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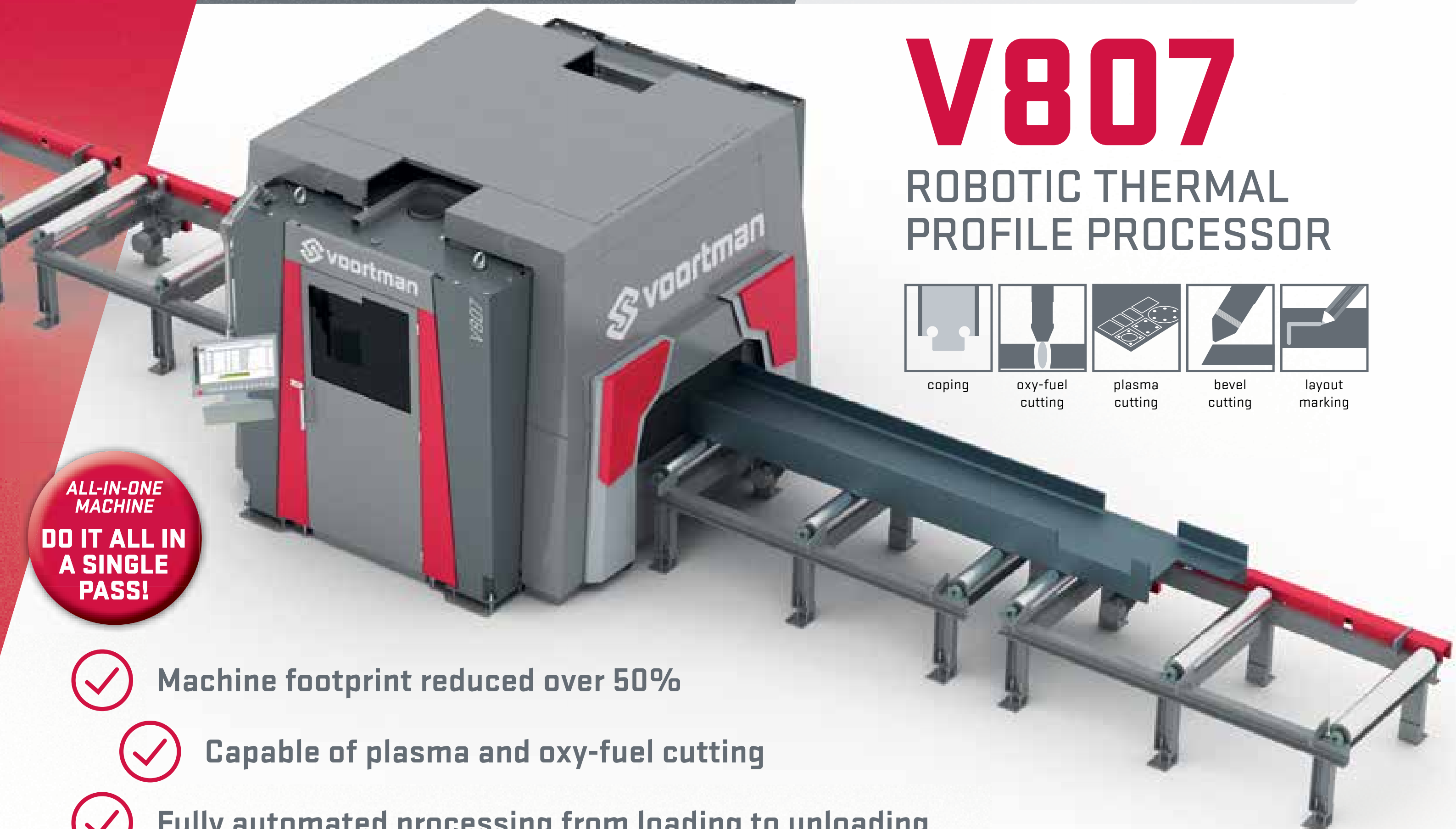

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ADVANTAGE STEEL

NO. 70 SPRING 2022

IN EVERY ISSUE

COLUMNS

On the Cover:
STEEL – AHEAD OF THE CURVE
A proven track record of breakthroughs!

INNOVATION & RESEARCH

LEADERSHIP

FEATURES

The Canadian Institute of Steel Construction (CISC) is the voice for the Canadian Steel Construction industry. The CISC represents a diverse community of structural steel industry stakeholders including manufacturers, fabricators, erectors, service centres, consultants, detailers, industry suppliers, owners and developers. Steel construction industry stakeholders are encouraged to apply to become a member or associate. Visit cisc-icca.ca for more information. If you are working on a project that you think should be featured, send us an email at ciscmarketing@cisc-icca.ca.

ED WHALEN, P.Eng.
President & CEO
CISC-ICCA

Canadian Codes and Standards – An Unclear Future

You wouldn't normally think codes and standards have drama, but there have been moments in the last few years.

The National Building Code of Canada looks poised to finally release the 2020 version in the early months of 2022. The main committee approved the last of the proposed code changes in late December. Crippled with a record number of code responses during the public review, COVID-related delays and appeals resulting from due process, the NBCC has been delayed a full two years and counting. Good thing they're not trades contractors, or they would be facing serious back charges by now. I'm sure government projects have allowed you to extend delivery time due to COVID-19? But this is government, and the people are all volunteers, so I suppose we will give them some slack.

As you know, the NBCC is a model code, and many provinces use it directly while others tweak it for the development of their own provincial building code. In some provinces, this tweaking takes years, thus delaying the implementation of specific construction standards (CSA, for example) by years or decades. It is not uncommon for some provinces to be regularly one or two cycles behind CSA S16. These delays will soon come to an end. The provinces have agreed to a speedier adoption of the NBCC (in some form or another), but in doing so want more input into the direction of the Code from the very beginning. We are not sure how that is all going to work, but there is a total revamp planned for the structure and operation of the National Building Code process. With all this upfront input from the provinces, they have agreed to adopt the 2025 Building Code (tweaked in some cases) in 18 months. That's good news! Problem is, when have you ever seen the provinces all agreeing on the same thing? Let the game of provincial lobbying begin.

The promised speedy adoption for the 2025 NBCC has some impact for the soon-to-be-released 2020 edition. With its release in 2022, and only three years until the next edition, this Code may not see the light of day in some provinces. With the 2025 NBCC to be fully adopted by all provinces by mid-2027, some provinces are likely to wait and adopt the 2025, never looking at the 2020 version. Although 2027 seems very far away, it is a blink of the eye for code development at the provincial level.

That said, the CSA S16, design of steel structures committee chaired by Jim Montgomery, Partner Emeritus from Dialog is soldiering on, preparing for the 2024 edition and to be referenced in the NBCC 2025.

You may also be interested to know there is a new pedestrian bridge guide in the works with an expected release date of winter 2023. This CSA "rush to release" guide will most likely become a CSA Standard in the years to come.

Codes and standards are going through dramatic change. Some good and some not. Governments want more say in the development and direction of codes, standards are being pressured to be available for free, SDOs (standards developing organizations), fearing free standards, want to own the industry sector's intellectual property via copyrighted standards (like genetic testing services – give us your blood and we own your genetics), and construction associations are now expected to finance one new standard after the other as SDOs race to increase their standards portfolio to protect against growing competition.

We will always need our national and provincial building codes, and the beauty is they are government-funded for the good and safety of the country. How the new format works out is hard to say, but it will have drama fit for a soap opera, I'm sure. On the standards front, we may need, sooner than later, some serious consideration on the viability of financially supporting Canadian-specific standards. Winter is coming. AS

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Ensuring a Culture of Continuous Learning and Discovery

BY :: CRAIG MARTIN, P.Eng.
Chairman of CISC's Education & Research Council

The writer Mark Twain is well known for his one-liners. Who can forget his classic quip, "*Politicians and diapers must be changed often, and for the same reason*"? Mr. Twain was both humorous and insightful, and on the topic of learning he stated, "*Never let formal education get in the way of your learning.*" In other words, once we finish our diplomas and degrees, we don't know it all. The world changes at a rapid pace, and we need to ensure we are always learning, always exploring new ideas – finding new ways of working, of creating and of building.

