with KidStart, in which she spends three hours a week mentoring a nine-year old girl.

The Board of the Allen D. Williams Scholarship Foundation selected Tijana for her proficiency in understanding the role of consultants in the engineering industry, her ability to establish strong client relationships and her involvement in large complex projects while expanding her leadership skills. Her commitment and dedication to her profession and her community through her volunteer work were attributes that also stood out to the Board.

The scholarship commemorates Allen Williams, past ACEC Chair and Founder of Williams Engineering Inc. It provides the winner with funding to cover registration, airfare and accommodation to attend the annual conference of the International Federation of Consulting Engineers (FIDIC).

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Controlling exposure to risk

The first step in controlling risk is the identification of risk. Just as the design consultant identifies design parameters in a programming process, the design consultant must identify the risk parameters of a specific project. There are many factors that influence risk. At a minimum, firms should always consider the following:

- **The nature of the project** — aspects such as sufficiency of scope, site, budget and schedule; community sensitivity or opposition; unusual regulatory requirements; or a history of a high incidence of litigation.
- **The firm's capabilities and experience** — the appropriate design expertise and ability to spend the time necessary on the project.
- **Specific client attributes** — client attitude, funding, understanding of the nature of professional services and level of sophistication.
- **Construction industry factors** — the influences on the delivery of a project, such as the type of contractor selection process; the inclusion of other parties in the design and construction process; and the state of the local construction economy.
- **Constraints on time and cost** — the compensation for design services, the project budget and scheduling constraints.
- **Forces external to design and construction** — the general economic climate and the attitude of the community and government to new projects; the overall political situation, and laws, rules and regulations that might be forthcoming.

Risk Assessment

Once a firm has identified as many risk factors involved in the project as possible, it must assess the impact of the risk factors on the firm's ability to provide services in a professional and profitable way. The assessment should include looking at the possibility of loss — of something bad happening — but also thinking about the probability that the services will be affected by one of the identified risk factors. In addition, this exercise should include assessing the potential impact of risk factors on a firm's reputation. Such an analytical effort is usually best conducted not by an "expert" in the firm, but through the combined efforts of those who will be involved with the project — the staff who will interact with the client, consultants and construction contractors.

With a realistic understanding of the risks that might impact the delivery of services and the long-term financial health of the firm, the firm must evaluate its ability to manage the risks and must examine both its professional duties and its proposed contractual obligations. The firm must assess the power and authority the client is willing to provide to the firm to carry out its professional and contractual duties.

Perhaps most important in assessing the level of risk faced by a firm is whether or not the firm, both objectively and subjectively, feels it can be in charge of its own future with respect to the particular project — objectively in that the firm knows its resources, abilities and power, and subjectively in that the experience of the firm's staff can give a valuable "gut feeling" about the project.

Risk Management Options

After a firm has gone through the process of identifying risk factors and assessing their impact, it must explore the options available for managing the risk. The basic options should be well understood within firm management and, in many cases, should be a matter of discussion, and perhaps negotiation, with the client. In most cases, the following five categories of conceptual risk management should be considered:

- Avoidance of the risk by declining the project
- Retention or acceptance of the risk with compensation for the exposure
- Transfer of the risk to a third party (i.e., through insurance)
- Allocation of the risk by contract provisions, such as indemnity or limitations of liability clauses
- Mitigation of the risk through practice management techniques and increased capabilities

How each risk mitigation technique is adapted to the characteristics of each project represents a skill acquired through education, expertise, and the assistance of specialists such as lawyers and insurance advisors.

Risk management is not a reactive process once a problem surfaces; it is a proactive effort to identify the best method to control the risk environment in which the design consultant practices. The prudent management of risk allows a firm to pursue its practice objectives and to not ignore professional opportunities because of unfounded concerns.

This article was contributed by ENCON.

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2016 CANADIAN CONSULTING ENGINEERING AWARDS

AWARDS

PRIX CANADIENS DU GÉNIE-CONSEIL

THE COMPETITION WAS TOUGH!

On the following pages we are proud to present the winning projects in this year's Canadian Consulting Engineering Awards / Prix Canadiens du genie-conseil.

The winners were announced and celebrated in Ottawa at a gala dinner on October 25. Congratulations to all!

Now in their 48th year, the awards are held jointly by *Canadian Consulting Engineer* magazine and the Association of Consulting Engineering Companies-Canada (ACEC/AFIC). They are the longest running and most important national mark of recognition for consulting engineers. The winners are projects that demonstrate a high quality of engineering, imagination and innovation.

This year's number of entries far exceeded previous years. We received 77 entries from across Canada. By comparison in the last four or five years we have received around 60 to 65 projects — so the competition was tough!

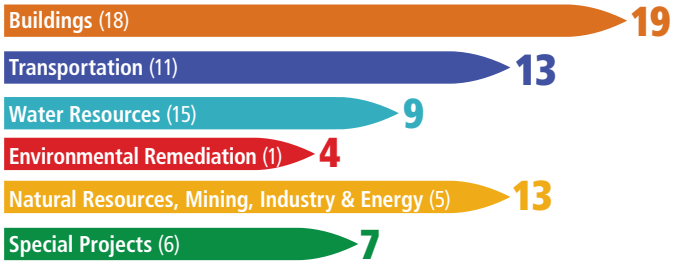
The jurors selected 20 projects to receive Awards of Excellence and five Special Awards.

The **Schreyer Award** is the "grandfather" of the special awards and is the top technical award. This year it goes to a highly innovative wood structural design at the Grandview Heights Aquatic Centre in Surrey, B.C. by Fast + Epp. The **Tree For Life/Un Arbre à Aimer environmental** award is given to BBA for their work on a plant in Edmonton that is the world's first commercial biorefinery that converts non-recyclable household garbage into clean energy. An award for a project that has special societal and cultural value, the **Engineering a Better Canada** award, went to Stantec for the beautiful wooden Mistissini bridge. It was built for a remote James Bay Cree community in Northern Quebec. The **Ambassador Award** is for an international project. It goes to AECOM's Montreal office for studies that helped Haiti protect its infrastructure from the ravages of storms and climate change. Lastly, the **Outreach** award goes to North Vancouver's COWI team who volunteered to build the Rio Abajo footbridge for a small community in Nicaragua.

TOTAL NUMBER OF ENTRIES 77 | 64 **NUMBER OF ENTRIES LAST YEAR**

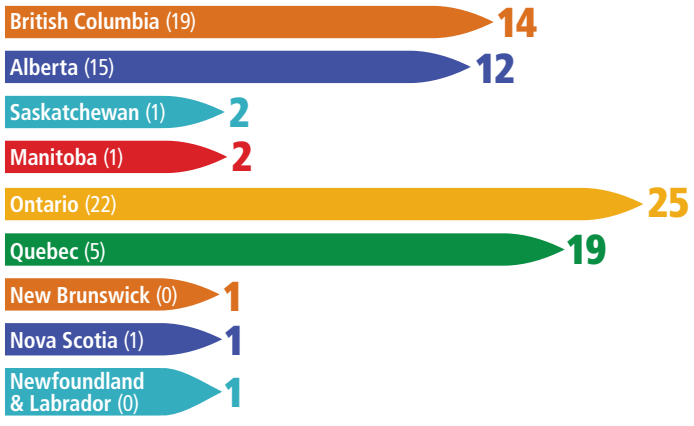
ENTRIES BY CATEGORY (last year's total in brackets)

TECHNICAL



NON-TECHNICAL

PROVINCE OF ENTERING FIRMS



Note: Awards are not chosen as one project per category (which would not be fair since the number of entries in each category varies widely). Rather awards are given by their merit.

CHAIR'S COMMENTS

How to choose?

It was a great pleasure to be on the panel of jurors for this year's Canadian Consulting Engineering Awards.

Every year I am amazed at the ingenuity, creativity and caring of engineers throughout Canada. Believe me, the jury did not have an easy time singling out the few projects you see here.

Besides selecting 20 projects for awards of excellence, we were also charged with selecting five of those winning projects for special awards. How to choose between projects like a pedestrian bridge in Nicaragua, the huge Union Station project in Toronto, flood mitigation in Haiti, an Alberta plant that turns garbage into biofuel, and changes to an ice arena in Nunavut that have dramatically lengthened the available use of the facility and produce zero greenhouse gases in operation? Some projects are technically challenging. Others are creatively addressing a changing earth. And some have significantly improved the lives of people in the communities in which they were undertaken.

But choices do have to be made. So the projects we have honoured are those that, with the information we had available, were deemed to be the best of the best. They are projects that deserve recognition from consulting engineers, Canadian engineers in general, and the Canadian public who may hear about these projects for the first time through these awards.

Thank you to all the companies involved for letting us learn more about your great work, and congratulations to all the winners.

— Peter Judd, P.Eng., Jury Chair

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

Also, for more details about the awards' history and purpose, visit http://www.canadianconsultingengineer.com/awards/about/

CANADIAN CONSULTING ENGINEERING AWARDS JURY

The jury met to make their final decisions in Toronto in June.

CHAIR

Peter Judd, P.Eng., was general manager of engineering for the City of Vancouver until his retirement last year. 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 also spearheaded Vancouver's Olympic and Paralympic Operations during the 2010 Winter Games.

JURORS

Mohamed Al-Hussein, Ph.D., P.Eng., is a professor in construction engineering and management at the University of Alberta. He holds the NSERC Industrial Research Chair in the industrialization of building construction. He is a past chair of the Canadian Society for Civil Engineering national construction division (2004-2008) and has held advisory posts such as on the City of Edmonton Infrastructure Technical Advisory Committee.

Annette Bergeron, P.Eng., MBA, FEC, was president of Professional Engineers Ontario in 2013, and president and chair of the Ontario Society of Professional Engineers in 2005 and 2010. She currently serves on the boards of Engineers Canada, and the Electrical Safety Authority (of Ontario), after teaching and administrating at Queen's University in the Faculty of Applied Science, and School of Business. She has twice been named one of the Top 25 Women of Influence in Canada.

Jim Burpee, P.Eng., retired in 2014 as president and chief executive officer of the Canadian Electricity Association. Involved in the North American electricity industry for 38 years, he held senior executive roles in Ontario Power Generation and its predecessor Ontario Hydro. During that time he oversaw 17,000 MW of fossil and hydroelectric generation, two different nuclear sites, energy trading and corporate development.

Gerry Chaput, P.Eng., is Assistant Deputy Minister of the Provincial Highways Management Division, Ontario Ministry of Transportation. His division oversees the planning, engineering, construction and maintenance of 16,500 kilometres of highways and 2,700 bridges, delivering the province's largest capital construction program. He served as president of the Transportation Association of Canada from 2014-2016.

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William (Bill) Edwards, P.Eng., is chair of SJ Energy in New Brunswick. In March he retired as Commissioner of Transportation and Environmental Services and as Commissioner of Saint John Water for the City of Saint John. He had a 30-year career with the city, including acting as Chief Building Inspector and Chief City Engineer. In 2012 he received the Queen's Diamond Jubilee Medal for his work with the Canadian Federation of Municipalities.

Vanessa Fong, B.Sc., M.Arch, OAA, is an Ontario architect and principal at VFA, a studio specializing in holistic, contextual design. She has served on the council of the Ontario Association of Architects for three years and is currently its vice-president of communications. She also sits on the board of the Design Industry Advisory Committee, a cross-disciplinary research group that promotes the contribution of designers from all disciplines to economic, social and environmental goals.

Louise Millette, Eng., Ph.D., is director of the Department of Civil, Geological and Mining Engineering at Polytechnique Montréal, and the first woman to hold the position. She is also head of the Sustainable Development Office at the university. Outside academia her roles have included helping to draft the "First Strategic Plan for Sustainable Development of the Montreal Community." She has served on several boards and was recently appointed to the board of the Canadian International Resources and Development Institute.

Chantal Morissette, M.Sc.A has been head of the City of Montreal's Water Service (Service de l'eau) since 2011. She manages $30 billion worth of assets related to producing drinking water for 2 million people, as well as wastewater treatment and storm water management. The service has 900 employees and operates six drinking water treatment plants and a wastewater treatment plant said to be third largest in the world. She has served on the board of the American Water Works Association and is currently on the board of CERIU (Centre of expertise and research in urban infrastructure).

Catherine N. Mulligan, Ph.D., Eng., is a professor in graduate studies and research at Concordia University in Montreal. She is also Concordia Research chair in Geoenvironmental Sustainability. After graduating from McGill University in chemical engineering, she worked as a research engineer for 14 years, then obtained her doctorate in geo-environmental engineering. In 2010 she was given the A.G. Stermac Award for outstanding service to the Canadian Geotechnical Society.

Stephen Panciuk, P.Eng., is senior vice president and national engineering professional lead at Marsh Canada. Based in Ottawa, he specializes in developing and implementing a national strategy for large design firms, and project errors and omissions liability insurance. After earning a civil engineering degree he had five years' experience in the heavy civil construction industry before entering the insurance business. He is a frequent speaker at conferences and a member of the Association of Consulting Engineering Companies-Canada contracts committee.

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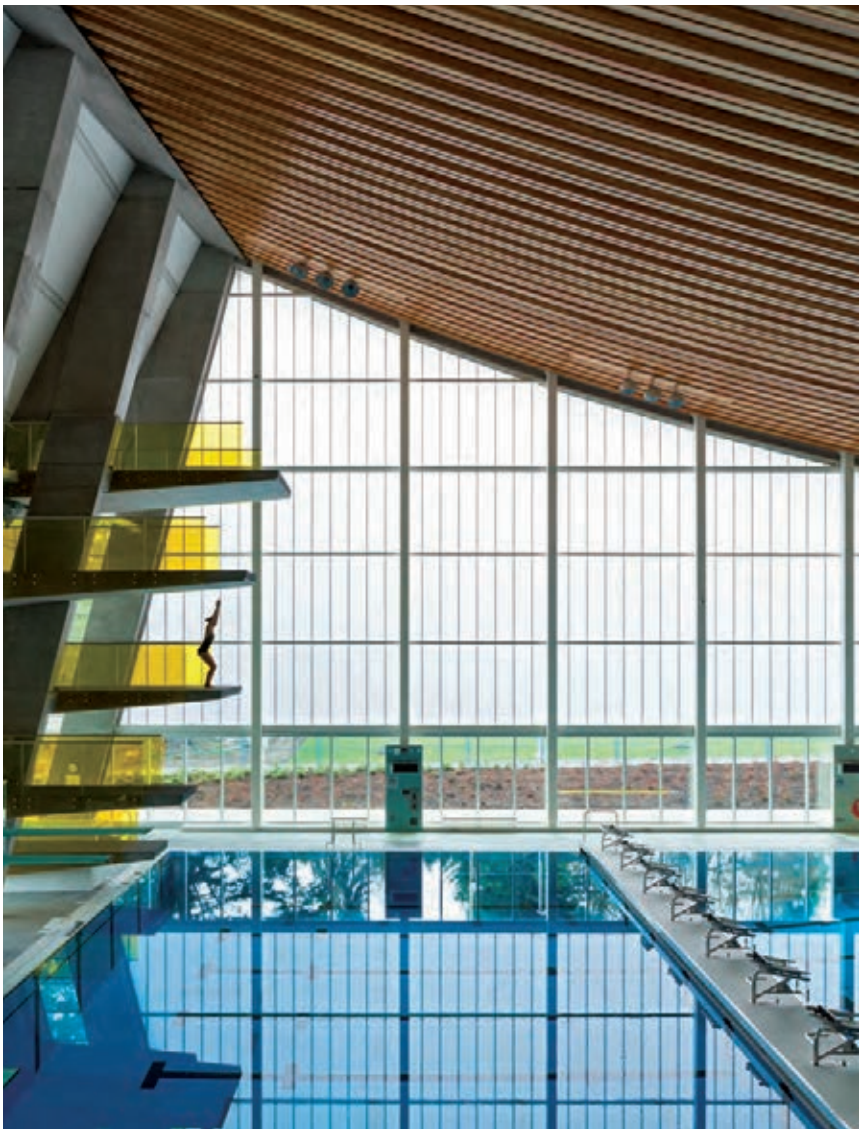
SCHREYER AWARD &
AWARD OF EXCELLENCE

Grandview Heights Aquatic Centre

Fast + Epp



Ema Peter Photograpy

The glulam beam roof (only 300-mm deep) soars above the dive tower.

"We gave this project the top technical award. It shows out-of-the-box thinking, particularly in how it spans the primary structure across the long span rather than the short span, and accommodates an undulating roof structure that has hanging timber 'cables' suspended between concrete buttresses."
–Jury

The $55-million Grandview Heights Aquatic Centre fulfils the City of Surrey's desire for an iconic building that serves a diverse population. It is also to be a catalyst for civic growth.

For an aquatic centre of such a size — 8,825 m² — the design team recognized that the roof structure is a crucial point of visual interest. The architect challenged the team to "think outside the box" and explore spanning the primary structure across the long span rather than the short span — despite knowing this break with convention had the potential to substantially increase costs.

Shying away from typical ribbed ceilings of steel that would corrode from the chemicals and harsh humidity of an aquatic environment, Fast + Epp pioneered an ambitious and daring design — a hanging timber suspension roof. The architect (at first somewhat surprised by the audacity of a timber "catenary" roof) jumped on board. Once the decision was made to orient the leisure pool and lap pool end-to-end on site (they would normally be side by side), the challenge was to create a roof structure that would extend

over the 40 m x 105 m area.

The engineers investigated the feasibility of an almost-exclusively wood roof solution and developed what is likely the world's most slender long span timber catenary roof; it free spans 55 metres and 40 metres. A VEE shaped concrete column provides support between the spans. Small 5" x 10" (127 x 254 mm) long span glue-laminated wood beams act as cables under a double layer of plywood sheets as the main structural system.

The roof not only achieves the significant clear spans required for the pools, but uses only a 300-mm deep structure (compared with a typical 3,000-mm steel truss structure). By reducing the building volume, the engineers were able to ensure long-term energy cost savings for the facility's operations. Using the pools' 4.5-m excavation depths to bury concrete foundations deep underground allowed the team to stabilize the roof cables.

The warped roof geometry was also designed to manage rain water. As a cost savings measure the design was refined so only one cable curvature radius was required.

Unbalanced snow loading, wind uplift and dynamic excitation

The following are the key technical difficulties and their solutions.