A key focus area for the CISC and the Education & Research Council (ERC) is working to ensure that a culture of continuous learning and discovery is established in our industry – to support innovation and our mission to see steel continue to be the construction material of choice in Canada. I've shared in a previous column about the work the ERC is doing to support research in Canada, and I wanted to share this time around what the ERC is doing related to continuous learning.

A core program of the ERC is our investment in professional upgrading courses for the design and engineering community. In partnership with CISC staff, the Council works to prioritize areas where it is critical to keep steel professionals up to date on changing design and fabrication requirements. Each year, the Council directs funding support to course development to help ensure that the CISC's training material is current and relevant to our industry. Through this work, the CISC has established many courses for its members and the industry, including:

- Budgeting Steel Structures
- Project Leadership
- CSA S16 / CISC Handbook Overview
- Seismic Industrial Design
- Single-Storey Building Design
- Industrial Building Design
- Steel Bridges
- Steel Erection Estimating

In addition, several new courses are under development by CISC, and the ERC is proud to support these efforts.

Another exciting program of the ERC that supports continuous learning is our biannual "CISC Educators Forum." This event brings together engineering and architecture professors from Canada's university network to share best practices and hear from industry leaders on the state of the steel construction industry. This important event allows the CISC and its membership to connect with those that are shaping the next generation of steel professionals, supporting both alignment and understanding of the industry's evolving needs. Our next forum is planned for spring 2022 – watch for more details in the coming months!

On behalf of the ERC, I would like to express our gratitude for the continued support of the CISC and our funding partners. We have accomplished a great deal with your support and are focussed on expanding our support to address our industry's changing needs. If you have a passion for supporting the next generation of steel professionals and for the future of the Canadian steel construction industry, I encourage you to consider becoming an ERC financial supporter. AS

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LINCOLN ELECTRIC

CHARLES ALBERT, P.Eng.
Manager of Technical
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CISC Engineers' Corner

CISC provides this column as part of its commitment to the education of those interested in the use of steel in construction. Neither the CISC nor the author assumes responsibility for errors or oversights resulting from the use of the information contained herein. Suggested solutions may not necessarily apply to a particular structure or application and are not intended to replace the expertise of a licensed professional engineer or architect.

QUESTION 1: S16:19 Clause 25.2 states that "Columns shall be fitted with at least four anchor rods. When four non-colinear anchor rods for erection safety are not feasible, special precautions shall be taken." What are the special precautions and where can I find information in this regard?

The provision is intended to ensure stability during erection (with an ironworker on a column, for example), although it may not be a design requirement to support the completed structure. (See Figure 1.) Requirements similar to the one specified in CSA Standard S16 are also found in some provincial safety codes, and for this reason, the local building construction authority should also be consulted.

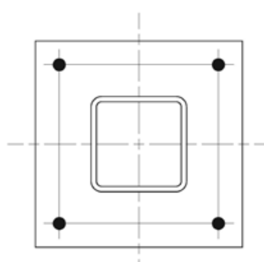

FIGURE 1
Base plate with four anchor rods.

To take the province of Quebec as an example, the *Safety Code for the Construction Industry* (S2.1, r.4) states in Clause 3.24.11: "… provide an erection procedure where the columns are anchored with fewer than four anchor rods or where the position of the anchor rods does not ensure stability of the columns in all their axes."

QUESTION 2: How does the presence of bolt holes in the flanges affect the beam resistance?
Before the publication of CSA S16:19, the general rule was that the moment resistance is not affected as long as the flange area reduction due to fastener holes does not exceed 15 per cent of the gross area. However, S16:19 Clause 14.1.3 introduced new provisions for beams with an area reduction over the 15 per cent threshold.

Figure 2 illustrates the moment connection described on pages 3-91 and 3-98 in the 12th edition of the *Handbook of the Steel Construction*. Both the top and bottom flanges of the beam are connected to flange plates using 7/8-inch bolts, and the area reduction exceeds 15 per cent.

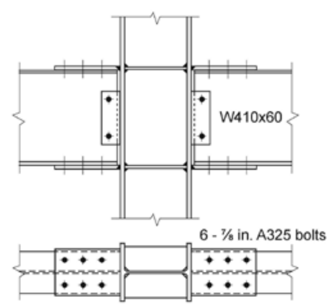

FIGURE 2
Beam with bolt holes in the flanges.

S16:19 has also clarified that there is no strength reduction when a compression flange with standard-size holes is filled with correctly sized bolts. For the Class 1 beam in Figure 2, the effective plastic section modulus is given by:

$$Z_e = \alpha Z + Z_n \leq Z$$

Questions on various aspects of design and construction of steel buildings and bridges are welcome. They may be submitted via email to info@cisc-icca.ca. CISC receives and attends to a large volume of inquiries; only a selected few are published in this column.

where a = 0.05 for sections with holes in one flange and a = 0.12 for holes in both flanges. Z is the plastic section modulus, and Z_n is the plastic modulus of the net cross-section.

The calculation of the reduced moment resistance (M_r) due to fastener holes did not appear in the first printing of the 12th edition and will be incorporated in future printings. It can also be found in the CISC "Revisions and Errata" webpage *(https://www.cisc-icca.ca/revisions-and-errata/)* which will eventually move to the Steel Store *(https://steelstore.cisc-icca.ca/)*.

For other types of construction, such as the Gerber system, the CISC Commentary on CSA S16:19 Clause 13.6.2 states: "OWSJs are frequently connected to supporting girders by bolts, which require bolt holes in the top flange. [...] Narrow-flanged beams, which tend to be most efficient when the compression flange is well supported, often will not accommodate standard bolt holes in the tension flange without being subjected to the mandated strength reduction. [...] The use of beams with wider flanges will avoid the net-section fracture issue and increase the stability of the girder."

QUESTION 3: Our company has been increasingly using 350W steel instead of the more common 300W grade for channels, angles and plates. Some suppliers have pointed out that the 300W material meets the requirements of the 350W grade. Can I use the properties of the higher grade?

It's important to note that only the steel mill can certify that a structural product meets a specific standard. In some cases, a mill may dual-certify a product to more than one grade. For example, Gerdau produces channels, angles and flat products to its "GGMulti" grade, which includes both CSA G40.21-300W and 350W, as well as several other grades.

But if a product is certified to a single grade, then only the minimum specified yield and tensile strengths corresponding to that steel grade may be used. The levels reported on mill test certificates cannot be used as the basis for design, as stated in S16:19 Clause 5.1.2. AS

"IT'S IMPORTANT TO NOTE THAT ONLY THE STEEL MILL CAN CERTIFY THAT A STRUCTURAL PRODUCT MEETS A SPECIFIC STANDARD."


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CSSBI Engineers' Corner

BY :: BRETT PERRAS, P.Eng.
Steel Market & Industry Development Engineer at Canadian Institute of Steel Construction (CISC-ICCA)

QUESTION 1: What could be the cause for a prefabricated load-bearing steel stud wall bottom track to pull away from the studs, resulting in failure of the screw connections? This occurs near the bottom track flanges of the load-bearing CFS system.

Lack of compression of the wall studs during the fabrication of the top and bottom tracks can result in axial force being transferred through the vertical stud to the top and bottom tracks, inducing a shear force in the screw connection on each flange. The connection gap between the wall stud and the top and bottom tracks in load-bearing applications is limited to 1/8" according to AISI S240-15 Section C3.4.3 (a), unless otherwise specified by a professional engineer.

Screws must be re-installed following the requirements outlined in CSA S136-16, Section J4. The screws are required to provide lateral-torsional restraint at the top and bottom tracks. The track distortion is a non-structural item but may cause visual issues when the sheathing is applied.