- Unbalanced snow loading. Following an analysis of unbalanced snow loading, vertical deflections were in the order of 1,000 mm (which nearly caused the architect to faint!). By breaking the timber cables at the central column support or roof slab structure, and bracing this central structure with a shear wall at one end and steel brace at the other end, the engineers effectively reduced roof sag to a more acceptable 250 mm.
- Wind uplift forces. The relatively light timber cable structure had insufficient self-weight to prevent wind forces from lifting the roof. Adding concrete topping weight to the roof would have been structurally counterproductive and costly, while adding hold-down cables inside the building would be unsightly. Thus, wood cables were sized to have sufficient strength to resist snow loads and self-weight in tension, and just enough strength to resist wind uplift as skinny compression arches — the perfect balance.
- Dynamic excitation. A further concern also related to wind forces. Given its extremely slender profile, could the roof be subjected to unacceptable dynamic excitation (effectively becoming a Galloping Gertie of Tacoma Narrows fame)? The engineers felt the proposed warped roof geometry, as well as the damping effect of glued roof insulation, would sufficiently mitigate the potential for resonance. To confirm this, Fast + Epp recommended accelerometers be placed on the roof after erection, and that together with a metronome and a "jumping party," engineers could determine if a problem existed. The results revealed no further roof stabilization was required.

The facility is seeking LEED-certification, and meets stringent FINA standards to host sporting events in its 10-lane, 50-m Olympic size competition pool and dive platform. The best contribution a structural engineer can make to sustainability is to design efficient structures with minimal material; the Grandview Heights Aquatic Centre was successful in achieving both of these desires. Since it opened in March 2016, the anticipated number of visitors has been surpassed. CCE

Grandview Heights Aquatic Centre	
Award-winning firm/structural engineer:	Fast + Epp (Paul Fast, P.Eng., Derek Ratzlaff, P.Eng.)
Owner:	City of Surrey
Architect:	HCMA Architecture + Design
Mechanical:	AME
Electrical:	Applied Engineering Solutions
Geotechnical:	GeoPacific
Contractor:	Ellis Don

Alison Faulkner, Fast + Epp

Exterior view of the Surrey building, with its "warped" slender long span timber roof.

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BBA is pleased to be recognized for its contribution to the Enerkem Alberta Biofuels project.

Congratulations to Mr. Réjean Breton, founder of BBA, for receiving the Beaubien Award, which is granted for lifetime contributions to the Canadian consulting engineering industry!

TREE FOR LIFE AWARD & AWARD OF EXCELLENCE

Enerkem Alberta Biofuels

BBA

Plant at the Edmonton Waste Management Centre. BBA provided detailed engineering for the modular process units.

BBA

"Winner of a special award for environmental stewardship, this commercial refinery for converting non-recyclable garbage into biofuels deals with the challenges of being a "first" technology. The process converts the waste material to biomethanol, and has the potential for very significant environmental benefits, potentially reducing landfilled material by 90%."
–Jury

Enerkem Alberta Biofuels is the world's first commercial biorefinery that converts non-recyclable household garbage into clean, renewable energy. BBA was chosen by Enerkem for its industry expertise to provide detailed engineering for the plant.

Canadians each generate an average of 1,031 kilograms of solid waste per year. From this, an average of 25%, mostly organic waste like food and cardboard, is recycled. The rest of the waste is non-recyclable and mostly dumped in landfills. Some regions incinerate the waste, but when it is deposited in landfills, it decomposes over the years and creates greenhouse gases, such as methane, along with other soil contaminants.

The Enerkem Alberta Biofuels Project is a global game-changing facility because it provides a sustainable alternative by recovering carbon molecules contained in non-recyclable waste and producing biofuels. The plant is fed with materials such as textiles, non-recyclable plastics, wood residues and packaging. Until now this waste could not be recycled in any other way.

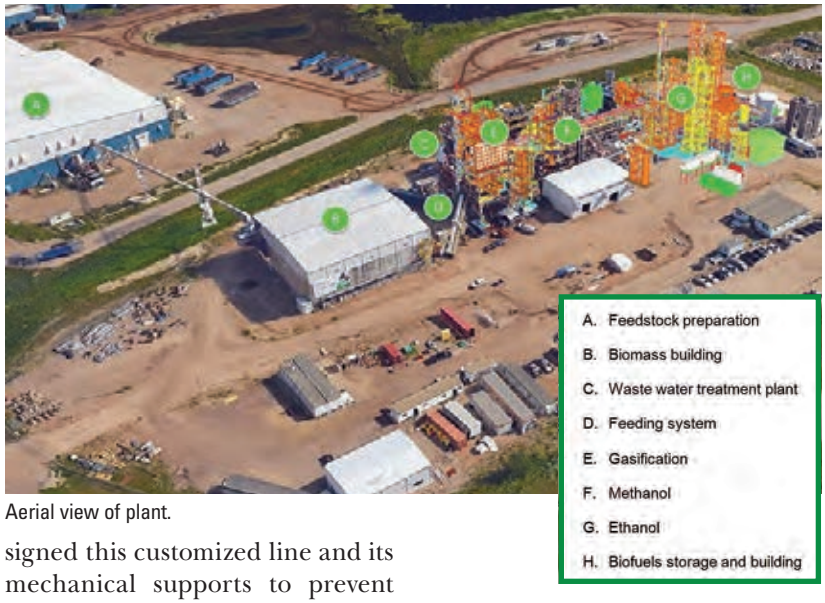
Biomethanol, a chemical building block

Located on the site of the Edmonton Waste Management Centre on Aurum Road NE, the Enerkem Alberta Biofuels plant initiated the commercial production of biomethanol in the summer of 2015. The biomethanol product is sold as a chemical building block to produce secondary chemicals, which can then be used for thousands of everyday products.

BBA also participated in the de-

sign of a plant expansion to produce cellulosic ethanol, a renewable fuel that is blended with traditional gasoline. Ultimately the plant will have a yearly capacity to process 100,000 dry tones of non-recyclable waste. It will enable the city of Edmonton to increase its rate of waste diversion from landfill to 90%.

The project benefits Canadians in many ways: reducing the production of greenhouse gases; generating biofuels as an alternative to finite fossil fuels; and building a sustainable bio-economy.



Aerial view of plant.

Modular units and piping challenges

BBA's mandate for Enerkem was to provide modular detailed engineering for the methanol purification and ethanol production process units. Enerkem wanted the plant to be designed in modules and to use the least surface area.

Going beyond its engineering mandate, BBA proposed a construction strategy and changes to the project schedule to gain value. Instead of following the standard development sequence, the idea was to design and fabricate modules to align with the construction plan. The goal was also to optimize the time spent on site by large cranes during construction.

The BBA team's design optimized the weight and volume of the modules to minimize the overall costs. They developed a vertical layout for the modules, minimized their structural steel weight, and efficiently integrated the piping routing into the structures.

The piping between equipment was sized from 1" to 6" in diameter. One of the largest conduits operates at extreme temperatures with a flow of wide-ranging components from the garbage. BBA's mechanical engineering experts designed this customized line and its mechanical supports to prevent the installation of costly expansion joints. The constraints analysis ensured the system would operate reliably under various conditions. The solution is unique in that the conduit is made of various material liners.

The entire design was modelled in 3D so that the plant and its modular approach could be adapted and reproduced by Enerkem for future projects.

Equipment and material research

Since the plant is unique worldwide, the selection of mechanical equipment, piping, valves and instruments was a first and had to be defined. The engineering had to consider fluid velocities, product composition, pressure, temperature, expected plant life, reliability and space limitations. Finding solutions could only be done through the cooperation of BBA design experts, the Enerkem technology team and suppliers.

At the start of this project, Enerkem's research had been demonstrated through a smaller-scale facility located in Westbury, Québec. The capacity of the Edmonton plant is seven times greater than the demonstration plant and it is supplied with a different feedstock, so BBA worked jointly with the Enerkem technology team to integrate evolutional research into the project.

Thanks to the Enerkem Alberta Biofuels plant, garbage is now seen as an opportunity to create something useful. The project is a significant step toward a sustainable economy where items that are no longer useful are being decomposed to the molecular level and recomposed into a valuable product. **CCE**

Enerkem Alberta Biofuels plant, Edmonton

Award-winning firm/ prime consultant for detailed engineering:	BBA, Mont-Saint-Hilaire, Que. (Nathalie Blackburn, P.Eng., Stéphane Campagna, P.Eng., Normand Thibault, Tech., Yannick Labrie, Tech., Nicholas Allen, P.Eng., Stéphane Fortin, P.Eng., Jason Salama, Tech., Marc-André Perron, P.Eng., Yves Robitailles, P.Eng., Samuel Fortier, P.Eng.)
Client-owner:	Enerkem

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ENGINEERING A BETTER CANADA AWARD
& AWARD OF EXCELLENCE

Mistissini Wooden Bridge

Stantec

"This bridge won the special award given to a project that showcases how engineering enhances the social, economic or cultural quality of life of Canadians. The bridge demonstrates the strength of wood in a demanding design, supporting road traffic loads on four spans each nearly 43 metres long. It also provides a vital link in a remote community, and the local Aboriginal work force participated in its construction."
–Jury

The Cree Nation of Mistissini is located at the southern tip of Lake Mistassini in the James Bay region of Northern Quebec. They wanted a bridge to cross a body of water called the Uupaachikus Pass in order to make some land across the water more accessible for development.

Stantec designed a 60-metre long glue-laminated (glulam) wood beam, semi-continuous arched bridge for the First Nation. The bridge has a unique architecture and is innovative in its use of wood as the dominant building material. The use of wood enabled the local community to participate in the project and promoted the region's socio-economic development.

Completed in 2014, the bridge comprises four continuous spans combining straight girders and arches in wood. The latter were added inside each span in order to minimize the effects of the interior spans and lend an important architectural aspect to the design.

Above all, the designers had to create a structural system capable of supporting road loads on spans nearly 43 metres long. The longest item manufactured by glulam plants was merely 24.4 metres. To accommodate this assembly challenge, a staggered joint method was used. The shear interface between the arch element and straight beam is distributed through special plates fixed by annular nails. These connectors create an air gap and produce a better uniform stress distri-

Stantec

The 60-metre long glulam arched wood bridge has a unique architecture that resonates with the Cree community.

bution on the wood.

Given the structure's complexity and innovative aspects, Stantec involved the timber frame manufacturer and their plant in Chibougamau early in the project, involving them in meetings and allowing the design to be adjusted to the plant's manufacturing tools.

Stantec

Bridge underside.

No expansion joints

The glulam properties made it possible to eliminate expansion joints over the 160-metre bridge, giving the structure greater durability. Since temperature affects wood less than steel or concrete, the designers opted for fixed supports on all sections in order to eliminate the need for expansion joints. This approach proved to be a major asset for structural sustainability, since expansions joints are usually a weakness in steel or concrete bridges due to water damage.

Deck waterproofing and sealing

A membrane adhered to the wood decking could not ensure watertightness; it might tear because the planks are installed with spaces to allow the wood to expand and contract with humidity changes. Instead a marine plywood layer was added over the entire deck surface, thereby allowing for contraction and expansion of the wood, and protecting the deck planks when the asphalt surface has to be replaced in future.

Wooden bridge construction using glulam for load-bearing elements is rare in North America. Codes and standards require the use of rot-resistant materials or, require treatment using a wood preservative. Quebec glulam is sourced primarily from spruce — a very resistant tree species from a mechanical standpoint, but practically impossible to treat using common industry preservatives. As such, Stantec designed a deck with primary protection against all types of weather, while the joints between structural elements (beams and columns) were designed to dry quickly after exposure to rain and snow. As well, a sealing product was used for the wood's exterior surfaces in order to ensure structural sustainability and enhance its architectural appearance.

A source of pride for the community

The project was warmly welcomed by the people and promoted their participation. The structure's aesthetic aspects integrated perfectly into the community's environment and the bridge has quickly become a source of pride. Also, the use of a wooden bridge gives the local community chance to carry out the bridge maintenance without the need to call in outside expertise.

The choice of wood for the construction also promoted the region's economic development. The price of raw materials in Mistissini is around 25% higher for concrete and steel, compared with larger urban areas. What's more, the glulam supplier's plant is less than 90 km from the construction site, and they supply black spruce sourced from the region.

The designers not only compared construction costs of various solutions, i.e. wood versus steel/concrete, but also carried out a carbon footprint analysis, which was based on the foundations (piers and abutments) as well as the deck. In the end, the wooden bridge solution yielded negative carbon emissions equivalent to 497 tonnes of CO_2, compared to a steel/concrete bridge with CO_2 emissions equivalent to 969 tonnes. In total, the difference between the two solutions was 1,472 tonnes of CO_2, equal to the amount of CO_2 emitted in the combustion of 640,000 litres of gasoline.

The project has received awards of excellence from the Quebec Association of Consulting Engineering Companies (AFG Quebec) and from the Quebec Transportation Association. **CCE**

Mistissini Wooden Bridge, Quebec	
Award-winning firm (prime consultant):	Stantec (Denis Lefebvre, ing., Alessandro Cirella, ing.)
Owner:	Cree Nation of Mistissini
Contractor-construction:	BSL/Nisk

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AMBASSADOR AWARD &
AWARD OF EXCELLENCE

Infrastructure Protection in Haiti

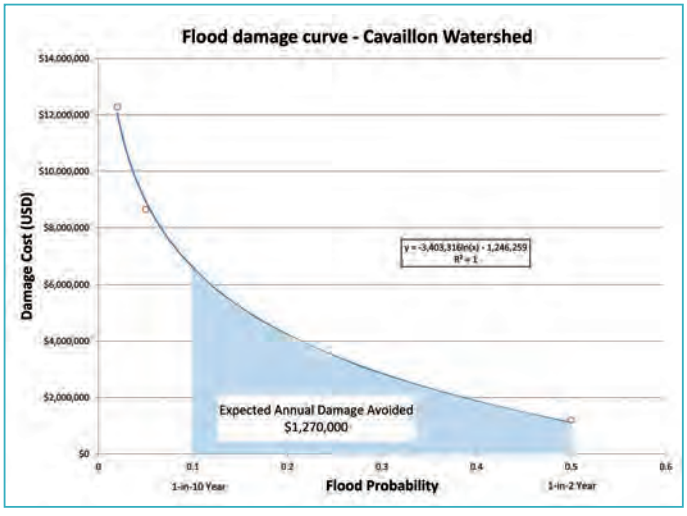
AECOM

"Winner of the special award for international work is this project in a Caribbean country that is subject to dramatic weather events. The engineers proposed all manner of civil works to help contain flooding and help to sustain the agricultural community. Perhaps as important is the transfer of knowledge to the Island residents, helping them to continue to make improvements."
–Jury

AECOM was commissioned by the Haiti Ministry of Agriculture, Natural Resources and Rural Development (MARNDR) to conduct preliminary studies for flood protection in Haiti. AECOM put forward an innovative technique combining engineering, hydrology and social economy to identify, assess, design and prioritize future infrastructure needs in five watersheds.

The solutions were discussed and agreed with the communities, while providing the best protection against natural disasters and limiting their impacts on the environment — all in the context of climate change.

In its latest report, the Intergovernmental Panel on Climate Change (IPCC) predicts that droughts and major tropical cyclones will intensify, and that heavy precipitation during hurricanes will be more frequent in the Caribbean. Haiti is often subject to flooding, droughts, hurricanes, and earthquakes. It is also one of the most vulnerable countries in terms of climate change when considering both the risks of physical impacts and the environmental and socio-economic factors that aggravate the situation.



AECOM

An ecological disaster that has persisted for nearly a century in the country is the reduction in forest cover, from 60% in 1923 to less than 2% today. The loss of vegetation has had considerable impact on soil erosion and water retention during heavy rainfall. The frequency and impact of flooding have increased in the valleys, where most of the population and critical infrastructure are located.

Prioritizing the infrastructure needs

To face the growing threat of these natural catastrophes, Haiti implemented a flood prevention program (Natural Disasters Mitigation Program or PMDN) for the most affected areas.

AECOM

Water harvesting structure in one of the areas covered by AECOM's study. Within a six-month time frame AECOM had to do analysis and propose precise measures to be implemented in a territory of 2,400 sq.km.

Using an innovative approach, AECOM identified and prioritized the infrastructure needs for five watersheds that cover roughly 2,400 sq.km, or 9% of Haitian territory. The works AECOM proposed consist of a wide range of constructions such as several kilometres of retaining and gabion walls, 200 dykes and sills in gabions, 330 micro-dams and 4,500 gully check-dams.

Besides protecting existing infrastructure (buildings, roads) and controlling flooding, the proposed works will protect farmland and rural activities. They will allow for new crops to be developed and the introduction of animal husbandry on formerly flood-prone zones. Most importantly the works will help to prevent casualties, income and material losses in the local riverside communities.

Adapted technology

Various techniques have been designed recently to determine flooding damage curves by taking into account climate change. However, these curves can only be valid for specific environments and protection works in a given country; unfortunately, they are not available in Haiti.

To address this shortcoming, AECOM adapted a technique specifically for Haiti, enhanced certain parameters and transferred it to the MARNDR. In this way AECOM helped MARNDR select priority measures and intervention sites for investment, based on rigorous social and economic premises.

Combining engineering and socio-economic data

The traditional hydraulic modeling approaches used to compute the extent of flooding are not suitable due to Haiti's lack of critical historical hydrological and rainfall data. As well, there is insufficient detailed and accurate topographic data available.

Since flooding has long-lasting negative impacts on agricultural parcels, urban and rural infrastructures, as well as on the victims, AECOM designed an innovative methodology that takes a more comprehensive approach to the impacts of past flooding events. The approach combines engineering (notably hydrology) and socio-economics to estimate the probability and the impact of flooding events and to compute the corresponding damage curves.

AECOM trained 25 Haitian staff to collect engineering, sociological, economical and hydrological data, based on spatial analyses. They surveyed 1,200 households to gather data on damages and the extent of flooding during the last hurricanes and tropical storms. A unique technique for household sampling, based on the overlaying of several GIS layers was used (land use, built density and flooding risks).

With this technique, data gathering is much more precise, less time-consuming and more economical compared to traditional techniques used to estimate flooding impacts.

Reducing gullies and silting

The infrastructure proposed by the study will have positive impacts on the environment. For example, the works planned in the upstream areas of the watersheds will reduce the formation of gullies on steep slopes and help to trap sediments. This will help to prevent silting at structures such as dams and irrigation canals downstream. The works also protect infrastructure along riverbanks, such as roads and ditches that can be damaged or destroyed by bank erosion, scouring, and landslides.

Furthermore, water-harvesting structures such as small dams and hillside impoundments yield benefits for the water table. They also provide irrigation for increased crop production, which further prevents erosion. **CCE**

An improved method for planning protection infrastructures against natural disasters caused by climate change in Haiti.

Award-winning firm/ prime consultant:	AECOM, Montreal (Pierre Roy, P.Eng., Vincent Locquet, P.Eng., Josilien Édouard, Martin Harvey, P.Eng., Jacques Langlois, PhD, Sébastien Boudreau, Henri Tichoux, François Trudeau)
Client:	Ministère de l'Agriculture, des Ressources Naturelles et du Développement Rural (PMDN-MARNDR), Haiti

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Rio Abajo Footbridge

The bridge is a lifeline over a fast-moving river during rainy season.