Using inadequate screw sizes in relation to the steel thickness can also result in screw failure. The screw specification should follow the minimum requirements outlined in the AISI S240-15 Commentary, B1.5.1.1 – Steel to Steel Screws, Table C-B1.5.1.1-2, "Suggested Screw Sizes for Steel-to-Steel Connections."

FIGURE 1
Photo representing the failed screw connection from the wall stud to the bottom track.

QUESTION 2: I would like to build an 8" exterior wall with two staggered 6" cold-formed steel studs at 16" o/c. Is it possible to build exterior walls with staggered studs?

Typically, cold-formed steel stud exterior walls are not staggered for the following reasons: individual bottom and top tracks cannot be installed for the two separate wall studs due to the staggered configuration. The lateral bridging within the wall system providing lateral restraint to each wall would collide with the staggered stud. Exterior wall pressures would only be applied to the outermost wall fastened to the exterior sheathing, resulting in a tributary width of 32" o/c.

Standard practice consists in constructing a double wall, utilizing smaller cold-formed steel studs that can be installed side-by-side rather than staggered – i.e., two 3-5/8" walls with individual bottom and top tracks or one bottom and top track that encompasses both studs with appropriate clips top and bottom at each stud.

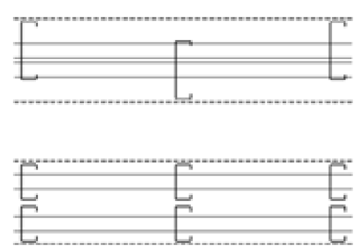

FIGURE 2
Staggered wall construction compared to two independent walls.

QUESTION 3: The roof purlins I am designing have spans of 3.66 m (12'-6"). Do I still have to provide one discrete bracing if I consider the unbraced length of the purlin equal to the span of 3.66 m?

According to CSA S136-16 C2.2.2, at least one torsional brace per bay must be installed. The torsional bracing prevents twisting about the longitudinal axis of the member and allows the designer to take advantage of the lateral support provided by the roofing.

If a brace is not installed, a conservative approach must be followed, such as designing the purlins as completely laterally/torsionally unbraced members. AS


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CISC's Commitment to Supporting Research and Innovation

Opening the door to achievement

BY :: HELLEN CHRISTODOULOU, PH.D. Ing., B.C.L., LL. B, M.B.A.
Director, Steel Market and Industry Development
Canadian Institute of Steel Construction (CISC-ICCA)

The CISC's Education & Research Foundation, with long-standing and new partners within the steel industry, is committed to providing funding for engineering and architecture students and Canadian universities and technical colleges that demonstrate a strong interest and zeal for the advancement of the use of steel in construction. Opening the door to achievement is key and has an immeasurable value for the steel industry, the educators and up-and-coming professionals.

FOR ENGINEERING STUDENTS THIS YEAR

Engineering students are encouraged to apply for the G.J. Jackson Fellowship, a prestigious award of $25,000 that is awarded annually to an engineering student. Over a one-year period, this fellowship is granted to a deserving student who, in the following academic year, will be registered in their first to fourth year of full-time graduate studies in structural engineering, with major emphasis on the study of steel structures. It is awarded annually in memory of the late Geoffrey Jackson, who for many years was a leader in the Canadian structural steel fabrication industry and a founding member of the Steel Structures Education Foundation (SSEF), now the CISC Education & Research Council. For details: **https://www.cisc-icca.ca/scholarships/jackson-fellowship/**

FOR ARCHITECTURAL STUDENTS THIS YEAR

A theme that offers inspiration, that encourages out-of-the-box thinking and that nurtures creativity outside purview of the curriculum encompases the fundamental attributes that contribute to the success of the Architectural Student Design Competition.
Architecture students conceive of a unique design using exposed structural steel that demonstrates their understanding of the properties, capabilities and potential of steel and their appreciation of the design capabilities as they relate to formal expression, detail and surface finish. For details: **https://www.cisc-icca.ca/architectural-student-design-competition/**

THE 2021-2022 COMPETITION THEME

Students in Canadian schools of architecture are asked to design a pedestrian bridge that will span two sites to establish a meaningful connection. The bridge, by its elegance and gesture, should draw attention to, and be the symbol of, a link between an origin and destination. By focusing on the bridge, one should discover a new perspective. The bridge is to act as a platform to pause and view an intermediate space. The purpose is not just about crossing, but about offering an opportunity to gain knowledge about a site. To favour viewing, its structure may incorporate a platform, benches and seats, interpretation plates, signage, lights and any other appropriate feature.

THE SITE

The site is in Canada and left to the students' discretion. It may be in the wilderness, between steep mountains, cliffs and valleys or in an urban environment. The bridge can connect two municipalities, a suburb to a forest, or allow passage over a river or a motorway. The choice should be explained in the text describing the proposal. Images of the context and the bridge's connection with the site at either end should be clearly illustrated.

THE PROGRAM

The program is about connecting two sites while offering a unique perspective of an in-between space. The bridge's design must elegantly express a path made of steel spanning between two topographies, offering the opportunity to pause and observe. The structural steel construction of the bridge must be part of its essence and appearance. Structural steel offers a variety of expressions, from solid rectangular plates to curved and delicate members, it may express simplicity or intricacy; the choice is left to the competitor's creativity. AS

BEYOND JOISTS AND DECK

A BRIDGE
to a View

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21st Annual Architectural Student Design Competition 2021-2022

Registration Deadline (free)
April 1, 2022

Submission Deadline
May 13, 2022

Program

The program is about connecting two sites while offering a unique perspective of an in between space. The bridge's design must elegantly express a path made of steel spanning between two topographies offering the opportunity to pause and observe.

The structural steel construction of the bridge must be part of its essence and appearance.

Structural steel offers a variety of expressions, from solid rectangular plates to curved and delicate members, it may express simplicity or intricacy, the choice is left to the competitor's creativity to propose an original signature.

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Photo credit: Timothy Kolczak

CANADIAN INSTITUTE OF STEEL CONSTRUCTION
INSTITUT CANADIEN DE LA CONSTRUCTION EN ACIER

G. J. JACKSON FELLOWSHIP

THE G. J. JACKSON FELLOWSHIP

The G. J. Jackson Fellowship is a prestigious annual award currently valued at $25,000 over twelve months. The Fellowship was established in 1987 and is presented annually by the Canadian Institute of Steel Construction (CISC) in memory of the late Geoffrey J. Jackson. Its purpose is to develop exceptional researchers, educators and practitioners specializing in the design, fabrication and use of steel structures.

GEOFFREY J. JACKSON

Geoffrey J. Jackson was born in Stamford, Lincolnshire, England, February 25, 1929. After receiving a Diploma in Civil Engineering in 1954, he emigrated to Canada. Mr. Jackson was, for many years, a leader in the Canadian structural steel fabrication industry. His vision and dedication was the driving force in establishing the Steel Structures Education Foundation, the precursor to the CISC Education and Research Council. Mr. Jackson served as both the Chairman, and a member of the CISC Board of Directors. He was also a long-time member of the Canadian Steel Construction Council Board. He served on the SSEF Board until his death in August 1986.

ELIGIBILITY

The Fellowship is available to a Canadian citizen or a permanent resident of Canada who will be admitted in the following academic year to a first to fourth year of full-time graduate studies in structural engineering, with major emphasis on the study of steel structures. Candidates for either a Master's Degree or a Doctoral Degree are eligible to apply. A candidate transferring from a Masters to a PHD program shall be eligible for an additional four years from the date of transfer. A candidate may be awarded the Fellowship only once. Applications must be received by the Canadian Institute of Steel Construction no later than January 28, 2022. Failure to provide all of the requested information in the application will result in disqualification.

For full award and application details visit the CISC website (https://www.cisc-icca.ca/scholarships/jackson-fellowship)

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2021 RECIPIENT

Michelle Chien is a PhD candidate at the University of Waterloo under the supervision of professor Scott Walbridge.

Michelle's research focuses on assessing brittle fracture risk in Canadian steel bridges. Currently Canada's brittle fracture provisions are highly simplified compared to the corresponding European design provisions. For her thesis project, Michelle is assessing the reliability level associated with the Canadian CSA S6 brittle fracture design provisions using a probabilistic fracture mechanics framework, to identify areas of possible refinement. This work aims to improve the Canadian provisions from a safety and economic perspective, and to propose new provisions for situations not currently addressed, such as pedestrian bridges, structures made from very thick plate, and cold worked or impact-damaged structures.

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CISC's Commitment to Leadership

Investing in Tomorrow, Today!

BY :: HELLEN CHRISTODOULOU, PH.D. Ing., B.C.L., LL. B, M.B.A.
Director, Steel Market and Industry Development
Canadian Institute of Steel Construction (CISC-ICCA)

CISC's vision is to invest in our tomorrow, today. The organization's long-time commitment to research grants, awards and scholarships represents this investment. Over the years, CISC has played a pivotal role in supporting innovative and industry-leading research advancements that address the specific needs of industry development and the improvement of steel construction. Through these efforts we have also witnessed the emergence of leaders, minds that have evolved and will be contributors in shaping the future of the steel construction industry.

There are many examples that the steel industry can use to illustrate that it has been the backbone of supporting the next generation of steel professionals through its various programs – dedicated and talented professionals that have shown leadership, vision and ingenuity for innovative steel solutions.

You will read about two such leaders in this edition of *Advantage Steel*. One is an established seasoned veteran, the other an up-and-comer on the cusp of a promising career, but both undeniably possess the traits that make a leader. These men have a knack for new ideas, thirst for problem-solving and vision. They are the true testament of tomorrow's leadership, dedicated in acquiring the knowledge and right mindset, skill development and values that has and will help build their commitment to the steel industry. Both appreciate the support they received from CISC to help them get their careers off the ground and both recognize the important role CISC will play in their careers going forward. Having been a part of their journey is rewarding for CISC. Commitment opens the door to achievement! AS

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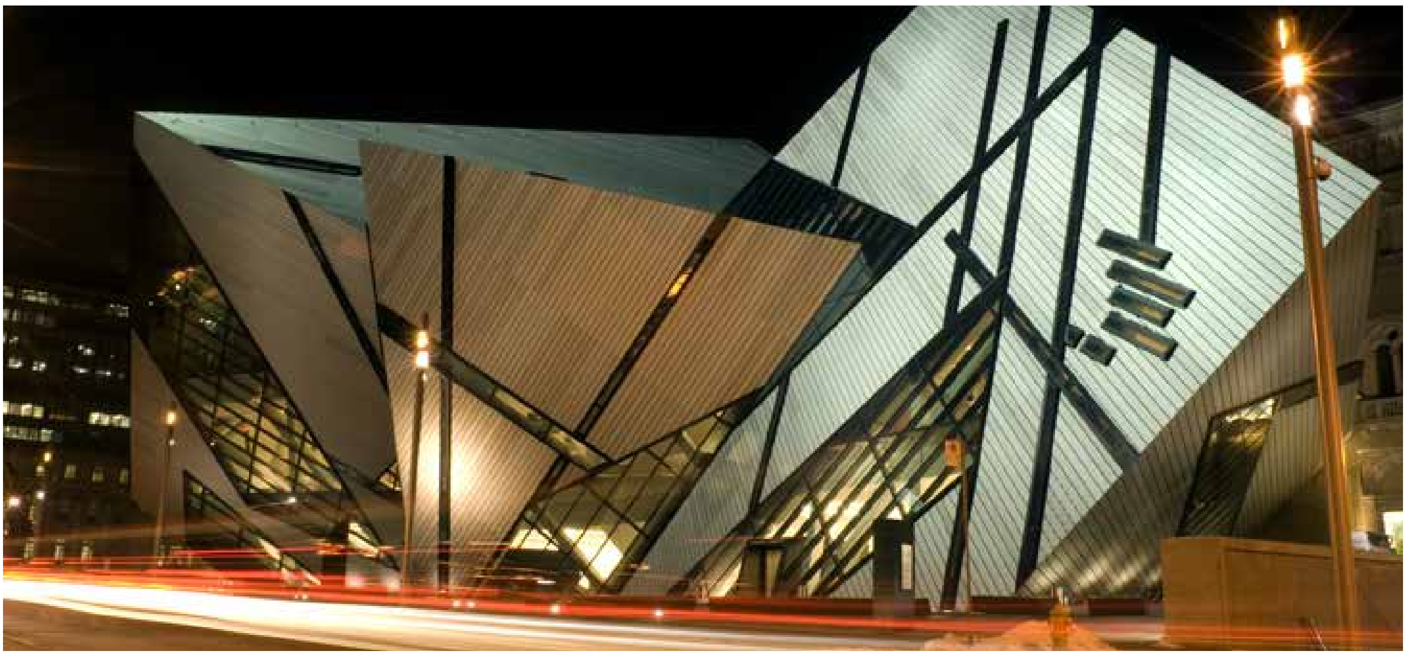
Leader Profile

The Seasoned Vet: Matt Humphries, Arup

BY :: DON NORMAN



The Royal Ontario Museum, one of the high-profile projects Humphries worked on during his career.

Leadership is a tricky concept to define. A leader is many different things to many different people. They are managers, mentors, trend-setters, coaches, priests and prime ministers. But what we are talking about here is a leader of industry. Such a leader needs to be a visionary – someone who is principled and, above all, someone who has effectively morphed those principles into success. Essentially, they must be someone who people in the same field will want to emulate. Matt Humphries, Associate Principal, Structural Engineering with Arup Canada, is that kind of leader.

Academic pursuits came easy to Humphries. As a high school student, when deciding on what path to take after graduation, he did what many of us do – he sought the advice of his guidance counselor. "I asked him what the difference between science and engineering was and he said, They're pretty much the same, engineering is just harder.' And this 19-year-old boy is like, Oh well, science it is,'" he joked.

But taking the easy path wasn't as appealing as that 19-year-old boy thought, and Humphries began to look for other challenges. While earning his BSc in Environmental Science at Queens, an opportunity arose to get into teachers' college. "I didn't necessarily think I wanted to become a teacher, but I really thought that the idea of learning how people learn would be really useful," he said.

That teaching degree opened an opportunity with a student-run organization, founded in 1990 by the Queens Engineering Society, called the Queens Project on International Development. The organization had a focus on engineering projects, but it also had an educational component, and that's how Humphries got his foot in the door. He wound up teaching at a primary school in a small Amerindian village called Kabakaburi in Northern Guyana, on the northeast coast of South America. "I taught for one summer in a large one-room school that went from kindergarten to grade three," he said. "It was an amazing, really wonderful place. Wonderful people. And I learned more than they did, for sure."

But while Humphries found teaching to be a fascinating experience, he was intrigued by the engineering projects the organization was doing. "That was what I was more interested in," he said. And in the end, that exposure was what convinced him to enroll in the engineering program at UBC.

It was at UBC that Humphries had his first exposure to CISC. He was enrolled in an engineering department co-op program offered through CISC called the CISC Fabricators Apprentice Program, where third- and fourth-year engineering students share time between two fabricators. Humphries was placed with George Third & Son and Canron West. "With George Third & Son, I did some really interesting work. They also made boilers and tanks," he explained. "Vancouver and British Columbia are very seismic regions, so I coded some software to make it easy to size boilers and tanks, and how you support them in that seismic zone, which was really fun." With Canron West, he was doing hands-on, steel detailing work. It was that hands-on approach of the program that most impressed Humphries. It was actual project experience. Internships often have the reputation of people milling about grabbing coffee for higher-ups. Not so with the CISC Fabricators Apprentice Program. "In both cases, I was actually involved in stuff that was moving things forward, project-related and interesting – actual important stuff."