COWI North America and Kiewit

COWI North America and Kiewit

"Winners of the Outreach special award, COWI engineers reviewed the design for this 81-metre footbridge, provided funding and sent a team to help with the construction. The bridge crosses a fast-moving river and gives the remote community its first year-round access to schools, clinics and markets in a nearby town. The impact of the project is truly life changing both for the community and the engineers involved."
–Jury

The isolated community of Rio Abajo in Nicaragua required an 81-metre footbridge over a fast-moving river to gain year-round access to schools, clinics and markets in a nearby town.

As part of a Bridges to Prosperity (B2P) industry partnership program, the COWI North America (COWI) and Kiewit team reviewed the footbridge design, provided funding and sent a team to construct the bridge with local volunteers. The team successfully completed the project on an impressive accelerated construction schedule, despite challenges due to the rural environment and a language barrier.

Swim or walk

Rio Abajo is a 3,000-person agricultural community with little more than a primary school and corner store. The town is a 30-minute walk from Pueblo Nuevo, a larger town that offers essential facilities such as a health clinic, secondary school, stores and markets. However, without a bridge to cross the river that separates the towns, during rainy season the Rio Abajo residents must walk two hours in the opposite direction to another major town, or swim across the fast-flowing river to Pueblo Nuevo.

Briselba Zavala Morales, a Rio Abajo elementary school teacher, told the B2P team of how she would cross the river to work each day. During her pregnancy, she narrowly escaped when the flooded river caught her and dragged her downstream. She has heard of this happening to children, too.

The flooded river prevents children from attending secondary

school year-round, inhibits the ability of farmers to deliver their goods to market, and creates a barrier to accessing healthcare services.

In 2015, COWI and Kiewit volunteered with B2P, a non-profit organization, to construct a footbridge over the dangerous river and help the Rio Abajo overcome their isolation. B2P works with bridge designers and constructors, local governments and student groups to build essential footbridges with rural communities in underdeveloped parts of the world. The goal of the Rio Abajo project was not only to create the year-round link, but also to provide the community with the skills necessary to maintain the bridge.

The superstructure was completed by the team and local volunteers in just eight days.

Team effort

The wide river crossing required an 81-metre long bridge, which is B2P's second largest suspension bridge worldwide. COWI and Kiewit each donated $25,000 to cover the cost and sent a combined crew of 12 volunteers to construct the bridge with the local residents.

The project was a great success, with the superstructure completed in just eight days. Key to this achievement was the strong team effort: COWI's design review complemented Kiewit's construction expertise and the team worked well with the local volunteers to keep the project moving forward.

Lack of resources and language barriers

The project challenges included constructing with a lack of resources in an underdeveloped rural environment. With limited options available, the team often had to improvise to complete the project.

The local volunteers were inexperienced in bridge construction and jobsite safety, many wearing personal protective equipment for the first time in their lives. The language barrier meant communicating using hand gestures and rudimentary Spanish. Overcoming these challenges required resourcefulness and flexibility from the entire team.

Employees used own time and funds

In addition to bridge construction, COWI engineers completed a design review of the B2P-designed footbridge. More than 20% of COWI's engineering staff voluntarily worked on this review. The design was divided into six packages, each of which was reviewed by a designated team. As well as reviewing the Rio Abajo design, COWI recommended improvements to B2P's standard footbridge design, which B2P has now implemented into their design package.

Furthermore, while the companies donated for the bridge materials, the four COWI engineers who travelled to Nicaragua to complete the construction did so entirely using their own funds and vacation time. The hours to plan and complete the project — the flights, fundraising, transportation and accommodation — all came out of their own time and pockets.

Nicaragua is the second poorest country in Latin America. The World Bank estimates that just 655,000 of Nicaragua's 2.3 million rural residents live less than two kilometres from an all-weather road. With its new footbridge, Rio Abajo residents can now safely travel to work or the market. The bridge diminishes isolation. Life in Rio Abajo stabilizes, and the local economy can develop and move towards self-sufficiency. CCE

Rio Abajo Footbridge, Nicaragua	
Award-winning firms (design review and construction):	COWI North America, N. Vancouver (Don Bergman, P.Eng.) and Kiewit
Owner:	Municipality of Pueblo Nuevo
Program manager:	Bridges to Prosperity (B2P)

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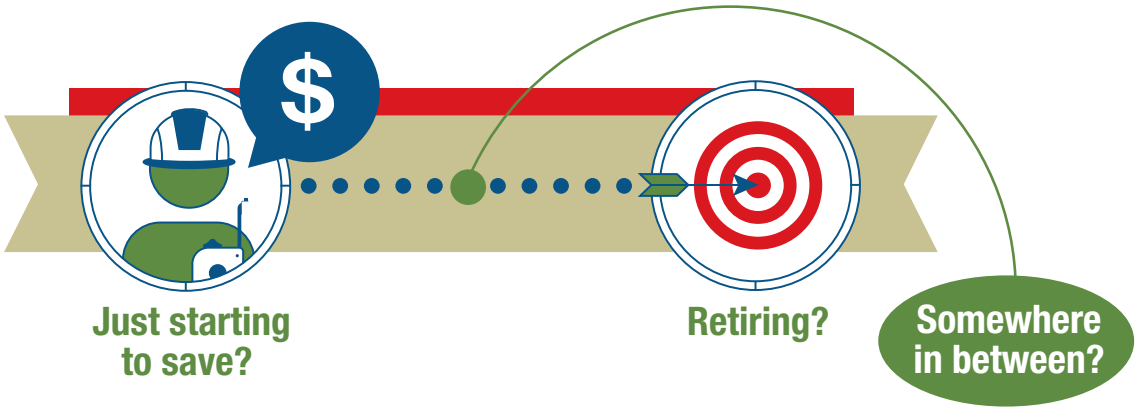

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AWARD OF EXCELLENCE

Varennes Net-Zero Library

Stantec

Located on the site of the former library, the new building is one of only about 10 in Canada that produce as much energy as they consume.

Stantec

"Demonstrating "the small community that could ... and did, "this municipal library is proof that net-zero buildings can be achieved at any scale while making no compromise in the design. Visits to the library have doubled since it opened, and it serves as a model and inspiration for the citizens and the engineering profession. "
–Jury

The City of Varennes in Montreal's south shore wanted to give its residents a new, modern, and welcoming library that promoted access to information and culture.

Stantec designed the electromechanical and structural systems, and carried out the civil engineering for this net-zero consumption building. Located on the site of the former library, the new structure is one of only about 10 buildings across Canada that produce as much energy as they consume, and the City of Varennes is the first in Quebec with a net-zero institutional building on its territory. The library serves as a model for sustainable development and shows that ambitious construction choices are now more accessible than previously imagined.

Building energy efficiency (low consumption)

The major challenge for Stantec's team was to design the energy-efficient systems to achieve the net-zero objective, or "energy production–consumption = 0 kWh." Before the installation of solar photovoltaic panels (for energy production), the building had to be exceptionally energy-efficient (low consumption).

Given Quebec's extreme weather conditions, the task was complex. The first step was to reduce the demand for energy through the overall design. Spread out on two floors, the building has an elongated shape and reduced depth, which provides optimal light penetration and cross ventilation.

Stantec recommended a system with water-source geothermal heat pumps, combined with eight 152-metre-deep geothermal wells. Hot/cold radiant flooring and high-efficiency variable-speed fan-coil units maintain comfort levels while obtaining an optimal power coefficient for the heat pumps.

The incoming outside air for oxygenation is mostly heated and humidified by a heat wheel. This strategy ensures that most of the heat and humidity contained in the air exhausted from the building is recycled for the fresh air. The heat wheel makes it possible to reduce outside air heating and humidification needs by more than 70%. In addition, the incoming outside air is preheated by thermal energy generated by the photovoltaic panels installed on the building's roof.

The design minimizes the need for artificial light. The windows have superior energy performance

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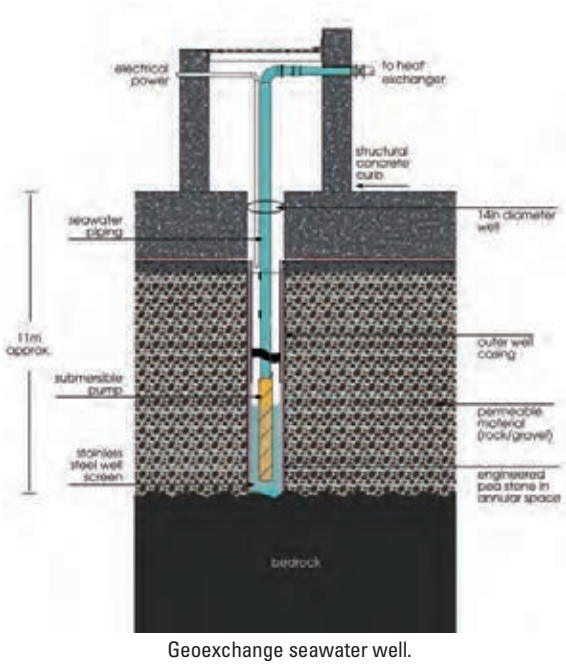
AWARD OF EXCELLENCE

351 Water Street



Geoexchange seawater well.

Stantec

Building in downtown St. John's.

Stantec

"This project showed an innovative use of seawater in a geo-exchange system. It reduced the use of energy by 35 per cent, and helped to create a sustainable and healthy work environment. The approach was also respectful of the historical surroundings."
–Jury

East Port Properties' goal in building 351 Water Street in downtown St. John's was to create a facility that was innovative, sustainable, healthy to work in, and respectful of its surroundings. It is the first building in Newfoundland and Labrador to be heated and cooled using seawater.

As prime consultant, Stantec designed the building and its mechanical-electrical systems. It consists of a 168,000-sq.ft., six-storey LEED-registered office tower standing above a six-level parkade and prime retail and commercial space.

The building uses the renewable energy source at its doorstep — the St. John's Harbour — for heating and cooling. It extracts and discharges energy from the harbour seawater, resulting in 35% less energy usage than a conventional building of equivalent size.

Designing the seawater heating and cooling system posed a unique challenge for Stantec. The building sits approximately 20 metres from the harbour. The land between is crowded with infrastructure, which meant it was not possible to use conventional intake and discharge structures.

The building also sits on low lying, manmade land that consists of highly permeable geological material and fill. Seawater permeates the underground soils below the building, which led Stantec to investigate whether it were possible to extract or discharge the energy from this underground seawater.

The team's search of the literature found no examples of a similar energy interface, so Stantec completed hydrogeological testing to confirm that vertically drilled water wells could produce the required volume of water from the soils below the building. The results

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351 Water Street

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from a test well confirmed the suitability of the site for the unique open loop system concept and the design proceeded as below.

Unique open loop concept and system

Depending on the season the HVAC system's heat recovery chiller absorbs or rejects heat to the harbour through heat exchange with three seawater wells.

Stainless steel torpedo pumps and piping are used in the geo-exchange system to limit corrosion of the system in the high saline conditions. An innovative process for raw water filtration reduces the suspended solids and improves the energy exchanger performance. The team drilled a hole about 11 metres deep with a casing, inserted a smaller pipe with a well screen and filled the annular space with an engineered pea stone. The system tests positively to 500 U.S. GPM and the water is very clear. Two wide mouth plate and frame heat exchangers isolate the chiller/heat pump water from the raw water. The system is charged with 35% propylene glycol.

The system is extremely cost-effective based on life cycle costs, and it requires a relatively minor addition of infrastructure beyond conventional systems.

Energy recovery and indoor air quality

In addition to the seawater heating and cooling system, the building's HVAC systems recover energy from waste heat sources whenever possible, including the building's general exhaust and tenant server rooms. When supplemental heating is required — generally only on the coldest winter days — two 400 kW electric boilers provide additional heating capacity to the heat pump system.

351 Water Street also has superior indoor environmental quality. Each floor is equipped with two variable air volume (VAV) air handling units; one for perimeter zones and the other for interior zones. Spaces such as meeting rooms and boardrooms are provided with demand controlled ventilation using CO_2 sensors where fresh air delivery is controlled. CCE

351 Water Street, St. John's, Nfld. & Labrador	
Award-winning firm (prime consultant, architecture, mechanical, electrical, interiors, geotechnical, environmental):	Stantec (Kerry Gosse, Strat Barrett, Bernie Ropson, P.Eng., Tony Costello, P.Eng., Lez Snow, Bob Macleod, P.Geo., Sterling Parsons, P.Eng.)
Owner/client:	East Port Properties
Other key players:	Pinnacle (civil), DBA (structural), Solterre (sustainability), Trendex (construction management /contractor)

Varennes Net-Zero Library

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and each office or zone has an occupancy sensor. A weather station is located on the roof to provide exterior data to a centralized DALI (digital addressable lighting interface) control system, so that lighting levels can be adjusted according to outside conditions.

Thanks to the above systems, the building's energy consumption is only 25% that for a building of comparable usage and scale. It thereby achieves an energy consumption level that is 75% below that set by the Model National Energy Code for Buildings (MNECB).

The team carried out multiple simulations before selecting the definitive HVAC design. Running simulations for a building in order to obtain its energy behaviour details, for every hour in a year, facilitates an analysis of the building's global operation and reveals interactions between building components.

Solar photovoltaic panels (energy production)

The shape of the building is oriented to maximize a southern exposure for the wall and roof surfaces. Pitched at 37°, the roof exposes 428 solar photovoltaic panels on its southern side. The solar photovoltaic panels have an efficiency of approximately 15%. They produce 100% of the energy consumed by the building, which is evaluated at 120,000 kWh/year, and equivalent to 0.19 GJ/m². A control system instantaneously records the energy consumption and electricity production on a screen at the library entrance. Annual energy savings are estimated at $40,000.

Source of inspiration and pride

Having obtained LEED Gold certification, the design includes many other sustainability features, including the fact that it was built on the same site as the former library (reduction in carbon footprint by 953 m²). It has a permeable parking area with honeycomb grass paving, retention ponds for surface runoff water, and electrical vehicle charging stations. CCE

Varennes Net-Zero Library, Quebec	
Award-winning firm (prime consultant):	Stantec, Montreal (Laurier Nichols, P.Eng., Michel Gendron, P.Eng., Isabelle Lauzon, P.Eng., René Dansereau, Tech.)
Owner:	Ville de Varennes
Architects:	Larocque et Gagné, Labbé & associés, Vincent Leclerc + associés
Project management:	Macogep
Other key players:	Natural Resources Canada (sustainability consultant) Concordia University (design consultant), Martin Roy et associés (LEED consultant)

AWARD OF EXCELLENCE

Westmount Recreation Centre

CIMA+

Top: graphic showing the underground building concept. Above: extra long beams support the earth roof.

CIMA+ s.e.n.c.

"We see this building as a testimony to the value of multidisciplinary engineering. It uses a bridge building method with long spans in order to create a green roof above an underground arena. The steel girders are six metres above the arenas and withstand significant unequal pressures from the earth without using internal buttresses."
–Jury

The city of Westmount on the Island of Montreal decided to replace its existing arena with a new partially underground structure. Going underground was a way to eliminate the architectural anachronism of having a massive arena structure in a heritage park and adjacent to the Westmount Park United Church. Also, the thermal stability found underground contributed to the building's LEED Gold certification since the building could take full advantage of the underground thermal stability — between 12°C and 15°C year-round.

Certain engineering feats are so spectacular that they become iconic of the cities where they are located. A building like the Westmount Recreation Centre that has been largely "buried" can claim no such status. On the contrary, its usefulness transcends its appearance, representing a completely different tour de force.

Borrowing bridge building methods

Building such a large underground arena with a park space on its roof was a challenge. The structural engineer borrowed from bridge-building methods, creating a green roof supported by long-span steel girders. The 6-m-high empty spaces above the rinks posed a real challenge because the structure needed to withstand the pressure exerted by unequal underground loads without using internal buttresses. Bridge girders were an ideal solution because they require only half the vertical clearance of a lattice steel structure (1.4 m instead of 3 m). In this way, the depth of the excavation was reduced, which in turn reduced costs.

The design features 37 extra-long metal beams of 32.5 metres each. The two rinks run parallel to each other and are separated at the ceiling by two central 64-m long header joists resting upon pillars placed on a 0.9-m-thick raft foundation. Supporting the beams that span the ice rinks — 19 on one side and 18 on the other — are 700-mm concrete walls that include elastomeric bearings nested

continued on page 46

AWARD OF EXCELLENCE

Robinson Place Ontario Government Building LEED Upgrades

Morrison Hershfield

Bird's eye view of stormwater retention pond and extensive landscaping at the complex in downtown Peterborough.

Morrison Hershfield

"At the time this was the only government building in Canada to meet a LEED-EBOM Platinum designation. It shows a high level of commitment to sustainability by Infrastructure Ontario and demonstrates that it is possible to drastically reduce water and energy consumption, while improving the comfort of workers and reaching out to the community."
–Jury

In 2010, Infrastructure Ontario made a strategic decision to pursue a LEED EB: O&M (EBOM) Platinum designation for Robinson Place. The 21,368-m², six-storey government building is located at 300 Water Street in downtown Peterborough, central Ontario. The LEED EBOM designation stands for "Existing Buildings: Operations & Maintenance," and measures operating efficiency while minimizing environmental impacts.

Infrastructure Ontario engaged Morrison Hershfield to champion the LEED EBOM certification process at Robinson Place. They were asked to engineer sustainability initiatives to increase the building's energy efficiency, conserve water and contribute to making it a healthier work environment.

In August 2014 the Canada Green Building Council awarded it the Platinum rating. It is the first government building and one of only 19 existing buildings to achieve LEED EBOM Platinum in Canada.

The building also has an Energy Star score of 89, which shows it is performing better than 89% of its peer buildings nationwide.

Building automation and metering upgrades

Optimal efficiency is achieved because the HVAC system is balanced throughout the entire building, which also maximizes tenant comfort. The systems and equipment are fully metered and sub-metered, and connected to the building automation system. The system provides real-time notifications of any unusual spikes in the consumption of gas, water or electricity to the facility management team. Operators and service contractors can access the revamped interface over the Internet for trouble-shooting.

The new building automation system was also updated so that forward compatibility would be less of a risk.

Another feature is that the high efficiency chiller and motors have a "plateauing" effect, which transforms the usage profiles and leads to reduced energy costs.

The lighting system design leveraged the building's original architecture and access to natural light; it includes new lighting and control systems, occupancy sensors and re-lamping with higher efficiency bulbs.

continued on page 46

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Robinson Place

continued from page 44

All energy used by the building has been offset with Green-e certified renewable energy..

Water conservation and stormwater management

The building's water conservation systems and strategies include rainwater harvesting, sub-metering and cooling tower controls, with the result that the building uses 37% less water than the average public sector building. The stormwater pond and rooftop rainwater collection systems are connected to a 35,000-L cistern that was rehabilitated by upgrading the flow controls, filtration and pumping systems. Non-potable water from the cistern is supplied to water closets, urinals and outdoor hose bibs.

The rooftop garden is a key element of the site's stormwater management system, while the planted areas are permeable and help with stormwater retention. Fish, frogs and marine plants live in the stormwater pond, which is bordered by natural rock and herb plantings. The on-site ground and roof garden vegetation comprises 31% of the property's site area.

The Facts

- Energy Intensity: 1,150 MJ/m²/year (base building plus process energy)
  - — Base building: 847 MJ/m²/yr
  - — Process energy: 303 MJ/m²/yr
- reduced energy intensity of 26%, normalized for data centre use (based on the MNECB Reference Building) annual energy consumption index: 0.85 GJ/m²
- reduction in water consumption: 15%
- 37% less water than in average public sector building (based on BOMA BESt 2013 data)

Process can be duplicated elsewhere

The process used for Robinson Place is now documented and easily duplicated across other facilities owned and operated by Infrastructure Ontario. As the first LEED EBOM project for Infrastructure Ontario, it will serve as a model for similar buildings and help the Agency chart a strong path for sustainability within its extensive portfolio. CCE

Robinson Place Ontario Government Building, Peterborough, Ont. — LEED EBOM Platinum	
Award-winning firm (prime consultant/ LEED, mechanical, electrical, commissioning):	Morrison Hershfield, Burlington, Ont. (Jeremy Carkner, P.Eng., Kyle Fridgen, P.Eng., Fin MacDonald, CET, George Ferreira, P.Eng., Lauren Spudowski, P.Eng., Susan Kapetanovic-Marr, P.Eng.)
Owner/client:	Infrastructure Ontario
Other key players:	Jeffrey G. Walls (contractor), Delta Controls (controls contractor), CBRE (facility manager)

Westmount Recreational Centre

continued from page 43

within niches, just like a bridge. The header joists supporting the other end of the I-beams also feature a particular type of reinforcement: their stiffeners each contain 14 slots elongated horizontally by ±30 mm. This way, even bolted to the stiffeners, the beams can still move forward and backward on their axes, which was particularly important for pouring the concrete for the roof and compensating for the beams' projected loss of camber.

Roof and site drainage

The roof anchoring system, consisting of studs welded to the girders binding the metal structure to the concrete apron, forces the roof to react as a monolithic material, somewhat like a living diaphragm that transfers vertical and lateral loads to the foundations.

The design of a landscaped environment on the building's green roof added another element of complexity. Hills, made up of a layer of topsoil on expanded polystyrene blocks (100% recyclable) assembled like a 3D-puzzle, achieved the desired effect while minimizing weight.

The project also required efficient drainage for the entire site. For this, the 5,960-m² green roof is a central element, acting as a natural filter and cleanser, and rerouting the water into underground drains. Two drainage structures were designed and stacked vertically. The 600-mm upper structure contains a bioretention basin capturing 83% of the annual volume, while the 1500-mm lower structure, containing a "stormchamber" basin, filters 17%. The peak stormwater flows generated for the entire site (including parking lots) are 25% lower than before the development.

The ecological and recreational overhaul, has greatly improved the site's appearance and sightlines. Also, the site excavation provided an opportunity to dispose of 150,000 tonnes of contaminated soil. CCE

Westmount Recreation Centre, Quebec	
Award-winning firm (structural,civil, LEED):	CIMA+ s.e.n.c. (Raymond Nantel, P.Eng., Munzer Hassan, P.Eng., Ian Olechnowicz, P.Eng., Guillaume Harpin, P.Eng., Alexandre Poulin, P.Eng., Stéphane Côté, tech., Mathieu Lacharité, P.Eng.)
Owner:	City of Westmount
Client/design-build contractor:	Pomerleau
Architects:	Lemay, MMA
Mechanical-electrical:	Beaudoin Hurens
Geotechnical /contaminated soils:	Qualitas

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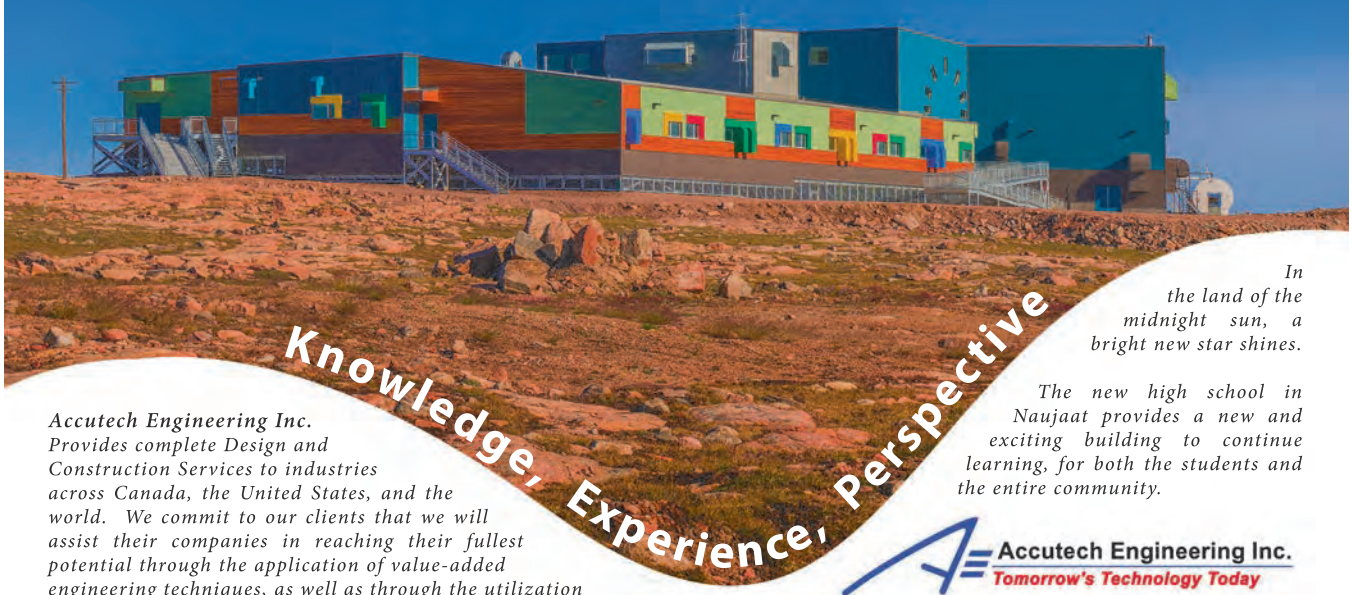
New High School
Naujaat, Nunavut

Member of ACEC - Manitoba



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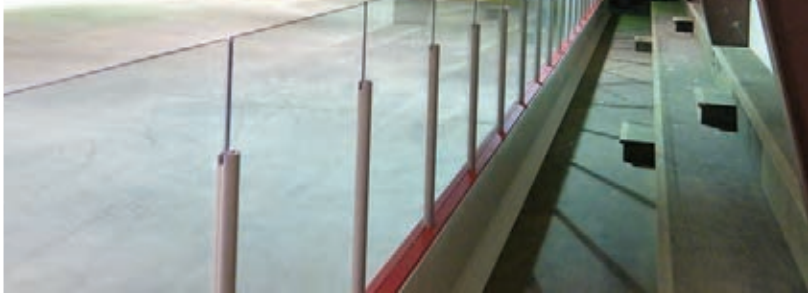
AWARD OF EXCELLENCE

Whale Cove Arena — Ice Plant

Accutech



Retrofitting the arena not only brought energy savings, but also extended the Arctic hamlet's hockey season by four months.

Accutech Engineering

"Engineering elegance and simplicity! We were impressed by the originality and the environmental savings in this arena retrofit. The new systems require practically zero operating and maintenance costs, even in this challenging northern landscape."
–Jury

Located 1,400 kilometres North of Winnipeg in Canada's high Arctic, the hamlet of Whale Cove wanted to transform their existing arena into a low cost, year round facility that would serve as both an arena and a centrepiece for the community.

In Nunavut, and Whale Cove in particular, hockey is tremendously popular. Home to a population of only 400 residents, Whale Cove boasts multiple men's, women's and youth hockey teams. The local players work hard to represent their community in programs like the Nunavut Stars Camp, the Kivalliq Cup, and the Arctic Winter Games.

The hamlet desired to renovate their existing arena with the central goal of extending the hockey season by four months. The existing arena's lack of infrastructure resulted in a shorter hockey season and a competitive disadvantage for their athletes when competing against larger centres with "Southern-style" ice plants.

In addition to a longer hockey season, the community was looking for a zero increase to their operating budget, a system with minimal maintenance, environmentally conscious design, low water consumption, and very low power consumption.

Elegant in its simplicity, more than the sum of its parts

Accutech Engineering, which has developed a proprietary design to provide "zero-energy" refrigeration systems to arenas within Nunavut, was retained by the Government of Nunavut to provide project management for the Whale Cove Arena retrofit. The Accutech system is extremely simple, yet had

never been done before.

The system consists of three primary building blocks.

- Concrete floor for the arena. This ensures the arena can be used during the summer months. It also provides thermal storage for the refrigeration system, and prevents rink-flood water from seeping into the permafrost.
- Thermosyphons. These provide energy-free refrigeration for the ice surface. With no moving parts, they are passive devices that transfer heat from beneath the arena floor to the cooler ambient conditions. Once installed, thermosyphons are maintenance free and allow for the design to eliminate pumps, compressors, and other conventional ice plant equipment.
- Ventilation system. It provides dehumidification, cooling and general building ventilation. The control system facilitates all aspects of the design with a simple user interface.

All the components were considered and designed with the end-users in mind and the need to maintain simplicity and low energy consumption.

Water, energy and cost savings

Electricity in Whale Cove relies on diesel engine generator sets, which have a consumer cost of $1.22/kW-hr. It was estimated that operating an ice plant would cost in excess of $300,000 a year and that it would produce nearly 330-metric tons of greenhouse gases per hockey season.

The solution is estimated to consume less than 0.5% the amount of electricity used by a conventional ice plant. This translates to a minuscule carbon footprint that will avoid producing 6,600 metric tons of greenhouse gas over a 20-year operational period.

Water in Whale Cove is treated at a central water plant and then delivered to local users via truck. The process is expensive both in the cost of treating the water and in the greenhouse gas produced by delivery. By implementing a concrete floor, the design drastically reduced water consumption, preventing excess water from percolating through the gravel floor.

How the community benefits

Besides having an extended hockey season, the community has gained a central gathering place for community feasts, skateboarding, roller blading, and lacrosse. The net payback of this facility to the community is in the increased opportunity for physical activity and increased ice time which will yield positive effects on both the physical and mental well-being of the residents for years to come. **CCE**

Whale Cove Arena — Sustainable Ice Plant, Nunavut

Award-winning firm/prime consultant:	Accutech Engineering, Winnipeg, Man. (Brent Wall, P.Eng., Ken Drysdale, P.Eng.)
Owner:	Government of Nunavut
Client:	Community and Government Services
General Contractor:	Kudlik Construction
Supplier:	Arctic Foundations of Canada (thermosyphons)

Congratulations to

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on their award of excellence.

It was a pleasure and honour for Arctic Foundations of Canada to be associated with this winning project.

We are proud to have provided the thermosyphons to this award winning project.

Arctic Foundations specializes in permafrost stabilization, ground freezing and frozen barrier containment technology.

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Email: toddcarriere@arcticfoundations.ca

AWARD OF EXCELLENCE

Union Station and Front Street Revitalization

Robb Williamson

Completed second subway platform with new art work.

AECOM

"At one of the busiest underground transit stations in Canada the engineers successfully designed and managed the construction of a second platform. Since it was critical to keep the subway trains running, they found ways to control the dynamic and static forces on the structure and used a complex shoring and staging process. A side benefit of the project was enhancing the public "space on Front Street."

–Jury

Union Station is Toronto's primary transportation hub for both transit and rail passengers. Over 26 million people pass through it annually.

Recognizing the challenges associated with the aging infrastructure, the Toronto Transit Commission (TTC) and the City of Toronto initiated a project to restore and refurbish the underground subway transit station, which is located north of Front Street and Union railway station.

Since an excavation of Front Street was needed for the changes to the station, the city seized the opportunity to reduce costs and minimize future disruption by undertaking the revitalization of the streetscape at the same time.

The TTC retained AECOM to provide project management, detail design and construction support for the station improvements. The city in coordination with the TTC retained AECOM for the Front Street revitalization project.

By adding a second subway platform and expanding the concourse to include a single TTC fare-paid area and pedestrian bypass routes, the transit hub was improved by creating much needed additional space for subway patrons. It gave a safer pedestrian flow and enhanced access to the GO Transit and VIA Rail stations to the south, and to the PATH system, office buildings and nearby attractions.

Busy Front Street was reorganized and transformed..

Robb Williamson

Complex modelling and shoring necessary

The project required innovative engineering to minimize disruptions to the subway operations, and roadway and pedestrian traffic.

AECOM found ways to control and contain the dynamic and static operational, gravity and ground forces to ensure the stability of the existing platform, the new subway platform and the underground structures. This work occurred throughout excavation, construction, commissioning and operation.

The removal of the station's south wall required complex shoring to support the station roof and concourse slab, while maintaining road traffic over the station. Extensive excavation support systems were used to address the unbalanced earth pressures on the station box during construction. In excess of 40 distinct phases of construction were identified to permit the station to remain in service.

The project team studied base load cases; modeling the forces and assessing how they could be contained. This analysis was also used to design the supporting structures built to serve during construction. AECOM also created robust methods to verify that the station extension would result in a negligible transfer of contaminants, noise and vibration into adjacent properties.

An intricate maze of pedestrians, traffic and utilities

Complex construction staging was required involving traffic, pedestrian flows and transit operations. Road lanes and sidewalks were realigned, utilities were diverted, and decking was provided to allow access to buildings and roadways.

The roadway above the station is a major utility corridor with extensive communications trunk lines, electrical duct banks and trunk sewers. The majority had to be supported throughout construction; the negative impact from their failure would have been immense.

The Front Street design addressed this intricate maze of shallow utilities, chambers and vent shafts, as well as the roof of the subway box and second platform below.

Several ongoing concurrent projects in the vicinity (e.g. the North-West PATH project) created

continued on page 54

AWARD OF EXCELLENCE

West Toronto Diamond Rail — Rail Grade Separation

Parsons

The new structure carries a commuter train corridor below grade through an underpass, while the CP freight tracks cross four new railway bridges.

Parsons

"This project's team found a unique technical solution using bridge slide technology to improve the performance of a 103-year old infrastructure. By using silent piling they also minimized the impact on the surrounding residential area. The project shows a remarkable understanding of the strategic significance of rail and public transit in our communities."
–Jury

Constructed 130+ years ago, the West Toronto Diamond is one of Canada's busiest rail intersections. It is where four operating railways intersect in the area called "The Junction."

The tracks carry primarily Metrolinx and VIA Rail passenger trains, as well as Canadian National and Canadian Pacific (CP) freight trains. Metrolinx, the crown agency that manages transportation in the region, needed to add more passenger trains to accommodate ridership growth. It also was adding Union-Pearson (UP) Express airport train service before the Toronto 2015 Pan Am Games. The bottleneck at the diamonds had to be rectified.

To ease the congestion and accommodate new capacity, a new kilometre-long rail underpass separating the commuter rail tracks from the freight train tracks was built. Parsons provided detailed design for the project and engineering services during construction.

The solution eliminated two at-grade diamond crossings. The new grade-separated structure carries the north-south Metrolinx commuter train corridor below grade through an underpass, while the CP freight tracks cross four new railway bridges at their pre-existing elevation and location. Using accelerated bridge construction (ABC), the four railway bridges were built adjacent to the site and slid laterally into place during four short-duration track closures. The entire project was constructed with minimal

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West Toronto Diamond Rail

continued from page 54

interruption of railway operations. Also, the bridges were designed for the later addition of two tracks.

Four bridge slides, 80 metres

In the preliminary design (done by others), the project staging outlined multiple track diversions and conventional bridge construction.

Parsons reworked the project, developing a staging program that eliminated six of the seven original track diversions by using the accelerated bridge construction technique.

The four mainline railway bridge spans, weighing a total of 12,600 tons, were assembled site-adjacent and slid laterally up to 80 metres into their final positions. Each slide was powered by computerized high-speed tandem hydraulic jacks, moving the structures on steel/bronze slide paths.

Due to time constraints, the bridges were slid on their permanent bearings and secured in place after the slides, without the need for subsequent jacking or remedial work to the slide paths. This was one of the first times this specific ABC technology was used on Canadian railway bridges.

In addition, the bridge construction was accelerated by incorporating full-depth precast deck slab elements — transversely connected by post-tensioning — and foundations consisting of a unique interlocking steel pipe pile wall system.

An active and extremely congested site

Besides being carried out amidst four operating railways, the tracks had to be kept active during the vast majority of construction. There were also geographic constraints, including existing roadway underpasses north and south. The area was dense with industrial and residential properties — many extremely close to the project area — and the geometry of the tracks and roadway added complexity. There were buried utilities running through the corridor — a trunk watermain, combined large sanitary/storm sewer, railway signals, and fibre optic main conduit.

Having met these challenges, the 100-year service life of the project provides many benefits for today and tomorrow. **CCE**

West Toronto Diamond Rail — Rail Grade Separation	
Award-winning firm (prime consultant):	Parsons (Joanne McCall, P.Eng., Victor Anderson, P.Eng., Brent Archibald, P.Eng., Hugh Tracy, P.Eng., Wayne Duncan, P.Eng., William Moore, P.Eng.)
Owner/client:	Metrolinx
Geotechnical:	Golder Associates

Union Station and Front Street Revitalization

continued from page 52

more challenges and required constant coordination requiring communications with all stakeholders. The designs also underwent several iterations to meet the requirements set out by the Environmental Assessment and the city's approved budget. Numerous stakeholders were consulted throughout all the project phases.

High quality public realm

On Front Street, AECOM created a high-quality public realm in a heavily used street by paying attention to small details. Elements were selected and designed for stormwater loading and management, and for heavy use by people and vehicles during events. Future repair and maintenance were also planned for. It was the first time granite pavers were used on the travelled portion of a major city street.

Software programs were used to verify that the re-grading would maintain the minimum cover on existing underground utilities. Stormwater management studies were done to ensure that existing vents and stairs were protected during the design storm event. Structural soil cell systems were used to provide adequate soil volumes for tree growth and manual irrigation.

The Union Station/Front Street project is an integral part of the Toronto Waterfront Revitalization. It has resulted in a pedestrian-friendly public realm that meets the complex needs of one of the busiest roadways in Canada.