The CISC internship gave Humphries a new appreciation for steel. "I liked steel before the internship, but loved it after," he said. "I like the way you can put all these standard pieces together to make something bigger. You have a bunch of shapes, and you put them together in all kinds of different ways and you can make anything. No other building material is as versatile. If you understand what is available and how the elements work, you can put it together to make virtually any structure."

When Humphries graduated from UBC, he received a post-graduate scholarship that afforded him the freedom to decide where he would go for his master's program. During that decision-making process, he met the man who would end up being his thesis advisor, Dr. Peter Birkemoe from the University of Toronto. "I really liked him. He reminded me a lot of my dad," said Humphries. "He was an amazing, multi-faceted, very interesting man and he did research on steel, and I liked steel."

Humphries' U of T. master's thesis examined sheer lag in welded tension connections, "which is about stress concentration in connections that involve welded members," he explained. The research was supported by a CISC research grant that provided Humphries with the fabricated steel needed for his work. "I really appreciated their support," he said. "It makes it a lot easier when you don't have to worry about paying for specimens to be built and you know that they're being built by a certified fabricator who knows what they're doing, instead of by a grad student in the shop, in the basement."

After university, Humphries didn't work directly with CISC until much later. But those early experiences with CISC stuck with him throughout his career. "CISC definitely has played a role in in my career in the sense of knowing that their network of fabricators is what we rely on for quality and making sure that we know that we're getting what we want in construction through our design "process."

The path Humphries' career took after completing his master's was strongly influenced by his own core values and the desire to keep things interesting. His first job at Halsall Associates aligned perfectly with what he was seeking. "Halsall were excellent structural engineers but also really interested in sustainability, and they had a very entrepreneurial mindset," he explained. "I really enjoyed it." He worked on several interesting projects, including the Royal Ontario Museum and the Student Centre at University of Toronto in Scarborough, both of which featured steel prominently in their construction. "Steel

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construction was always the construction that I had in my head when I was interested in engineering. The idea of putting these pieces together is kind of like Lego with discreet, specific shapes – it's interesting that way."

Eventually, Halsall was purchased by Parsons Brinckerhoff. As is commonly the case when small companies get absorbed into larger ones, the culture of the smaller company didn't survive the merger. "It went from being a 500-person, Canadian structure – entrepreneurial and interesting – to part of a much bigger, much less dynamic organization," he explained. "It's still engineering, it's still interesting, but I didn't feel at home anymore." It was then that Humphries began to investigate the idea of starting his own firm. However, an opportunity arose with UK company Mott MacDonald to open an office in Canada. For Humphries, this was the perfect compromise. He was able to exercise all the same skills, to go through all the experiences and learning you'd get with a start-up, but without the risk. "It's great, as a father of three kids, to have less risk with all those bills to pay," he said.

He worked at Mott MacDonald for four years before landing at his current position at Arup. "[Arup] had a culture that really reflected what I was keen on – collaboration, creativity, equity and sustainability – and they had been operating with that culture for a long time." Founder Ove Arup started the company in the 40s and delivered what is known as the "Key Speech" to his partners in 1976. The speech outlined Ove's vision for the company – a philosophy with an eye to aesthetics, sustainability and progress. It's easy to see why Humphries saw this company as a fit. "Sustainability is at the core of everything I do, and Arup's position on sustainability was a big factor in my agreeing to join them," he explained.

And sustainability is another one of the reasons that Humphries is drawn to steel. "Steel is recyclable, modular, reusable and easily designed for disassembly," he said. "It can also be produced with very low GHG content (in electric arc furnaces fed by renewable sources for example). It works in a complimentary way with timber too. Designed properly it's very resilient. All of these reasons make it a logical possibility for sustainable construction."

Humphries' first direct contact with CISC since his university days was as a result of his work on the New Vic project at McGill. "We were approached to incorporate steel from a bridge that was being demolished because McGill wanted to demonstrate sustainability and reuse," he explained. "We were looking for standards about reuse to determine at what point it ceases being more sustainable because you're using a heavier section than you need (the beams that were available were larger than needed). Since that time, CISC has engaged Arup to work with them to update some studies from the EU for the Canadian context. "There will be steel used in a variety of ways in the New Vic even without the reused steel, including some beautiful skylights," said Humphries. AS

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Leader Profile

The Up and Comer: Frederic Brunet, RJC

BY :: DON NORMAN

Unlike Matt Humphries, who is a well-established engineer working as a principal at a major firm with several recognizable projects under his belt, the subject of this leadership profile is an example of someone earlier in the leadership curve. But while his career isn't as fully realized, Frederic Brunet is establishing himself as future leader.

Brunet earned his Engineering Technologist diploma in 2012, but he soon realized he'd need to upgrade his credentials in order to achieve his personal goals as an engineer. He earned his Bachelor of Engineering in 2016 before enrolling in the Master of Engineering program at Polytechnique Montréal. Brunet says without a master's degree, the really desirable projects would be out of reach. He says that when he was younger, he envisioned himself working on highly-recognizable, city-defining designs. "I always wanted to do iconic buildings that would shape the skyline of a city," he says. "Doing a master's was the minimum."

In 2017, Brunet was awarded CISC's prestigious G.J. Jackson Fellowship. The $20,000 scholarship is awarded annually to an engineering student registered in full-time graduate studies with major emphasis on the study of steel structures. The namesake of the scholarship, the late Geoffrey Jackson, was a founding member of the Steel Structures Education Foundation (SSEF) and another shining example of leadership in the Canadian structural steel fabrication industry.

Without the CISC scholarship, Brunet says his experience would have been significantly different. "The scholarship allowed me to devote all my time to my master's studies. I was able to focus on my studies, my research project and various professional involvements I had at the time. I didn't have to think about money." He says without the funding, he may have still pursued his master's degree, but he would have had to do so part-time.

Brunet's research focused on the seismic design of heavy industrial steel structures. After completing his research project, he was hired as a structural designer at Montreal-based engineering firm SDK. His first project


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as a junior structural engineer was to design the gravity systems for the Molson Coors' New Brewery in Longueuil. "One of the reasons I was hired was because of the expertise that I developed throughout my master's degree," he says. While the brewery isn't considered "heavy industrial" (his research focus), he was able to apply the knowledge he acquired during his research to the work he did for SDK.

But for Brunet, who started working at RJC in the fall of 2020, his master's degree did more than just land him a job. "It gives me more confidence, for sure." With only three year's experience under his belt, he knows he still has some dues to pay before he gets the plum jobs he's always dreamed of, but the confidence he's earned inspires optimism in the young engineer. "I haven't done iconic buildings yet, but RJC are doing very nice buildings all around the country. So, I'm pretty sure I'll get there."

Through his studies and his work over the past several years, Brunet has developed a keen appreciation for steel. "Steel is a perfect material," he says. "It doesn't excuse you. It's more precise than other materials." And for an admitted lover of physics and mathematics, the appeal of precision makes perfect sense.

But while the precise and unyielding nature of steel is attractive to a left-brained empiricist like Brunet, it may be surprising to hear him sing the praises of the metal's flexibility – especially in terms of sustainability. "The greenest buildings are the ones already built, the ones we can retrofit and build on top of," he explains. "Steel allows this flexibility." He contrasts that with concrete: "If you have a [concrete] building in a prime spot in the city centre, it might be cheaper to just demolish it and rebuild something, which is not very sustainable." And with steel being 99-per-

“THE GREENEST BUILDINGS ARE THE ONES ALREADY BUILT, THE ONES WE CAN RETROFIT AND BUILD ON TOP OF. STEEL ALLOWS THIS FLEXIBILITY.” **- FREDERIC BRUNET**

cent recyclable, the advantages keep adding up. “When you think of ‘sustainable’ in my mind steel is a greener material than concrete,” he says.

From Brunet’s perspective, CISC has an important role to play in the steel industry in Canada. In addition to being a body that promotes the use of steel, and makes certain codes are well understood across the industry, it offers valuable learning opportunities. “I will attend many courses at CISC,” he says, noting that courses are often taught by professionals with very specific experience that a young engineer would not have otherwise had the opportunity to encounter. “For a young professional like me, it’s very valuable to just see case studies and how they design things. It [offers] background on how to design complex things that are outside the standard.”