As Christopher Hume of the Toronto Star (August 6, 2015) put it: "The new Front is a product of a different mentality, one that doesn't ignore complexity but embraces it." The area has been dubbed "the new entrance to the city, Toronto's front door." **CCE**

Union Station (TTC) and Front Street Revitalization	
Award-winning firm (prime consultant):	AECOM (Abbas Khayyam, P.Eng., Bryan Shaw, Olivia De Santos, Bob Dobbin, Steve Fenwick, David Leblanc, P.Eng., Ken Ng, P.Eng., Marc Gregoire, EIT, Britton Cole, Taining Sun, Roberto Donatelli, Barbara Porpealia, Irene Kiriu, Sandro Sciortino).
Owner/client:	City of Toronto, Toronto Transit Commission
Architect:	SGA-IBA Group
Other key players:	Taylor Hazell (heritage architect); H.H. Angus (vertical transportation), Leber Rubes (code); RBS Consulting (waterproofing); T2UE (utilities)
Suppliers:	Hammond Power (dry-type transformers + 1000V), Hubbell (wiring devices), Eaton Power (motor control centre, UPS, switchgear, etc.)

AWARD OF EXCELLENCE

Low Level Road Project

Stantec

Just one component of this multi-faceted project involved stabilizing the road with over 30,000 m² of multi-tiered retaining walls that are seismically designed.

Stantec

"The engineers brought harmony to a project that had multi-faceted conflicting and complex needs. It involved changes to 2.5 kilometres of roads and included the replacement of three at-grade rail crossings with new vehicle overpasses. Pedestrian and cycle trails and bridges, street lighting, and the relocation of utilities were involved."
–Jury

The project involved the realignment and elevation of approximately 2.6 kilometres of the Low Level Road in North Vancouver, B.C. The road parallels rail tracks along the north shore of the Burrard Inlet.

With international trade continuing to grow, the project was carried out to enhance rail and port operations. It was also designed to address long-standing community safety concerns and traffic congestion challenges in the area. Stantec was the principal consultant.

The work added space for two new CN mainline tracks that can accommodate 3,650-m (12,000-ft.) long trains. It also included the elimination of three existing road and rail crossings, and the provision of direct access to the port terminals. In addition, the engineers reconfigured three intersections and improved lanes for cyclists. Another component was an extension of the Spirit Trail pedestrian walkway.

As a sustainable solution for the community, this is the first transportation project in North America to achieve ISI Envision Platinum Certification. The certification covers five categories: community quality of life, sustainability leadership, resource allocation, natural world, and climate and risks.

Roadway realigned, stabilized with mult-tier retaining walls

Previously the roadway was vulnerable to rock falls, landslides, risks of seismic events (liquefiable soils, unstable slopes, etc.), and a predicted rise in the sea level. These hazards were mitigated by stabilizing the slopes with over 30,000 m² of multi-tier retaining walls. They incorporate seismic design and elevate the roadway above the 200-year predicted sea level rise.

The retaining wall types and configurations were optimized during detailed design development, which saved over $14.5 million in project costs.

The new road and pathway alignments maintain a green buffer zone between the community, roadway, and port terminals. The grade separation between the road and rail users also addressed the safety issues.

Three notable bridges

The project's new bridge structures include the Spirit Trail Woodland Suspension Bridge, which is a 56-m clear span that offers a sensitive solution in the context of the surrounding vegetation. Another, the Spirit Trail Overpass, is a tilted steel tied arch superstructure that is an aesthetically pleasing 42-m span landmark in the community. The

Neptune/Cargill Overpass is a 78-m long flared, two-span steel girder vehicle bridge that features integral support design (no joints or bearings) to minimize future maintenance costs.

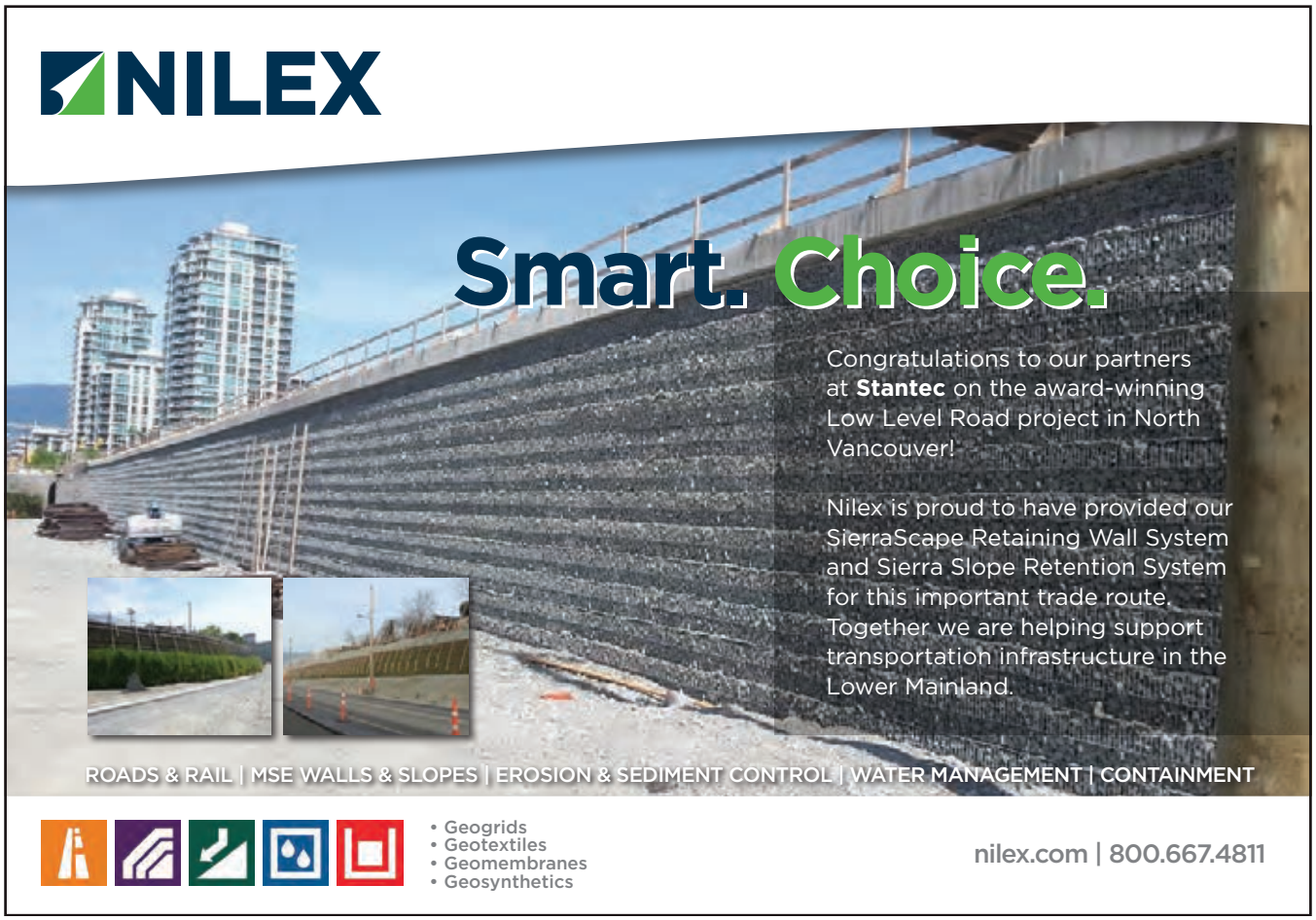
Stakeholder engagement and First Nations involvement

The Port led a robust stakeholder engagement program, involving residents, businesses and the City of North Vancouver, to develop a design. It took into consideration local needs and resulted in multiple design iterations within difficult timeframes. Environmentally sensitive areas were protected. For examle, an eagle's nest tree habitat was preserved directly adjacent to the Spirit Bridge. View impacts were addressed, noise and dust during construction were minimized, and access for local residents and businesses was maintained.

The Port of Vancouver awarded contracts with significant financial value to First Nations communities, while art installations along the project corridor recognize the cultural and historical significance of the area. **CCE**

Low Level Road Project, North Vancouver, B.C.

Award-winning firm (prime consultant, design):	Stantec (Kip Skabar, P.Eng., Emily Dunlop, Henrik Kristiansen, P.Eng., Garry Romanetz, P.Eng., Richard Lanyi, P.Eng., Lourette Swanepoel, Thys Fourie, P.Eng., Peter Brayford, Helen Zhang, P.Eng., Charter Chan, P.Eng., Adam McIntyre, P.Eng., Alberto Elvina, P.Eng.)
Owner/client:	City of North Vancouver, Port of Vancouver
Project management:	MMM Group (WSP)
General contractor:	B&B Heavy Civil
Other key players:	Delcan/Parsons (traffic management), Morrison Hershfield (woodland bridges design check), De Leur (road safety audit), Levelton (concrete testing), ME2 Transportation Data (traffic analysis), Protech Surveys (field surveying), Arbortech /ACL (arborist)
Supplier:	Nilex (rock-vegetated MSE walls and geogrid)



AWARD OF EXCELLENCE

Giant Mine Roaster Complex Decontamination

AECOM

The Giant Mine in Yellowknife, Northwest Territories, operated from 1948 to 1999 producing over seven million tons of gold. When the mine operator declared bankruptcy in 1999, control of the mine was transferred to Canada's Department of Aboriginal Affairs and Northern Development Canada (AANDC).

The ore processing methods, housed within the roaster complex, generated sulphur dioxide gas and arsenic trioxide particulate. The complex, with a footprint slightly smaller than a football field, comprised two roaster buildings, a calcine/kiln plant, an electrostatic precipitator building, a baghouse building, a 46-m high stack, and other ancillary structures. At the project initiation, the buildings, known to contain significant quantities of arsenic trioxide dust, asbestos, cyanide, and other hazardous materials, were at risk of collapsing and releasing hazardous materials to the environment.

AECOM and sub-consultant Golder Associates were retained by Public Works and Government Ser-

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AECOM

Completing the hazardous waste survey in one of the buildings.

"This was an urgent, high-risk project, and its execution protected workers, the public and the environment in an exceptional way. The engineers' work involved assessing and remediating a large former gold mining site, where a variety of hazardous materials had to be removed, notwithstanding that some of the buildings were near collapse."

–Jury

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AWARD OF EXCELLENCE

Whitehorse Diesel to LNG Conversion

Aerial view of the plant, which includes three large LNG storage tanks and a vaporization unit which converts the liquid to gas and then feeds it to the reciprocating engines, which in turn drive the generator.

Allnorth Consultants — KGS Group — CAP Engineering

"This is a "first of its kind" project creating a standalone generating station fuelled by liquid natural gas (LNG) to feed into a small hydro grid. The experience gained here can be leveraged for further LNG use across Northern Canada to reduce the reliance on diesel for back-up power, with its associated greenhouse gases. The project also involved the local community and First Nations in the construction."
–Jury

Delivering reliable power to the residents of the Yukon with its Arctic and subarctic climate is important and challenging. The isolation of Yukon's hydro-based electrical system from North America's grid, along with spikes in demand from weather, transmission and hydro generation failures, all add to the challenges.

This project added an 8.8 MW liquid natural gas (LNG) fuelled power generating station, improved the system's reliability, and reduced both the costs and the environmental impacts of generating power.

The project was also ground breaking for oil and gas regulators in the Yukon: LNG had not previously been stored, nor used as a fuel for electrical power generation, in a greenfield facility of this scale.

Project drivers

In 2012, 99% of the Yukon's electrical grid drew power from 93 MW of renewable hydroelectric and wind power. That capacity was supplemented with 42 MW of back-up diesel power produced by the Yukon Energy Corporation's aging thermal generating equipment.

The diesel back-up generators were increasingly viewed as a reliability risk. Therefore, Yukon Energy Corporation, with First Nations support, and a $21 million investment from the Kwanlin Dun Band, decided to build an LNG fueled power generating station, improving reliability, reducing power costs and environmental impacts.

Yukon Energy Corporation assembled a team comprising All-

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Whitehorse Diesel to LNG Conversion

continued from page 59

north and CAP for project management, and KGS as design consultants. The corporation's in-house engineering team was also engaged.

Plant features

Constructed adjacent to the Whitehorse Rapids Hydroelectric Dam and Thermal Generating Station, the new plant includes three large LNG storage tanks and a vaporization unit, which converts the liquid to gas and then feeds that gas into the reciprocating engines that drive the generator.

The facilities as commissioned in 2015 include two reciprocating generators (total of 8.8 MW) with allowance for a third generator to bring the total capacity to 13.2 MW. The related infrastructure also includes a fluid (oil/glycol) transfer station, a small electrical substation to receive power from the generating units, and a switchgear module.

Cutting edge LNG power generation modules were used; efficiency tests during operations have surpassed expectations.

Site complexities

Extraordinary vapour dispersion computer modelling efforts were necessary since the site was near a major access road and the Yukon Energy Corporation headquarters. The design also had to conform to the requirements for seismic conditions and account for granular subsoil and high water table conditions on the site.

Through the use of 3D modeling and intense project management, the team was able to coordinate their designs and onsite work and limit the plant's footprint.

Environmental, social and other benefits

- Substantial annual fuel savings
- Reduction in electrical outages
- Reduction in pollutants
- Noise reduction and improved reliability
- Environmental impact of a LNG spill would have less impact than a similar sized diesel spill. CCE

Whitehorse Diesel to LNG Conversion Project, Yukon

Award-winning firms:	Allnorth Consultants - owner's project manager (Janna Gillick, P.Eng., Phil Bell, P.Eng., Ian Rothera, Marg Branchi, John Murray, P.Eng.); KGS Group - design (Hugh Williams P.Eng., Ashley Dent, P.Eng, Helmut Grauman. P.Eng.); CAP Engineering - construction management (Curtis Gamache, Kyle Power, Bob Brown, P.Eng.)
Owner/client:	Yukon Energy Corporation (YEC)
Other key players:	Intergroup Consultants (feasibility review and permitting)

Giant Mine Roaster Complex

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vices Canada to do work that included a detailed hazardous material survey and waste audit; prepare contract specifications; and complete resident engineering during decontamination and deconstruction of the roaster complex.

Developing standards for an urgent task

Assessing and demolishing such a highly contaminated complex was a challenge.

Hazardous waste identified included: arsenic trioxide dust, asbestos (amosite, chrysotile and crocidolite), cyanide, mercury, PCBs, hydrocarbons and other hazardous substances. Most importantly, almost all of the waste consisted of arsenic, asbestos, and cyanide mixed together. Hazardous waste abatement control measures needed to be developed to address the simultaneous removal of the materials from the buildings and an ambient air quality monitoring program was developed to protect the public.

The project adopted the same well-established abatement control measures for arsenic and cyanide as for high-risk asbestos abatement work, with air monitoring for all three contaminants, but with additional measures to address the increased risk.

Environmental review and storage

The remediation was subject to an ongoing Canadian Environmental Assessment Agency (CEA) Environmental Assessment because of significant concern from stakeholders. The site lies within the city limits of Yellowknife on the shore of Great Slave Lake.

The work proceeded under emergency provisions in advance of the environmental approval and was conducted in a fully transparent manner with all the ambient air monitoring results posted on a public registry.

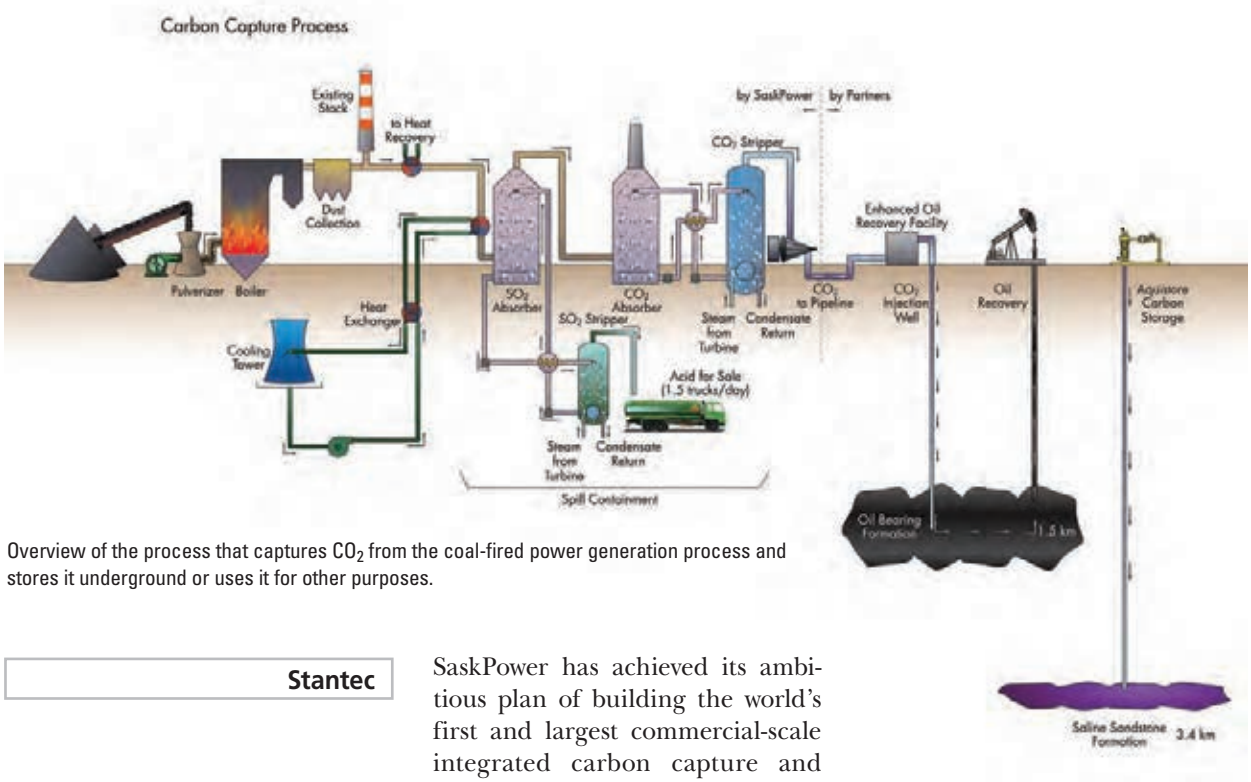
Completed in 2015, the project safely dismantled all structures and containerized over 9,000 cubic metres of the hazardous waste without adverse effects to workers, the public and the environment. The result is a much higher level of trust by regulators and the community for the overall remediation program for the Giant Mine. CCE

Giant Mine Roaster Complex Decontamination and Deconstruction, Yellowknife, NWT

Award-winning firm (prime consultant):	AECOM, Edmonton, Alta. & Yellowknife, NWT (Gordon Woollett, P.Eng., Cathy Corrigan, P.Eng., Rudy Schmidtke, P.Eng.)
Owner/client:	Aboriginal Affairs and Northern Development Canada/Public Works and Government Services Canada
Industrial hygiene quality assurance:	Golder Associates

AWARD OF EXCELLENCE

Boundary Dam Integrated Carbon Capture Storage



Stantec

Overview of the process that captures CO_2 from the coal-fired power generation process and stores it underground or uses it for other purposes.

Stantec

"Another "first," this project is a global leader — the first in the world to capture post-combustion carbon from an existing coal-fired power plant at a large commercial scale. It extends the life of the existing plant by 30 years and has the potential to keep coal as an energy option for the future. The challenges of integrating the systems into the existing plant were of a huge magnitude."
–Jury

SaskPower has achieved its ambitious plan of building the world's first and largest commercial-scale integrated carbon capture and storage project on a coal-fired power plant.

Driven by pending environmental CO_2 constraints and its aging generation assets, SaskPower selected an existing coal-fired plant, Boundary Dam Unit #3 (BD3) in Estevan, south Saskatchewan, to be retrofitted with a carbon capture system. The project has extended the life of the power plant by 30 years.

By capturing CO_2 emissions from the coal-combustion process, the system helps to reduce the utility's carbon footprint. It was designed to capture up to 1 million metric tonnes of carbon dioxide annually, equal to emissions from 250,000 cars. The carbon captured is then either sold for enhanced oil recovery purposes, or stored, permanently and safely 3.4 kilometres underground in a porous rock layer, sealed in by several layers of impermeable rock.

The project was complex due to: (a) the pioneering aspect of trying to achieve that which has never been done before; and (b) the sheer magnitude of the plant and system modifications that were needed.

Studies and design

As the owner's engineer and prime consultant, Stantec's work included studies of technologies, standards, etc., then support for the project's design and construction.

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AWARD OF EXCELLENCE

Capilano Break Head Tank and Energy Recovery Facility

Knight Piésold

The 4.5-m diameter energy recovery Francis turbine is one of the largest in North America.

Knight Piésold

"In this innovative project, the engineers met the challenge of using energy recovery while reducing the downstream water pressure in a potable water supply system. It uses a large energy recovery turbine at the terminus of a 7-km tunnel that carries treated potable water at high pressures. The energy that would otherwise be lost is expected to save Metro Vancouver 9,600 MWh a year."
–Jury

The Capilano Break Head Tank and Energy Recovery Facility (BHT & ERF) is a vital link in the Seymour-Capilano Water Filtration System that supplies treated potable water to the cities of Vancouver, North Vancouver, and Burnaby.

Knight Piésold designed and commissioned the BHT & ERF, which dissipates excess energy in the water flowing from the Seymour-Capilano filtration plant and recovers that energy to generate electricity. The facility has one of the largest energy recovery turbines in a municipal treated potable water system in North America.

Located adjacent to the Capilano Reservoir and the Cleveland Dam, the facility is at the terminus of a 7-km-long, gravity-driven tunnel from the filtration plant. Because the filtration plant is 30 metres higher in elevation, the gravity-fed treated water passing through the tunnel reaches excess pressures. Knight Piésold worked closely with Metro Vancouver to create innovative solutions at the BHT & ERF. The plant enables water to be distributed to consumers in the cities, while concurrently generating electricity that partially offsets the energy consumed by one 2,000 HP pump at the Capilano Pump Station.

The new facility can either dissipate the excess water pressure through pressure reducing valves, or it can convert the excess pressure and flow into electricity through a hydroelectric turbine. This energy, which would otherwise be lost, is expected to generate enough electricity, equivalent to powering up to 1,000 homes, to reduce Metro Vancouver's total energy consumption by approximately 9,600 MWh/year.

Pressure reducing valves and tank

Two multi-orifice, sliding-disc-type pressure reducing valves are provided in the BHT & ERF. Each valve can deliver the full 12.5 m^3/s design

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Capilano Break Head Tank and Energy Recovery Facility

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flow of the facility, and the control systems are fully redundant, so any single point failure will not jeopardize the continuity of the supply.

The turbine and pressure reducing valves discharge water into a large underground concrete "break head" tank. The tank is connected to the city water mains, providing a constant and seamless level of water supply to consumers.

Energy recovery turbine

The installation and commissioning of the energy recovery turbine, which has a 1.676-m diameter inlet pipe and a 4.5-m diameter spiral case, had little precedent in North America due to its size and scale.

The turbine experiences a variation of over 60% in the pressure head, which requires its controls to automatically shut the turbine down when the pressure head falls out of the allowable range. The pressure reducing valves and the turbine can operate either alone or together in order to meet varying water demands from the city.

The designers had to model tunnel and turbine surge characteristics to find operating times that prevent overpressures due to water hammer effects; these occur when the turbine rejects load. The tank has an underground overflow weir to prevent surcharging of the tank during a valve failure.

Dechlorination and environmental considerations

Given the sensitive aquatic habitat in the Capilano Reservoir, the engineers developed and upgraded a dechlorination system to treat overflow discharged into the reservoir. The dechlorination system delivers a metered dosage of calcium thiosulphate into the treated water, which neutralizes the residual chlorine, making it safe for aquatic species.

From the project's inception Knight Piésold worked closely with Metro Vancouver and met the April 2015 deadline for delivering water. CCE

Capilano Break Head Tank and Energy Recovery Facility, North Vancouver, B.C.

Award-winning firm (prime design consultant/owner's engineer):	Knight Piésold (Jeremy Haile, P.Eng., Rob Adams, P.Eng., David Levi, P.Eng., Michael Pullinger, P.Eng., Marko Barisic, P.Eng., Daniel Friedman, P.Eng., Harvey Dew, P.Eng.)
Owner/client:	Metro Vancouver
Other key players:	CP Automation (instrumentation and controls), Gygax Engineering Associates (structural), Northwest Hydraulic Consultants (physical modeling), Arie J. Smits (architect)

Boundary Dam Integrated Carbon Capture Storage

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Stantec provided services to:

- refurbish the BD3 boiler, replace the turbine/generator, and replace the associated mechanical, electrical, and instrumentation and controls for the balance of the plant.
- identify which BD3 components and systems required replacement or upgrade.
- reuse as much of BD3 as possible, while maintaining its reliability and safe operation.
- increase generation and overall plant efficiency wherever possible.
- support major technical EPC contracts; flue gas cooler, CO_2 capture, CO_2 compression balance of plant, heat rejection, and CO_2 pipeline.
- integrate SO_2 and CO_2 capture processes.
- enable electrical generation to operate independently of the CO_2 capture facility.
- reduce the SO_2 emissions from the coal process by up to 99% and the CO_2 emissions by up to 90%.
- demonstrate the economic, technical and environmental feasibility for coal-fired power generation with ICCS.

Innovation was paramount

Without reference projects, the project had many challenges requiring innovations and several "firsts." To help with the design a detailed 3D CAD model derived by laser scanning the existing plant was generated and maintained to provide an accurate reference for the engineering team.

The project advances ICCS technologies and helps the global power industry reduce their greenhouse gas emissions. It has been recognized globally as a showcase for ICCS, including receiving the Edison Electric Institute 2015 Edison Award.

There are also significant social and economic benefits. For example, the construction required 4.5 million direct construction man-hours during the 41 month construction and commissioning period, which ended in 2014. CCE

Boundary Dam Integrated Carbon Capture Storage, Estevan, Sask.

Award-winning firm/prime consultant:	Stantec , Regina, Sask. (David Cameron, P.Eng., Lucas Miller, P.Eng., Robert Swift, P.Eng., Jim Doolittle, P.Eng., Mike Richard, P.Eng., Shikhar Singh, P.Eng., Sandy Mackenzie, P.Eng., Randy Wedge, P.Eng., Gordon Boneschansker, P.Eng.)
Owner/client:	Saskatchewan Power Corporation
Other key players:	Clifton Associates (geotechnical); Midwest Surveys (survey)

AWARD OF EXCELLENCE

Goldcorp Éléonore Mine

SNC-Lavalin

Above: first gold pour. Left: part of the vast complex..

SNC-Lavalin

"This major mining infrastructure project in the remote James Bay region of Northern Quebec required well executed up-front planning and had a very good risk management process. The project involved building the above ground facilities for a gold mine, including the ore processing plant, a work camp for 400, administrative buildings, wastewater treatment plant, and tailings management facilities. There was also good involvement with First Nations."
–Jury

Goldcorp's Éléonore project comprises an underground gold mine, ore processing, and infrastructure in the James Bay Region of Northern Québec. SNC-Lavalin successfully provided engineering, procurement, and construction management (EPCM) services for the surface facilities of this ambitious $2.3 billion project completed in 2014. The project presented significant schedule, location, climatic, environmental, and labour challenges. It also exemplifies successful collaboration with First Nations and local communities.

In this complex and multifaceted development, Goldcorp was responsible for the mine, while SNC-Lavalin implemented the ore processing facilities — crushing, ore storage, process plant, paste backfill plant, and tailings filtration.

SNC-Lavalin also provided the on-site infrastructure: a permanent camp with 400 rooms, gymnasium, laboratory, administration buildings, industrial water treatment plant, water and waste-water underground services, tailings management facilities, and on-site roads.

Ambitious first gold pour date

Major complexity stemmed from the challenge of developing and maintaining a workable schedule based on the ambitious "first gold pour" date.

The following steps helped the project succeed:

- Seasoned project management experts reviewed the challenging schedule to strategically select which infrastructure construction activities to postpone until after the first gold pour.
- A project definition assessment (Project Definition Rating Index - PDRI) was completed to identify potential gaps and actions to reduce project risk. Subsequently, SNC-Lavalin completed additional FEED (front-end engineering design) studies, including metallurgical testing, to bring the project to a level suitable for detail design.
- SNC-Lavalin provided ongoing

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AWARD OF EXCELLENCE

Lower Mattagami River Project

Hatch

Smoky Falls plant before pouring concrete, showing scale of the work.

Hatch

"This was a very large hydroelectricity generating project that added 500 MW to Ontario's grid and was successfully completed on budget and ahead of schedule. It involved completely replacing the 1931 Smoky Falls generating station and increasing the capacity of four other linked stations downstream. There was an exceptionally strong involvement of local communities and First Nations."
–Jury

The Lower Mattagami River project is Ontario Power Generation's largest hydro project in 40 years. It has added almost 500 MW of power by updating three generating stations and completely replacing a fourth.

Hatch acted as the owner's engineer for the front-end study and design phases, and as the owner's representative during implementation. The $2.6-billion project was delivered on budget and ahead of schedule. It employed 1,200 people, 70% of whom were drawn from local communities.

Located about 70 kilometres northeast of Kapuskasing in northern Ontario, the Lower Mattagami complex consists of four stations. From south to north they are: Little Long, Smoky Falls, Harmon, and Kipling.

Smoky Falls, built in 1931 with only 52 MW, predated the other stations, was undersized and critically limited the volume of water transmitted through the complex. The other three 1960s dams were designed with some foresight towards future expansion and included two extra intakes each.

An enormous project

To maximize the potential of the resource OPG needed to:

• Build a new station at Smoky Falls (3 units of 90 MW, a 275-ton bridge crane, 130,000 m^3 of concrete, 6 intake gates), including a new headrace and tailrace channel. It had to rehabilitate the water-retaining structures and replace one of 10 spillway gates. It also had to construct new 230 kV transmission lines, and decommission the old station.

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Goldcorp Éléonore Mine

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and active deviation analysis (actual costs versus allocated budgets), forecast management, and tight risk monitoring and management.

• Project management, engineering, and construction management teams pursued flexible solutions, e.g. overlapping specific construction activities, and introducing night shifts for some disciplines.

Strike, forest fire, Arctic location

Further schedule challenges included two force-majeure events in 2013: a strike followed by a forest fire, which caused a six-week delay and pushed some civil and structural steel work into winter conditions.

Additional complexity factors were the remote location, the Arctic climate, constrained logistics, lack of infrastructure, extensive regulations, and the need to minimize environmental impacts.

Despite these challenges, construction and pre-operational verification (POV) were achieved within 36 months.

Tools and strategies for success

State-of-the-art tools helped SNC-Lavalin meet the challenges. The company's experts developed a 3D process plant model to support engineering inter-disciplinary coordination, conflict resolution, bulk material reporting and control, and client design reviews. All teams collaborated on this single platform — working in parallel and using a single source of information.

The project involved managing over 110,000 documents, of which 45,000 were issued for coordination to over 850 different stakeholders. A single on-line project document management system (PDM) was used which was available 24/7.

The Éléonore Project remains one of the largest private projects developed under Quebec's "Plan Nord" program and continues to generate major economic spinoffs for the local and regional communities. A Cree Inclusion Plan ensures Aboriginal stakeholders' input and provides Cree workers with training. Members of the Nation Cree of Wemindji benefited during construction and now benefit from well remunerated employment. CCE

Goldcorp — Éléonore	
Award-winning firm (engineering, procurement, and construction management (EPCM)):	SNC-Lavalin, Montreal (Martin Lachance, ing., Jean Fournier, ing., Guy Boily, ing., Robert Richard, Serge Therrien, Hagire Emrani, ing., Jean-Philippe Anctil, ing.)
Owner:	Goldcorp
Architects:	Denis Boucher Benoit Lachance, TRAME Architecture + Paysage

Lower Mattagami River Project

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• Add one-unit extensions of 68 MW, 100 MW, and 84 MW to the Little Long, Harmon, and Kipling generating stations respectively. At each station this work involved 12,000 m^3 of concrete, a cellular cofferdam, turbine/generator equipment and high-voltage substations.

From day one until completion of this enormous project, Hatch played a key role. Its engineers developed the Owner's Requirements document; prepared budget cost estimates; prequalified design-build contractors and turbine/generator suppliers; solicited and evaluated proposals; assisted OPG in the final recommendations for selecting the design-build contractor; provided environmental expertise; and provided Owner's Representative services during construction.

Technical difficulties and challenges called for innovative solutions. The project had to achieve a balance between maintaining the proper water level (in particular downstream to submerge the turbines) and achieving peak performance so that the four stations will meet their generation requirements for decades. Also the interdependence of the four sites required a specialized work-planning process.

Throughout the project's construction phase, Hatch made sure to maintain a high level of synergy while continually challenging the contractor and OPG in managing numerous requests for changes.

All the stations and their new units were delivered ahead of schedule in December 2014.

First Nations highly involved

Hatch was responsible for coordinating the project's Environmental Working Group, which had representatives from OPG, Moose Cree First Nation, and Taykwa Tagamou First Nation. The working group was mandated to advise the Mattagami Extension Coordinating Committee on the 24 terms and conditions of the project's environmental approval (EA). Hatch also led several environmental due diligence audits of the contractor's work.

The project has significantly contributed to opening the way for future sustainable development, including new opportunities for many First Nations workers. Specifically, 350 First Nation people benefited directly from career training, with a 96% completion rate. The project also enabled First Nations companies to share approximately $250 million in contracts. CCE

Lower Mattagami River Project, Ontario	
Award-winning firm/Owner's representative:	Hatch, Niagara Falls, Ont. (Fadi Chidiac, P.Eng., Bruce MacTavish, P.Eng., Flavio De Campos, P.Eng., Emile Chidiac, P.Eng.)
Owner/client:	Ontario Power Generation

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Smoky Falls Generating Station under construction for Ontario Power Generation (OPG)

AWARD OF EXCELLENCE

Coastal Protection, Cotonou, Benin

Norda Stelo

Aerial view of one of the breakwater "groynes."

Norda Stelo

"This six-year program was to stop erosion of 13 kilometres of shoreline that was causing serious problems for local residents. The construction of new breakwaters was done with environmental sensitivity and we especially liked how the engineers involved local engineers from the beginning."
–Jury

In Cotonou, Benin, approximately 13 metres of shoreline used to disappear under the effects of the sea each year. This situation had serious consequences for the densely populated surrounding area.

Under the auspices of international funding to adapt to climate change, Norda Stelo and its partners carried out work for nearly U.S. $100 million over a six-year period to stop the advancing sea and rehabilitate the banks.

The project involved conducting engineering studies and building eight groynes along a seven-kilometre stretch of the coastline. The groynes, which are pier-like structures made with concrete blocks and riprap stones, have a total length of 2,445 metres. They interrupt the force of the ocean waves and prevent the sand from being washed away. As part of the project, more than 500,000 metric tonnes of riprap stones were transported from three quarries located 250 kilometres from the construction site.

Transparency and communication

Conducting a major project in a densely populated area was a challeng. Although the project was desired by the population, the work had the potential to disrupt their daily lives and activities. Norda Stelo implemented measures to minimize the disruption and ensure safety throughout the construction period.

The number and diversity of stakeholders also made things complicated. However, transparency and effective communication were key factors in the project's success.

A relocation plan for affected residents was implemented by the Benin government, with support

from Norda Stelo. Several news releases and public meetings helped spread information to the community, while neighbourhood gatherings were held to discuss specific issues. A compensation plan for the impacted population was developed in accordance with Benin's laws and regulations.

Twenty Beninese workers joined the Norda Stelo team, including eight engineers and several technicians who participated in the topographic and bathymetric surveys (as well as in the monitoring and control activities), gaining coastal engineering experience.

Also, a concrete plant set up to produce the moulded X-blocks created local jobs and gave workers valuable experience.

Results speak for themselves

Studies were conducted and an environmental management plan was implemented to protect the terrestrial and marine habitats. Emphasis was also placed on protecting species that are important to fisheries and tourism, including those with special status, such as sea turtles.

The project was completed on budget and nearly four months ahead of schedule.

The results speak for themselves: the coastal protection works constructed in this project withstood violent storms that hit the entire West African coast in May 2015 and caused damage in several countries.

The project also demonstrated that erosion is spreading rapidly along Benin's coasts and needs to be addressed through monitoring, appropriate development, and other initiatives. **CCE**

Coastal Protection, Cotonou, Benin	
Award-winning firm (prime consultant):	Norda Stelo, Quebec City (Gervais Bouchard, P.Eng., Paul Gendron, P.Eng., Victor Gbaguidi, Ph.D, Marc Drouin, P.Eng., Lester Trujillo Gonzalez, Ph.D.)
Owner:	Ministère de l'urbanisme, de l'habitat et de l'assainissement du Bénin
Other key players:	Baird Engineering (modelling/analysis of coastal processes and design development of project), ECCO-GC, Benin (geology/quality control), Boskalis (construction/production); Best Ingénieurs-conseil (site supervision).

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2016 AWARDS—WINNER'S GALLERY

MEET THE WINNERS

Meet some of the people who were involved in the award-winning projects

SCHREYER AWARD

1. Grandview Heights Aquatic Centre, Surrey, B.C. Fast + Epp. *Left to right:* Duane Palibroda, Alison Faulkner, Derek Ratzlaff and Brian Seo.

TREE FOR LIFE AWARD

2. Enerkem Alberta Biofuels, Edmonton. BBA, Mont St-Hilaire, Que. *Left to right:* Nathalie Blackburn, Normand Thibault, Lyne Ricard, Yue Lu, Jason Salama, Stéphane Campagna.