Brunet’s passion for the career path he chose is palpable. He describes a game he played with friends where everyone gets to choose their ideal job in a world where everyone is paid the same wage. “90 per cent of our friends chose something they are not doing right now,” he says. But for Brunet, the answer is always “structural engineer.”

Brunet’s passion stems from the elegant simplicity inherent in the engineering process. “You start with a calculation – with pen on paper,” he explains. Those calculations lead to drawings, and then the drawings come to life in the finished product. “It just started with a calculation, and afterwards you have a building that will stand for 100 years or more and possibly shape horizon of the city. I’m very passionate about the fact that I can go on site and see the results of the things I calculated.” AS

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Inspiring the New Generation of Bridge Engineers

BY :: HELLEN CHRISTODOULOU, PH.D. Ing., B.C.L., LL. B, M.B.A.
Director, Steel Market and Industry Development
Canadian Institute of Steel Construction (CISC-ICCA)

The CSCE-CISC Canadian National Steel Bridge competition provides future engineers an ideal opportunity to test their skills, analytical power and adaptability. The competition stimulates them to be innovative, practice professionalism and use structural steel efficiently. Civil engineering students are challenged to an intercollegiate competition that supplements their education with a comprehensive, student-driven project experience from conception and design through fabrication, erection and testing, culminating in a steel structure that meets client specifications and optimizes performance and economy.

The competition offers both a structured and fun way to increase awareness of real-world engineering issues such as spatial constraints, material properties, strength, serviceability, fabrication and erection processes, safety, aesthetics, project management and costs. During their academic year they are dedicated to designing and building a model-scale bridge, tested under various loading conditions, to meet set judging criteria. This is an arduous process, which includes active fundraising, the preparation of preliminary bridge design concepts and ordering, fabricating and assembly of the model bridge.

Students are responsible for the design and erection of their bridge by themselves, but they have a backup of assistance from faculty and industry advisors. Apart from the requirement to effectively apply engineering principles and theory, the success of this competition is premised on individual commitment, effective teamwork, collaboration and networking.

This competition offers students an opportunity to put their skills to the test and gain confidence and knowledge in the process. Working under pressure, encouragement, collaborative work and gained skills are all important lessons that will stay with them throughout their professional journeys, and the CISC is proud to play an active role in helping, supporting and inspiring the next generation of bridge engineers. AS

"LOGIC WILL GET YOU FROM A TO B. IMAGINATION WILL TAKE YOU EVERYWHERE." **– ALBERT EINSTEIN**

The UBC Steel Bridge Team

2021 Winners of the CSCE-CISC Canadian National Steel Bridge Competition (CNSBC)

Some members of the UBC Bridge team posing with Vancouver's Burrard Bridge in the background.

Let's introduce ourselves

We are a dedicated team of students from the University of British Columbia (UBC) that were elated to win the 2021 CSCE-CISC Canadian National Steel Bridge Competition, ranking first overall.

For the 2020-21 school year, our team consisted of 50 members, from both the undergraduate and the master's level engineering programs. All team members worked in synergy, collaborated and tirelessly worked together to design, draft, fabricate and construct a steel bridge, approximately 20 feet in length, having a 2,500-lb. capacity.

Amazingly enough, for the 2021-22 school year, the team expanded to 70 members. Without exception, all members are hard-working and driven, with the common mission of competing with other university engineering teams in competitions across North America and, ultimately, worldwide.

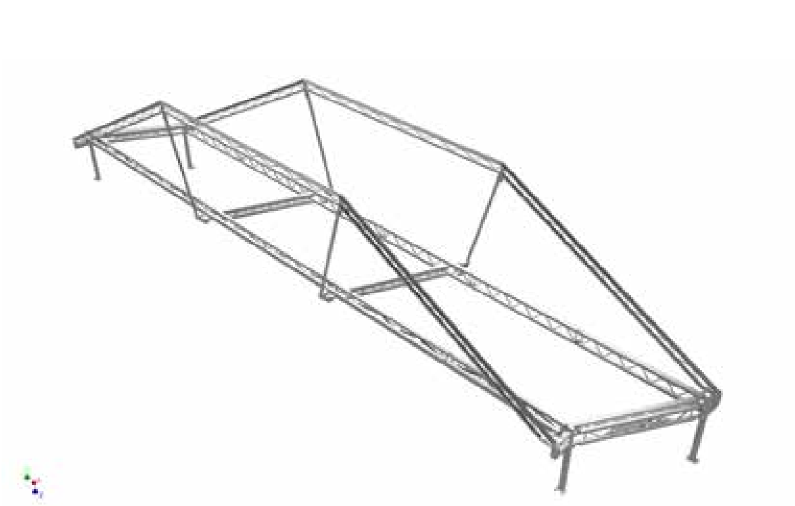
How are UBC Steel Bridge members passionate about the competition and about steel?

We are believers that this competition ideally provides an invaluable medium for the creation and the nurturing of a learning space for students to practise important skills – skills that they will carry throughout their professional journeys. These skills include leadership, teamwork and communication, all important components. This is all done in a welcoming and open team environment where members connect and freely share their ideas. This competition is not only a learning opportunity for students, but a chance to collaborate and build a strong community of students who are equally passionate about civil engineering, bridges and steel.

Working on our projects in preparation for competitions is both transformational and inspiring. It has a big impact on us, the up-and-coming engineers, for we can indulge with our innovative solutions to classic structural problems. During our studies, our course work is premised on equations and methods of analyses, so this competition challenges us students to think outside the box and determine, evaluate and understand other factors that affect the design and the structural behavior of the built model-scale bridge. Members are exposed to the steel fabrication process, connection design and erection and become more sensitized to key design factors that may ultimately affect safety and efficiency. We missed this part in the 2020-2021 season, in view of restrictions for the pandemic.

The planning and design choices for our steel bridge for the 2020-2021 competition

A major long-term learning goal for the UBC Steel Bridge team is for all members to gain a holistic understanding of the design



project, specifically bridge design and analysis, extending past the school curriculum and incorporating innovation and creativity in design development. We encourage members to develop teamwork and communication skills and gain long-term connections.

In 2020-21, our team participated in the CNSBC competition with a "pony truss" bridge design, a type of arch-truss bridge. Despite having trouble designing this type of bridge in the past, we decided to take a risk and went all in to make this design feasible. Our team explored unique steel fabrication techniques such as laser cutting plates and numerous moment connection joints, which were used to significantly reduce fabrication times. Previously, the long fabrication period was one limiting factor that had to be overcome. Another notable change in the past year was the formation of the new BIM (Building Information Modelling) sub-team, which rendered the construction sequence of the bridge to aid both the design and construction process.

Challenges during the COVID-19 lockdown

Our executive team worked very hard to plan and deliver a fun and engaging environment online despite the new normal, making every effort to ensure members had a smooth learning experience to fullest potential. Participation was the highest in 2021, creating an even stronger sense of community, and team members are excited to hopefully meet in person again in 2022.

Many of our members will be returning to the team during the 2021-22 school year. Incoming leads are inspired with plans to improve work efficiency and tutorials, and enhance learning tools and team-building activities. We plan to create an even more engaging forum with our Steel Bridge members, alumni and sponsors.

So, what is next?

This year, we plan to attend multiple international competitions, one of which is the CNSBC 2022, to broaden the team's exposure to bridge design and to aim in being recognized globally as one of the top competitors of student steel bridge competitions. We are targeting the design and fabrication of more complex bridge; this time it will be a cantilever bridge design.

We must live in a new reality for now, so we will opt to provide a hybrid learning environment for members to meet new people and attend events safely. The team strives to promote diversity and create an inclusive environment by providing all members with a fair opportunity, free from explicit and implicit bias, including and not limited to age, gender or race.