ENGINEERING A BETTER CANADA AWARD

3. Mistissini Wooden Bridge, Quebec. Stantec. *Left to right:* Denis Lefebvre, Alessandro Cirella.

AMBASSADOR AWARD

4. Planning Protection Infrastructure for Natural Disasters in Haiti. AECOM, Montreal. *Left to right:* Sébastien Boudreau, Josilien Édouard, Jacques Langlois, Vincent Locquet, François Trudeau, André Lauzon, Pierre Roy, Pierre Roy, Martin Harvey.

OUTREACH AWARD

5. Rio Abajo Footbridge, Nicaragua. COWI North America and Kiewit, Vancouver. *Second from left:* Ralph Salamie (Kiewit). *Seventh from right*: Don Bergman (COWI).

The above special award-winners also won Awards of Excellence. For others involved, see the list of members of the award-winning firms at the end of the articles describing the projects.

AWARDS OF EXCELLENCE

6. Varennes Net-Zero Library, Quebec. Stantec. *Left to right:* Michel Gendron, Laurier Nichols, René Dansereau, Isabelle Lauzon.

7. 351 Water Street, St. John's, Nfld. Stantec. *Left to right:* Lez Snow, Kerry Gosse, Brad Dawe, Bernie Ropson.

8. Westmount Recreation Centre, Quebec. CIMA + s.e.n.c. *Left to right:* Alexandre Poulin, Stephane Côté (front), Guillaume Harpin (back), Munzer Hassan, Ian Olechnowicz, Mathieu Lacharité.

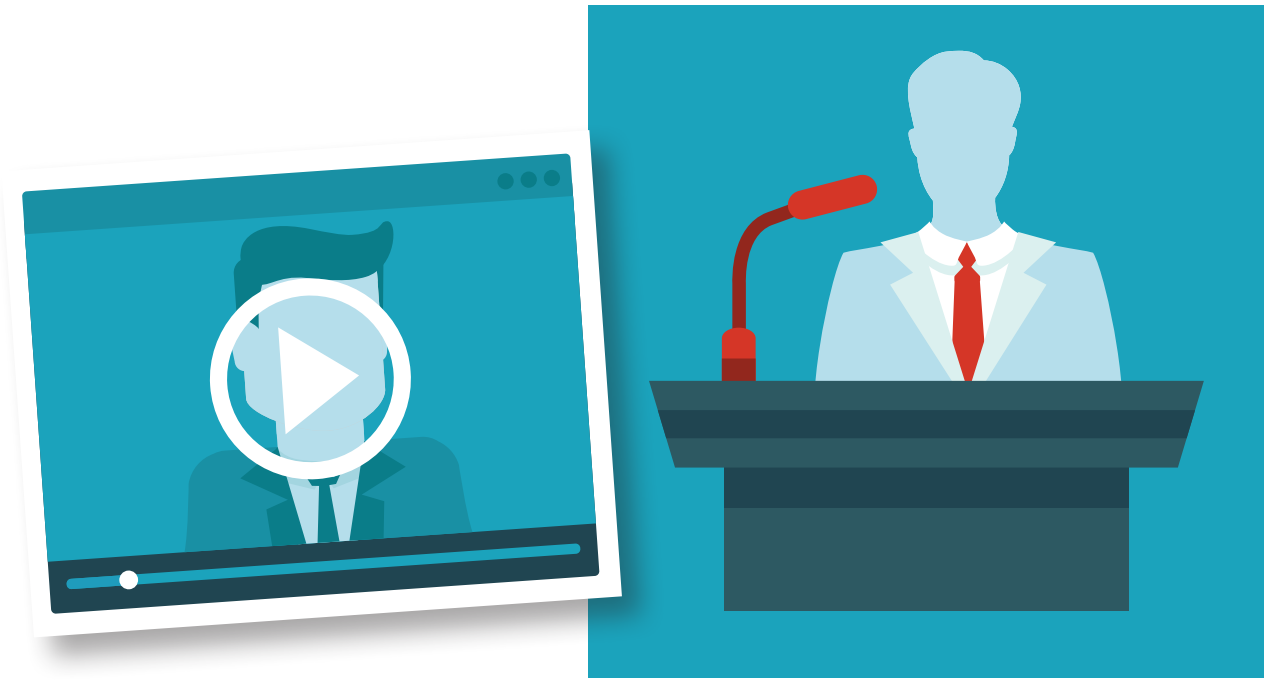
9. Robinson Place Ontario Government Building, Peterborough, Ontario. Morrison Hershfield, Burlington, Ont. *Left to right, top:* Jeremy Carkner, Fin MacDonald, George Ferreira. *Bottom:* Lauren Spudowski, Kyle Fridgen, Susan Kapetanovic-Marr.

10. Whale Cove Arena, Nunavut. Accutech Engineering, Winnipeg. *Left to right*: Brent Wall, Ken Drysdale.

11. Union Station and Front Street Revitalization, Toronto. AECOM. *Left to right, standing:* Tom Minutillo, Sandro Sciortino, Harry Hilario, Alex Daher, Farhad Howleh, Jim Albury, Britton Cole, Henry Hilario, Roberto Donatelli, John Prowse, Taining Sun, Vijay Kumar. *Seated:* Salini Ullal, Barbara Porpealia, Iren Kirui, Olivia De Santos, Abbas Khayyam.

12. West Toronto Diamond Rail-Rail Grade Separation. Parsons. *Left to right:* West Toronto Diamond Rail-Rail Grade Separation. Parsons. *Left to right:* Victor (Vic) Anderson, William (Bill) Moore, Brent Archibald, Hugh Tracy.

13. Whitehorse Diesel to LNG Conversion Project, Yukon. Allnorth - KGS Group - CAP Engineering. *Left to right, top:* Curtis Gamache (CAP), Ashley Dent (KGS), Janna Gillick (Allnorth). *Bottom:* John Murray (Allnorth), Hugh Williams (KGS), Kyle Power (CAP).
14. Giant Mine Roaster Complex Decontamination and Deconstruction, Yellowknife, NWT. AECOM. *Left to right:* Cathy Corrigan, Gordon Woollett, Rudy Schmidtke.
15. Low Level Road Project, North Vancouver. Stantec. *Left to right:* Neal Cormack, Cozmin Radu (Port of Vancouver), Kip Skabar Carter Chan.
16. Boundary Dam Integrated Carbon Capture Storage, Estevan, Saskatchewan. Stantec. *Left to right, back row:* Bob Drever, Sandy MacKenzie, Ameya Bhandarkar, Garret Sliva, Graham McTavish. *Front row:* Terri Lamb, Jim Doolittle, Shikhar Singh, Pai Sanpasertparnich, Mary Worel, Murad Chowdhury.
17. Capilano Break Head Tank and Energy Recovery Facility, Metro Vancouver. Knight Piésold. *Left to right:* Jeremy Haile, David Levi, Jugoslav Bajkin, Hein Steunenberg, Rob Adams, Michael Pullinger, Marko Barisic.
18. Goldcorp Éléonore mine, Quebec. SNC-Lavalin, Montreal. *Left to right:* Guy Boily, Jean Fournier, Martin Lachance (SNC-Lavalin), Guy Belleau (Goldcorp).
19. Lower Mattagami River Project, Ontario. Hatch, Niagara Falls, Ont. *Left to right:* Bruce MacTavish, Fadi Chidiac.
20. Coastal Protection, Cotonou, Benin. Norda Stelo, Quebec City. *Back row, third from right:* Paul Gendron, with local Benin team.



WEBINARS

By Carl Friesen

On-line presentations can be a good tool for engaging and recruiting clients, and also for internal training. Here's some advice on what works and what doesn't.

With their focus on technical excellence, it seems that engineering firms would be a natural fit with new communications technologies such as webinars. Engineers love a technical challenge — and at least until recently, webinar technology delivered plenty of challenges. And given that many engineers prefer to stay in the background, they might prefer the chance to do a presentation from the security of their own office, without having to appear on camera or on a stage.

There's a solid established base of best practices for these online training sessions. They are a flexible way to present new technology, case studies, thought leadership and other information.

The term "webinar" combines "web" with "seminar," and is sometimes referred to as "enterprise conferencing." They are generally presented by an expert in a given field, who talks about a topic usually for about an hour, as slides are shown on the screen. Participants access the webinar via the Internet, and there is usually a way to ask questions and for the presenter to respond. They can be live or recorded.

Some webinars are split-screen, with a video feed of the presenter on one side and the slides showing on the other. Some webinars are open to anyone who has keyed in the right online code; some are closed.

Why they're useful

Webinars can be a great way for en-

gineering firms to show what they offer, and move a prospective client along in the business development process.

Today the technology is low-cost and increasingly robust and user-friendly. Webinars can be set up in a way that registering for the event requires entering a name and an e-mail address, and agreeing to further mailings from the webinar provider. This procedure allows the firm to build its mailing list of potential clients, and do it in compliance with Canadian Anti-Spam Legislation (CASL).

Webinars can also be a good way to provide internal training within a firm, which is particularly valuable in companies with multiple locations. As well, webinars can help individuals who provide special services, such as forensics, to gain the support of senior members of the company who hold existing client relationships, thus supporting cross-selling and extending the firm's services.

Yet it seems that few engineering companies have embraced webinars as a way to market their services to potential clients, or to support internal training.

How one engineer uses webinars to teach — and learn

One engineer who has embraced the tool is Mark Peterson P.E., who is based in Montano and on the staff of Advanced Engineering and Environmental Services, a firm with offices throughout the western U.S..

Peterson develops and presents webinars on topics that include stormwater management and detention pond design. The sessions are hosted through the American Society of Civil Engineers. Peterson says he likes teaching and he earns revenue from it. But he says that there are two more big benefits to creating this kind of content.

One benefit comes from the questions he receives from his audiences. It gives him valuable feedback on client concerns and issues, so that his professional work meets their needs better. Also, he learns from the questions and comments, because there are usually some people in the audience who know something about the topic that he didn't.

"It seems that every company webinar starts with the first 10 slides about the company history. Ultimately, no-one cares."

The other benefit he finds is that pulling together enough information to do a presentation — and to be able to respond to those questions — forces him to research and think through his topic in greater depth.

A one-hour webinar contains about 10,000 words, which is getting close to a book in length. Creating the webinar makes the presenter research current information, and maybe find ways to explain issues using diagrams and animation.

Effectively communicating your knowledge

Another business professional who has used webinars to market engineering services is Heather V. Stevens, a Guelph, Ontario, based consultant with the Webinar Insiders Club (webinarinsidersclub.com). She has facilitated and presented webinars on behalf of mechanical equipment manufacturers and distributors.

She says one difficulty that engineers have with webinars is that while they have their technical information well in hand, they often haven't taken the time to learn how to present it effectively using webinar technology.

Three common errors Stevens has seen include:

- Trying to put across too much technical data. Many webinars fail because the presenter has tried to give a depth of information that would be better provided in a printed document at the end of the presentation. "You can't download an entire engineering handbook onto someone through a webinar; it's just not effective," Stevens says. "You need the follow-up material to go with it."
- Unnecessary information. "It seems that every company webinar starts with the first 10 slides about the company history. Ultimately, no-one cares. "That's where you'll have your attention drop-off," says Stevens She says she's even seen details on the company's history on internal webinars, as they were simply adapted from presentations for external use.
- Inconsistent slide formats. Many webinars feature slides cobbled together from a variety of presentations, sometimes with different formatting and fonts. Stevens says that it's best to have one standard firm-wide webinar template in PowerPoint (or Apple's Keynote program). It's also important to choose fonts that can be obtained by anyone in the firm — such as the widely-used Arial.

Have an end goal

Stevens has some success factors for webinars that work for engineering firms.

First off, decide on your end goal. The purpose is not to produce a webinar — it's to achieve some other goal. For engineering firms, the goal is rarely the sale of a product as would be the case for many small businesses. Rather, the pur-

pose is to convert someone at the early stage of their inquiry, into someone who sees the firm as a source of possible solutions for their project or issue. The goal is to get them to contact your firm, or agree to be contacted. "Plant a seed of interest," Stevens advises. Engineers can accomplish their business objectives while also staying true to their values of providing technically excellent information.

Also, determine the teaching objective. For example, some firms might want members of the audience to be able to grasp a few key points about the company's offering. Or, it might be for the audience to have a basic general understanding. "Every slide in the webinar has to serve that purpose," Stevens says.

Engage the audience

Find case studies and stories that bring the ideas to life. Rather than providing too much technical detail, it is important to present stories about how one of the firm's clients achieved success using the ideas being presented in the webinar. It is engaging stories that will cause members of the audience to stay around to the end of the session, and to pay attention rather than checking e-mail or their favourite team's standings.

Have the presenters trained in webinar effectiveness. Many engineering firms will gladly pay for public speaking skills improvement, or may have an internal Toastmasters club. They need to take a similarly intentional approach towards webinar training.

Create slides that are light on text. Many webinar creators try to put too much text on a single slide. Staying on the same slide for more than a minute or so tends to bore the audience. Drop-offs mount and attention wanes. So, it is better to use three or four slides with just a few lines, than one slide with many bullet points.

Choose your tools and a moderator

Use the right technology, the right way. There are several robust, well-developed, cost-effective solutions for webinar platforms. Stevens recommends any of GoToMeeting, Adobe Connect, or MS Lync. All of these are paid platforms, and offer technical training and a level of reliability that is generally not available with free solutions such as Google Hangouts (which often won't get through corporate fire-

walls, in any case). Professional-level webinar services will record the webinar so you can make it available later, if you so choose.

While experienced webinar presenters can do it all themselves, beginners would be best to have an experienced moderator along on the webinar to trouble-shoot. The moderator can also welcome registrants and introduce the presenter at the beginning. They can then read audience questions to the presenter during the question-and-answer section at the end. This leaves the presenter free to focus on the content of the presentation. Most services such as GoToMeeting will provide an experienced moderator and technical support, for a fee.

A wired connection to the Internet — not WiFi based — is preferable in that there is less chance that the connection will fail. It is generally best to invest in a separate microphone such as the Blue Yeti. Just relying on the sound produced using the computer's built-in microphone will have many people dropping off the webinar out of frustration.

Stevens advises that if someone isn't comfortable with the material, they should consider creating a script and following that, rather than trying to just talk to the slides.

There should always be a Call to Action — a CTA — at the end. This might be to download an e-book or white paper, or to request a consultation from a member of the firm. They may simply ask to subscribe to the firm's newsletter or social media feed. The objective is to bridge from the webinar into a process that leads to a new client relationship. **CCE**

Carl Friesen is a freelance writer based in Mississauga, Ont.

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ELECTRICAL

Rittal Systems has added the LED System Light, the first lighting system designed specifically for industrial enclosures. It shines into every corner with a brilliant 900 to 1200 lumens. The units can be installed into a TS 8 enclosure. Also, Rittal has introduced the ChillZone app, an energy savings estimator for the Blue e+ line of industrial enclosure cooling solutions. www.rittalenclosures.ca

HVAC

The Luxaire Eclipse rooftop replacement solution from **Johnson Controls** has 10-ton XX heat pumps and 3- to 5-ton ZQ 14 SEER air-conditioning units. The units are an "exact-fit" replacement that match the footprints of other manufacturers' units. www.luxaire.com

BUILDING ENVELOPE

The **Gypsum Association** has released an environmental product declaration (EPD) for glass mat gypsum panels, also known as exterior gypsum sheathing. Glass mat gypsum panels consist of a non-combustible moisture resistant core encased in fibreglass. www.gypsum.org/stewardship/life-cycle-assessment-tools/

INFRASTRUCTURE

A new addition to the UtilityScan GPR line of ground penetrating radar systems by **GSSI** is the UtilityScan Pro, which has the SIR 4000 control unit for configurability and flexibility. UtilityScan systems help to identify subsurface utilities, including gas, sewer, and communication lines. In addition they can be used for non-destructive testing, bridge deck assessments and concrete scanning. www.geophysical.com

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Len Murray, President & CEO, is pleased to announce the following Principal and Associate appointments.

Welcome to our new Principals:

Simon Douglas, P.Eng.

Since joining KCB's Power and Transportation Group in 2005, Simon, a Senior Civil Engineer, has managed large multi-disciplinary teams and demonstrated strong technical, engineering, client and leadership skills in his role as KCB's Project Manager for the BC Hydro Site C project.

Rick Friedel, P.Eng., P.E.

Rick joined KCB in 2003 and spent several years completing long-term assignments in our Mining Environmental Group (MEG) offices in Canada, South America and Australia. He returned to BC in 2011 to start up a group in Vancouver to support the company's oil sands work and shortly thereafter was promoted to Manager of the MEG Engineering team.

Tim Keegan, Ph.D., P.Eng.

Tim is a Senior Geotechnical / Geological Engineer and Manager of our Edmonton office. Tim has over 30 years domestic and international design, construction and operations experience for roads, railway, water resource and tailing dams, environmental, pipeline and mining projects. He leads our design projects, regulatory approvals, and construction management for railway infrastructure across North America, and for geohazard / ground-hazard risk management programs.

Welcome to our new Associates:

Brian Borton, P.Eng., P.E.

Brian has worked on a wide variety of projects throughout North America and, since joining KCB in 2003, he has gained extensive structural design and analysis experience as well as project and design management experience on civil infrastructure projects including bridge, hydro and heavy industrial projects.

Kate Patterson, M.Eng., P.Eng.

Since joining KCB in 2007, Kate has gained extensive experience as a civil engineer, technically specializing in climate and hydrology assessments, hydrotechnical design, erosion estimation and protection, tailings staging, sedimentation pond design and cover design. She has excelled in project management and coordination for a number of projects from conceptual studies to existing mines.

Robert Cross, M.Eng., P.Eng.

Rob has extensive experience in the transportation, hydroelectric and mining sectors. He joined KCB in 2009 after receiving his M.Eng. in Geological Engineering and has since worked on projects in North America, South America, Africa, and Asia. Rob's entrepreneurial spirit led him to Toronto in 2012 to take on the role of office manager at our new location there.

Chris Gräpel, M.Eng., P.Eng.

Chris is a Civil / Geotechnical Engineer with over 20 years of experience in dams, water resources, mining and transportation (highways and railways) engineering and construction. He joined KCB in 2012 and has worked in both our Edmonton, Alberta and Lima, Peru offices. Chris is currently responsible for the Edmonton Civil Projects group, and the expansion of our services with the Alberta government, City of Edmonton, mining and utility clients.

Robert Cheetham, P.Eng.

Rob is a Senior Civil Engineer with over 20 years of international experience in the civil, water resources, river engineering and floodplain mapping, hydrological and hydraulic analysis and surface water management for private and municipal clients. Rob is responsible for managing and coordinating projects for the City of Calgary, TransAlta and SaskPower, developing conceptual and feasibility designs, preparing design documentation and reports, and providing support during construction.

KCB is an international engineering, geoscience and environmental consulting firm with offices in Canada, Australia, Peru and Brazil.

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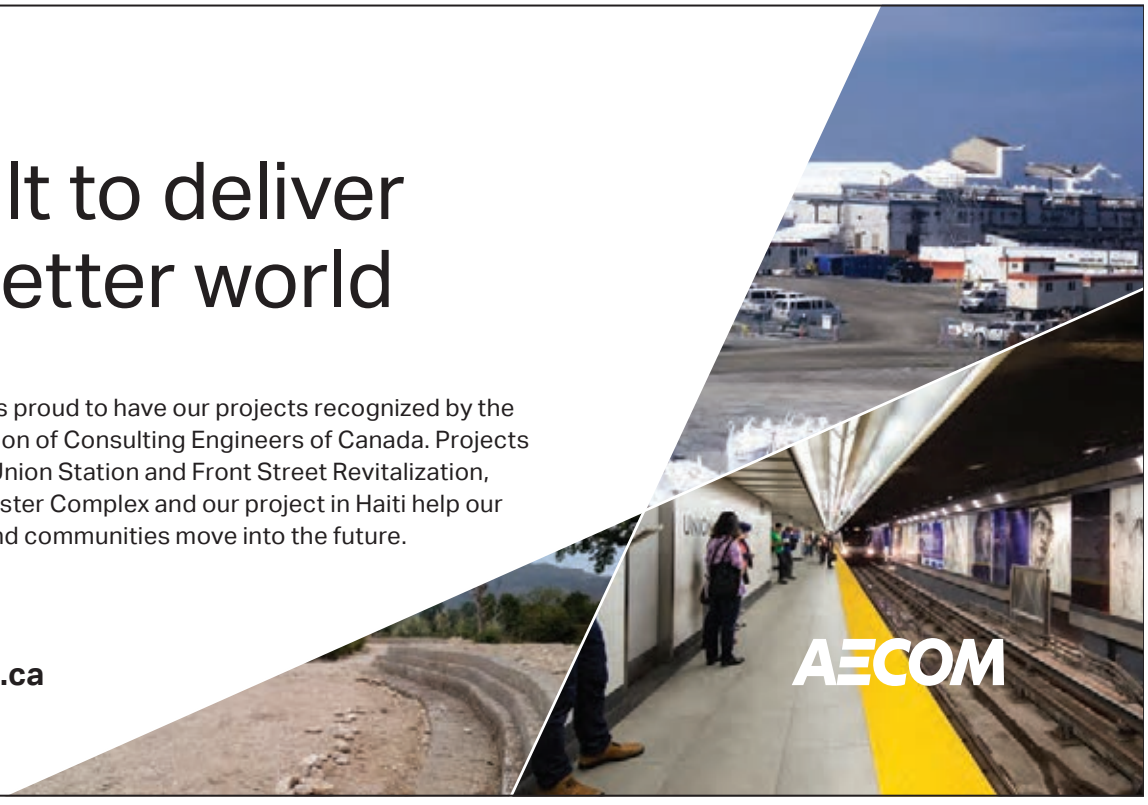

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ADVERTORIAL

KSB PUMPS

Pump Upgrades – Invest a Little, Save a Lot

Replacing older submersible pumps with newer, more efficient, low maintenance models can result in significant net savings for operators. Available adaptors make it easier to add up-to-date equipment without having to upgrade existing piping infrastructure.

Submersible centrifugal pumps have been a mainstay of water and wastewater treatment facilities for years. These versatile workhorses are widely used to draw water or other fluids out of sumps or wells. Submersible pumps are typically installed on a duckfoot and claw arrangement. The duckfoot, also referred to as a discharge elbow, is a mounting fixture located at the lower end of the discharge pipe. When the submersible pump is lowered into place at the bottom of the well (usually with a guidewire or guide rail system), a claw adaptor mounted at the outlet nozzle of the pump engages with fittings on the duckfoot to ensure that the pump is properly aligned with the discharge pipe. The weight of pump holds it in place. When it is necessary to gain access to the pump to clear a blockage or for maintenance, the pump can be disengaged from the duckfoot and hoisted to the surface.

KSB Amarex N Pump with Interchangeable Mounting Adaptor

Improvements to a Mature Technology

While submersible pumps have been around for a long time, the technology incorporated into these machines has not stood still. Manufacturers have incorporated many improvements that have significantly improved the reliability and efficiency of this equipment. KSB Pumps Amarex N models are a good example of this trend. Current models of the Amarex line feature improved hydraulic designs, often developed using state-of-the-art computer-aided design tools that increase pumping efficiency while also reducing vulnerability to blockages due to solids and fibrous materials. Improvements to hydraulic efficiency are backed up by more efficient motors, resulting in a useful reduction of energy costs. Modern pumps also incorporate improvements such as longer-lasting seals and leak-proof cable entries, both of which reduce maintenance requirements. Even small details, such as the use of corrosion-resistant stainless steel bolts with a common head size, make life simpler for maintenance crews and reduce operating costs. As a result of these cost-saving innovations, it can often be economically beneficial to replace older, less efficient machines with newer models.

Replacement Made Easy

One obstacle to changing out older pumps can be that this would trigger costly changes to the supporting infrastructure, including the duckfoot and outflow piping. KSB has addressed this problem by introducing a number of adaptors that enable new Amarex N pumps to be used as direct substitutes for older submersible pumps from KSB and other major manufacturers. (These adaptors are sometimes referred to as "claw adaptors" since they prominently feature a pair of hooks that fit over the duckfoot.)

Is an Upgrade Justified?

Experience has shown that many submersible pumps are selected on the basis of a "best guess" estimate of their ultimate service requirements. As a result, these pumps might be operating under conditions that are far from their best efficiency point (BEP). Off-optimum operations can be a significant energy waster. Pump replacement is an opportunity to rectify this situation by swapping in pumps that are properly sized for the actual operating situation. To do the job properly, it can be extremely helpful to do a careful assessment of the as-installed operating profile that the new pump will encounter. KSB's System Efficiency Service (SES) can provide the necessary information by tracking system parameters such as pressures, flow rates, temperatures and pump performance over a full range of operating conditions in order to determine the "right" pump specifications for the job.

KSB provides sales and service for pumps for the industrial, municipal, energy, mining, agriculture and building services sectors. KSB Pumps has 5 locations across Canada including Calgary, Edmonton, Montreal and Atlantic Canada with headquarters located in Mississauga. Tel: 905-568-9200, www.ksb.ca

ADVERTORIAL

GRUNDFOS

Atlantic Property Management Co. Achieves Nearly 80% Energy Savings with Grundfos Energy Audit and Smart Pump Retrofit

Killam Properties Inc. owns and manages both existing and new development apartment complexes in Atlantic Canada, Ontario and Alberta. "We have a lot of opportunity in retrofitting older buildings," said Julian Boyle, Director of Operations. "We wanted to embrace new technology, and have an energy-efficient pumping solution that would save on energy and maintenance costs."

Killam and Grundfos recently looked at two older buildings for retrofit; 1Oak in Dartmouth, and Chapter House in Halifax, Nova Scotia. 1Oak in particular, a 47-year-old building with 150 units, was costing Killam a whopping $180,000 annually in energy costs. "We wanted to retrofit both of those buildings completely from a pumping technology and really allow ourselves to see the differential in energy savings." said Julian Boyle.

Grundfos Sales Manager, Gordon Inkpen, completed an on-site visual inspection and inventoried the 21 existing constant speed pumps. Information such as pump age, operating hours, flow, pressure and power was collected and sent back to Grundfos' Energy Optimization (EO) team. The EO team performed an Energy Check, which ultimately gave an overview of the pumps' energy consumption, and proposed a replacement pump solution.

Grundfos proposed the installation of 17 MAGNA3 and 4 ALPHA circulator pumps in both buildings, with a projected combined annual energy consumption of 34,882 KWh, and an annual energy and maintenance savings of over $6,600.

Grundfos MAGNA3 and ALPHA were chosen for the following reasons:

- MAGNA3 and ALPHA are the most energy-efficient pumps in the market, with the fastest return on investment. These smart pumps can reduce power consumption by up to 75% without sacrificing comfort.
- With MAGNA3 & ALPHA's unique AUTOADAPT control function, pump performance is automatically adjusted to meet the ever-changing demands of the system, and additional energy savings of up to 85% or more can be achieved.
- The large display on the pumps shows current energy consumption, temperature, flow and head, allowing for recommissioning of each building, and fine tuning flow rates to suit actual heating requirements on the spot.
- The Grundfos GO allows for intuitive handheld pump control and access to Grundfos online tools on the go. Using an Android or iPhone you can control, data collect, and report on one or more pumps at a time quickly and effortlessly.
- MAGNA3 and ALPHA are easy to install, commission and maintain. Just plug and pump. Maintenance savings can be as much as, or even more than, energy savings.

The MAGNA3's and ALPHA's have been running flawlessly since their installation in June 2016. Two months into the retrofit Killam was already seeing savings. "We were very confident that the pumps were going to save us 50% of the energy," said Boyle. "We are seeing somewhere between 70% to 80% savings depending on the day." The retrofit also allows Killam to qualify for an incentive rebate of $4,140 from their local power authority.

"If you're concerned about energy costs today, you really should be looking at smart pumping technology like Grundfos provides," said Boyle. "It was a real pleasure working from start to finish with Gord and Grundfos."

Article by Melissa Almonte of Grundfos. Grundfos is the world's largest manufacturer of pumps and pumping systems. Grundfos' Canadian headquarters is in Oakville, Ont. 1-800-644-9599, www.grundfos.ca

ADVERTORIAL

NATIONAL PRECAST CONCRETE ASSOCIATION

Under control: inverted precast concrete cone regulates the flow of raw material for a cement silo

The Lafarge cement plant in Exshaw, Alberta, had a problem. Inside of a 130-foot-tall, newly constructed cement silo, the company required a structure that would allow for even distribution of raw material during unloading operations. In addition to offering controlled output, the structure also needed to be capable of handling the immense weight of the material inside.

General contractor PCL Construction Management's solution was a 30-foot-tall, 52-foot-wide inverted cone constructed from cast-in-place concrete. While this approach made sense at first, representatives from all parties involved realized it wasn't the best approach given the cone's size and unique installation location.

To solve the problem, PCL Construction Management contacted Eagle Builders of Blackfalds, Alberta, to manufacture a precast concrete cone. Eagle Builders partnered with local engineering firm Grubb Engineering to ensure the finished structure would meet all of the project's tight tolerances and stringent requirements.

Kelly Grubb, owner and principal structural engineer with Grubb Engineering, said a major reason for selecting a precast cone was a compressed construction schedule.

"They were under a crunch for time," he said. "With precast, you can get all of the work done in the plant, get the pieces out there and erect them fairly quickly."

The components

Eagle Builders and Grubb Engineering landed on a design that included eight identical precast concrete segments weighing approximately 43,000 pounds each. The 16-inch-thick, 31-foot-long segments were each reinforced with roughly 4,500 pounds of 25M rebar to withstand the weight of the silo's contents.

According to Jason McNutt, infrastructure project manager for Eagle Builders, the segments were assembled on a large piece of concrete on the floor of the silo called the discharge slab. Connecting the cone to the slab presented a few challenges.

"These eight pieces sat on a cast-in-place section on a 10-degree inward slope," he said. "You've got precast that has been produced to one shop drawing by a certain fabricator, but then you also have the cast-in-place with all of its own tolerances that was produced by another contractor."

Though accounting for those differences and the out-of-the-ordinary job site was difficult, the close relationship between the precaster and engineer allowed all issues to be solved quickly and efficiently.

"We couldn't really exist without collaboration," Grubb said. "We can only be successful as a team, not as individuals."

An optimal solution

Going with the precast option offered many advantages, including an expedited construction timeline and eased installation for the general contractor.

"We were able to deliver a better quality product with less time spent on site, which was really one of the big drivers of this project," Grubb said.

The National Precast Concrete Association (precast.org) represents more than 600 manufacturing firms and nearly 300 supplier companies operating in the precast concrete sector of the construction industry in North America. Visit us at www.precast.org

Specifier's Literature Review

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Engineering rests on mathematics, but things aren't looking good for future generations because children are not being taught the basic skills.

Phil Sullivan and poor math scores

"There's a huge distinction between mathematics educators and mathematicians." —Sullivan

Since an Ontario report recently showed that mathematical skills in schools are dropping — only 50% of Grade 6 students met the provincial standard — criticism has mounted over how the subject is taught. One person who strongly advocates changes to math curricula is Professor Phil Sullivan, PhD, P.Eng. A retired professor of the Institute for Aerospace Studies at the University of Toronto, Sullivan volunteers with the Professional Engineers of Ontario (PEO) York Chapter and the PEO Education Committee.

CCE talked to Professor Sullivan in late August.

Q. What sparked your concerns about math teaching in schools?

When I started doing volunteer work with the York Region PEO education committee I rapidly became aware of just how bad a lot of the students' mathematics skills are. Actually, if I back up even further: the original cause of all of this was disgust at one of my grandson's Grade 6 textbooks. It was a very expensive textbook and was badly written.

I started reading around the subject, and while I'm certainly not an expert in how to teach children mathematics, I looked at the literature and talked to some colleagues.

Believe it or not, historically in the United States — and I think Ontario followed this pattern — the problem goes back to the Sputniks. When the Russians put a satellite into orbit the Americans were so concerned that U.S. students were being left behind, they introduced the New Math.

But as Richard Askey, a professor of mathematics at the University of Wisconsin, has pointed out, mathematics is like a stool that sits on three legs. In the New Math period the only leg used was the structure of mathematics. That didn't work. Then the educators adopted the second leg, which is Procedures (computation). However, the level was too low, and good problems and structure were both ignored. That failed badly. Then the U.S. National Council for Teachers of Mathematics focused on Problem Solving. It too has turned out to be false. We're struggling to try to get out of that third phase where the educators have ignored the fundamental principles and standard computational techniques.

Q. Put simply, children are not learning their multiplication tables, and not learning to do calculations in their own heads? Is that part of the problem?

They're being allowed among other things to develop their own techniques to add, subtract, multiply and divide. Basically the use of the standard techniques that we learned in schools during the 1950s and 60s have been downplayed. Another problem is an excessive allowance of the use of calculators.

An added complication is that there is a huge distinction to be made between mathematics educators and mathematicians. It is the mathematics educators who are controlling the textbooks.

Q. Do you have any perspective of how poor mathematical skills in schools might be affecting students entering university to go into engineering?

It's been shown that by the end of Grade 6 children's abilities to do basic arithmetic and work with fractions is a useful predictor of how well they will do in the later subjects like geometry and algebra. The fundamental problem is that they have to get to the point where — the phase is automaticity —where they can do without thinking some basic adding, subtracting, multiplying and dividing. If they haven't got to that point where it's automatic, they're going to do very badly in the following years in geometry and algebra and the related subjects.

Mathematics is a subject which is highly structured, in the sense that if you don't understand the basics, you are not going to get anywhere with the more advanced aspects. **CCE**

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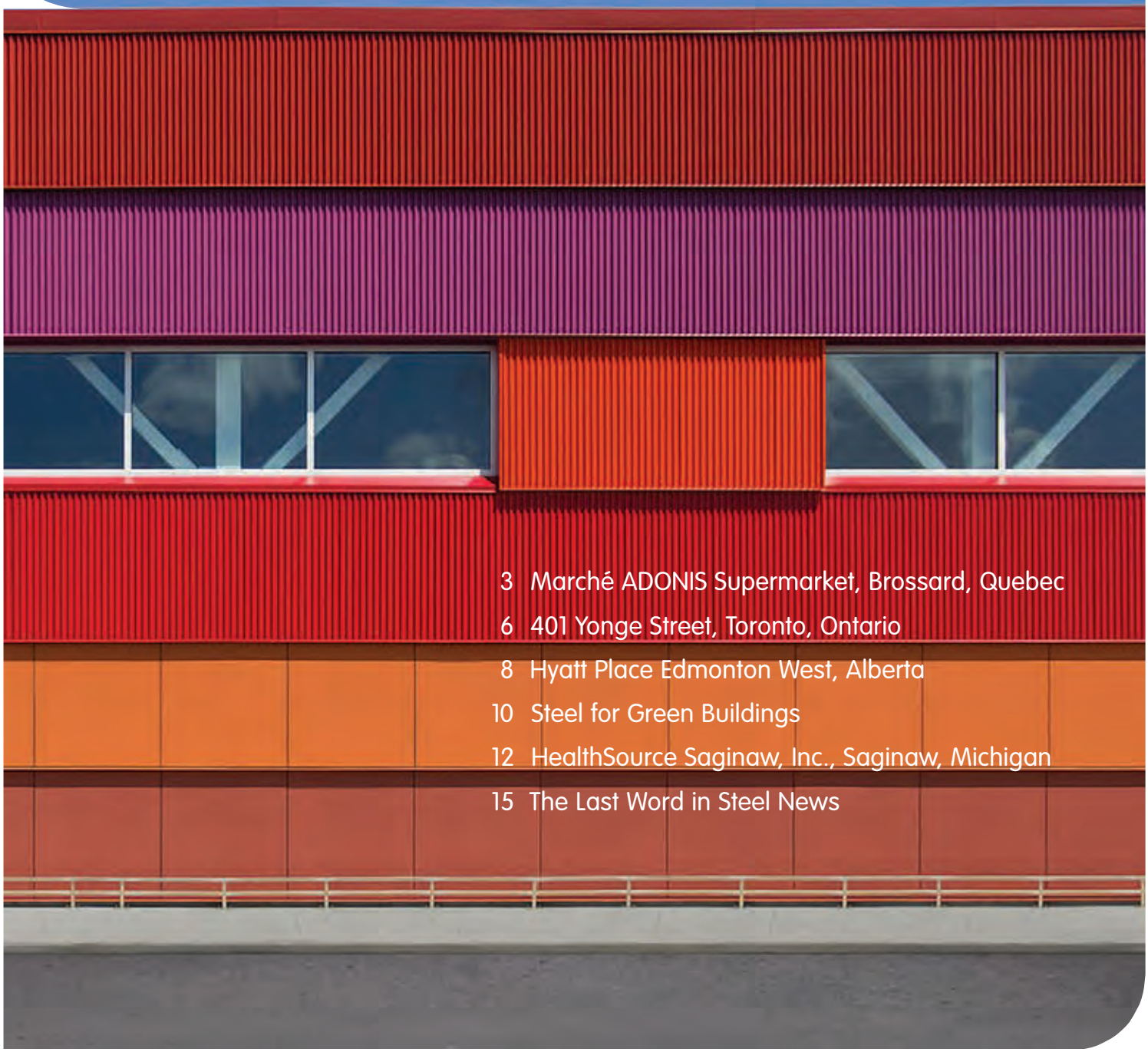

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