Find us at:

https://www.ubcsteelbridge.ca/
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Lastly, the teams owe a big thank you to the Canadian Society of Civil Engineers and the Canadian Institute of Steel Construction for partnering up and bringing this inspiring competition to light. A special thank you to the numerous sponsors – it takes a lot to get us to where we are. It's all of you who contribute, even just a little, that allows us to have continued success and to support our members in learning important engineering skills. Acknowledgements are extended to Professor Noboru Yonemitsu and Professor Carlos Molina Hutt, to the Steel Bridge fabricators and the various Steel Bridge alumni.

Steel – Ahead of the Curve

A Proven Track Record of Breakthroughs!

BY :: **HELLEN CHRISTODOULOU,** PH.D. Ing., B.C.L., LL. B, M.B.A.
Director, Steel Market and Industry Development
Canadian Institute of Steel Construction (CISC-ICCA)

"Steel – Ahead of The Curve; a Proven Track Record of Breakthroughs!" The title says it all. A track record is defined as a record of past performance that is often taken as an indicator of likely future performance. The Canadian steel industry has had a long and established history and has been the backbone contributor to Canada's economic growth and expansion. It has strongly and continuously invested in Canada and has been committed to research and innovation for the construction industry.

Steel is the only material than can be 'ahead of the curve' because it is a material with an established track record – no ambiguities, presumptions, or wishful thinking. With steady evolution exceptional performance, and a portfolio of breakthroughs in design and construction, the dedication of the steel industry has led to immeasurable improvements in the steel construction industry. Amazing projects, design achievements in steel solutions to solve complex design and construction challenges, the ingenuity and precision of fabrication, innovative processes, and the effectiveness of project execution have all set trends while positioning steel as the material of choice. You will read about four completely different projects, each unique and revolutionary in its own way – the proof of the pudding, as goes the adage!

The Baie-Saint-Paul Hospital Complex project illustrates how steel framing offered revolutionary technical and architectural design possibilities, resulting in a more efficient and lighter structure that met challenging winter construction conditions and a very tight construction schedule. Most importantly, the chosen design offered a 49-per-cent reduction in energy costs and a 23-per-cent reduction in water consumption when compared to similar buildings.

The Bay-Adelaide Centre project highlighted in the "Trio of Towers" article focuses on a another huge breakthrough project – the first ever tower in Canada to use 65 ksi steel, resulting in a 30-per-cent higher strength for the same cross-sectional area when compared to 50 ksi steel. This project is a unique collaborative effort between the fabricator and the mill developing advanced qualified welding procedures, requiring refined reanalysis of the structure with emphasis on safety and quality assurance, distinguishing Walters and ArcelorMittal as trailblazers.

The Deloitte Summit project in Vancouver recreates the appearance of a traditional Noguchi Japanese lantern, featuring a cluster of stacked steel-framed cubes. The uniqueness of such a concept speaks volumes about the versatility of steel, allowing for an additional floor to be introduced, resulting in a much lighter structural solution and achieving a greater flexibility for open floors and a lower profile structure. Canadian-made steel and local design and fabrication created the proper synergy in delivering this incredible building.

Lastly, the Lake William Suspension Bridge may be a simple project, but it is huge in effect. It is a testament to the versatility of steel and it spotlights how steel can be effectively repurposed.

"Out with the old and in with the new" has taken a whole new meaning – the same material has now been given a new life, has led to substantial cost savings and has a direct impact on reducing this project's environmental footprint.

These four projects are a few examples of the plethora of steel projects that are clear illustrations of how the most sustainable material in the world has reached new heights and is always "ahead of the curve." AS

STEEL... A MATERIAL WITH AN ESTABLISHED TRACK RECORD – NO AMBIGUITIES, PRESUMPTIONS OR WISHFUL THINKING.

FEATURE

THE BAIE-SAINT-PAUL HOSPITAL COMPLEX PROJECT:

Steel framing offers revolutionary technical and architectural advantages

BY :: FRANÇOIS COUTURE

Credit: Lemay-GroupeA

If there is one building that you do not want to see crumble in an earthquake, it is certainly a hospital. It has to remain open to take care of the injured. That is why the new Baie-Saint-Paul hospital, in the earthquake-prone Charlevoix region, was built with a steel frame to ensure that it would remain standing during a cataclysm. The $245 million budget was respected, so was the deadline, and the consulting engineers GHD went on to win Quebec's highest honours, the Grands Prix du génie-conseil québécois 2021 in the structure category.

The picturesque Charlevoix region is located northeast of Quebec City, between Petite-Rivière-Saint-François and the mouth of the Saguenay River, on the north shore of the Saint Lawrence River. From the beginning of the 19th century, rich American and English-Canadian tourists came to explore the region, famous for its bucolic nature and quaint villages. To this day, Charlevoix remains a haven for painters and landscape photographers who relish its unique landscape and 17th-century farmhouses. It also boasts a chic casino, a fashionable ski hill, its very own Club Med, splendid golf courses, whale-watching cruise boats and a monumental grand hotel called Manoir Richelieu. The region's lavish mansions serve as quiet retreats for the rich and famous, like the late Canadian business icon Paul Desmarais Sr., who built an expansive estate with an actual castle, all worth $46 million.

But there can be trouble in this paradise. With more than 200 tremors occurring each year, the Charlevoix seismic zone is one of the most active in Eastern Canada. Since the 1663 earthquake (estimated magnitude 7.3 to 7.9), five major temblors have shaken the area in 1791, 1860, 1870, 1925 and 1988. Because of these precedents, the Charlevoix area is considered at substantial risk.

A sunken-in topography

One of the reasons for all that seismic activity might be that a meteor of two kilometres in diameter hit the region about 450 million years ago. If you look at a Radarsat photo of the Charlevoix region, you can clearly see the edges and the sunken-in topography of a half-crater 54 kilometres wide. The other half is under the St. Lawrence River. It is thought that the impact weakened the St. Lawrence rift, a fault line that runs along the riverbed.

A study revealed that the two hospitals in Charlevoix were at considerable risk of being damaged in the event of an earthquake. It showed that in a major quake, the La Malbaie hospital would be compromised, and the Baie-Saint-Paul hospital, located near the crater's edge, may even collapse. Therefore, the local MPP and Quebec premier Pauline Marois announced in 2013 that the Baie-Saint-Paul hospital would be rebuilt by the Société québécoise des infrastructures (SQI), Quebec's infrastructure corporation.

A tall order

The team of professionals had to meet the expectations of project

Credit: Lemay-Groupe A

manager SQI to design and build the 34,746-square-foot hospital complex. Classified as a civil protection facility, it had to include an eight-stretcher emergency room, two operating rooms, 16 outpatient rooms, 28 acute care beds, seven mental health beds, a hemodialysis wing, a nursing home with 103 long-term care beds, a thermal plant and other ancillary services. The complex also needed a new 432-space parking lot and dedicated traffic lanes.

The civil and structural works, through the integrated design process, included the following achievements: complementary optimization studies, soil improvement by dynamic compaction and vibro-replacement to eliminate the potential for liquefaction, mass excavations for the implementation of the foundation elements, concreting works for the foundation works, erection of the framework and concreting of the floors, connection to the city network, execution

Credit: CISC

Project management: Société québécoise des infrastructures (SQI)

Contractor: Pomerleau

Subcontractors: Pomerleau Construction, Services intégrés Lemay et Associés, Groupe A, Tetra Tech, GHD Consultants, Bouthillette Parizeau.

Architects: Architecture Solution Charlevoix (GLCRM et associés architectes/DMG architecture/Bouchard et Laflamme architectes)

Engineers: Electromechanical Engineering: SNC-Lavalin; Civil and Structural Engineering: CIMA+

of the external works, execution of the traffic lanes, parking lots and the landing stage, and execution of a retention basin for rainwater.

The site was not optimal in terms of geotechnical engineering. Its liquefaction potential was eliminated using a hybrid solution combining dynamic compaction for the shallowest treatment depths and vibro-replacement for the rest of the site. The combination of these two techniques therefore allowed for the optimization of costs and construction schedules. The geotechnical characteristics of the site also required that the weight of the building be minimized, therefore a mixed steel and concrete frame was chosen. This hybrid construction marks a turning point in the hospital sector, which traditionally favoured exclusively concrete structures.

A value-added solution

Mr. Jérôme Bédard, a structural engineer, was responsible for the selected concepts related to the steel structure. He managed a design and supervision team of over 15 engineers and technicians. Mr. Bédard stood out by proposing a value-added solution for the contractor, perfectly meeting SQI's requirements and demonstrating a high level of quality.

"One key aspect that led to the choice of a steel structure was a reduction in weight, says Bédard. At 2,500 metric tons, it is more than twice as light as an equivalent all-concrete frame, resulting in lower ground stresses and fewer bracings. The weight of the structure has a direct influence on the seismic loads to be considered for the design, which have a preponderant influence due to the exceptional seismicity of the region."

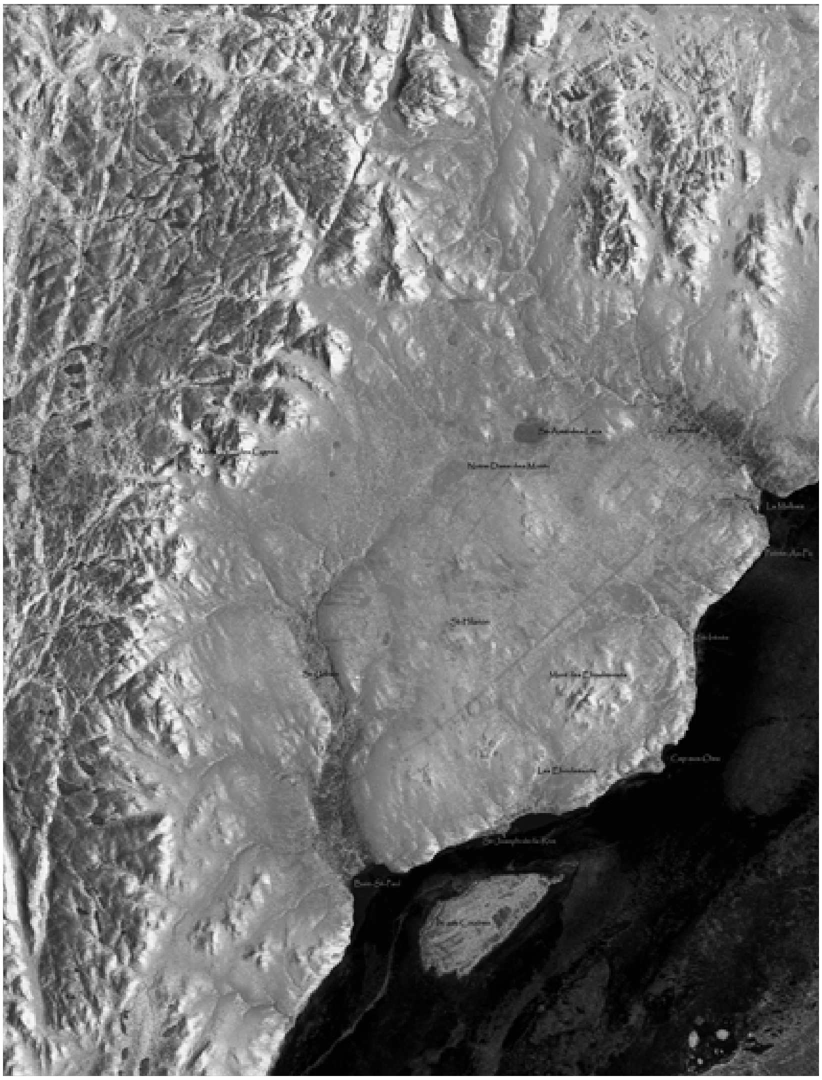
"Steel also allowed a better quality of fabrication, considering that the steel structure was prefabricated in our workshop and installed at the site in winter conditions," says Thierry Boueilh from Technometal. "This allowed the respect of a very tight construction schedule and a better adaptability of the bracing to the layout."

Modern and with a bold architecture reminiscent of the region's landscapes, the building impresses with its design and layout, which ensure the quality of services and care offered to users. The Charlevoix heritage is highlighted by the continuity of the outdoor spaces within the complex, which are inspired by the adjacent river and the surrounding mountains.

"Steel opened up new possibilities in terms of architectural design," says Lead Architect Éric Rivard from Groupe A. "We wanted to give the

Credit: Tetra Tech QI

Credit: Lemay-GroupeA



A Radarsat image of the Charlevoix region, showing the half-crater.

public building a strong symbolic element present in the landscape, like the many steeples in Charlevoix. The steel structure allowed for this freedom, which was realized with the integration of a work of art directly into the structure."

It is important to note that steel also provides a more even surface than concrete, which is inherently better in terms of infection control.

The steel advantage

Some people mistakenly believe that steel buildings do not stand up well to earthquakes. In reality, the opposite is true. In fact, steel buildings have a distinct advantage over concrete in the event of an earthquake.

Steel construction is lighter than concrete, without compromising strength. It has less mass – and therefore less force – to damage itself from seismic shaking. It requires less earthquake resistance to incorporate into the superstructure and foundation, which can also reduce construction costs. It is true that the seismic forces at the base (applied to the invert) would have been higher for a concrete frame, which would have implied a greater invert thickness (impact on costs and schedule).

In addition, steel makes a structure more resilient because it is a more ductile material, allowing it to bend considerably before breaking. It will react better to an earthquake than a more brittle structure. During small seismic events, a steel building is more likely to straighten than to crack. If the maximum seismic event for which the building is designed occurs, there may be severe deformation, but it will not gradually collapse. The building may have to be demolished later, but the safety of the occupants will be greater.

A smooth transition

The new hospital was inaugurated on Sunday, September 23, 2018. The emergency room of the old Baie-Saint-Paul hospital, 500 meters away, remained open until early in the day, but at 7:00 a.m., all services began in the new facility. The transfer of operations went smoothly.

"We took the equipment from the old ER and transferred it at 8:00 in the morning. We're glad we don't have resuscitation right away, but we would be ready to receive and resuscitate any type of case," explains Donald Caron, department head in the emergency department.

The 29 patients who needed to be transported from one facility to the other were personally escorted in an adapted vehicle. It took nine days of work to move the equipment, records and medications. Transferring the patients was the final step.

"Every room was new. It met the standards, with nice areas for staff and users," says Michel Delamarre, president of CIUSSS de la Capitale-Nationale.

"It's modern, large, state-of-the-art. It's really a plus for the region. I am very proud, very happy with the results," says Jean Fortin, Mayor of Baie-Saint-Paul.

LEED-certified

The Baie-Saint-Paul hospital, including its CHSLD, has obtained LEED certification in the "new construction" category. The building envelope was designed to achieve the sustainability levels required in the green building credit. This credit includes full commissioning of the envelope based on design criteria reviews and laboratory testing of building samples.

Nearly 58 per cent of the buildings are made of construction materials from the Charlevoix region, and 27 per cent of these materials are made of recycled content. A colossal effort to reuse mass excavation materials from the soil in the main building's right-of-way was also carried out to minimize borrowed materials for the parking lots and other related infrastructures.

The measures adopted will reduce energy costs by 49 per cent compared to similar buildings and reduce water consumption by almost 23 per cent.

The exterior design is distinguished by a green space area that exceeds zoning requirements by 132 per cent and by green features that promote universal accessibility and encourage active transportation.

Optimization measures relating to the choice of the framework, the invert and the configuration of the structural blocks have enabled a rationalization of materials and construction efforts. The reduction of the environmental footprint of the project is therefore obviously achieved through sustainable development measures, combined with this type of "at source" reduction. AS

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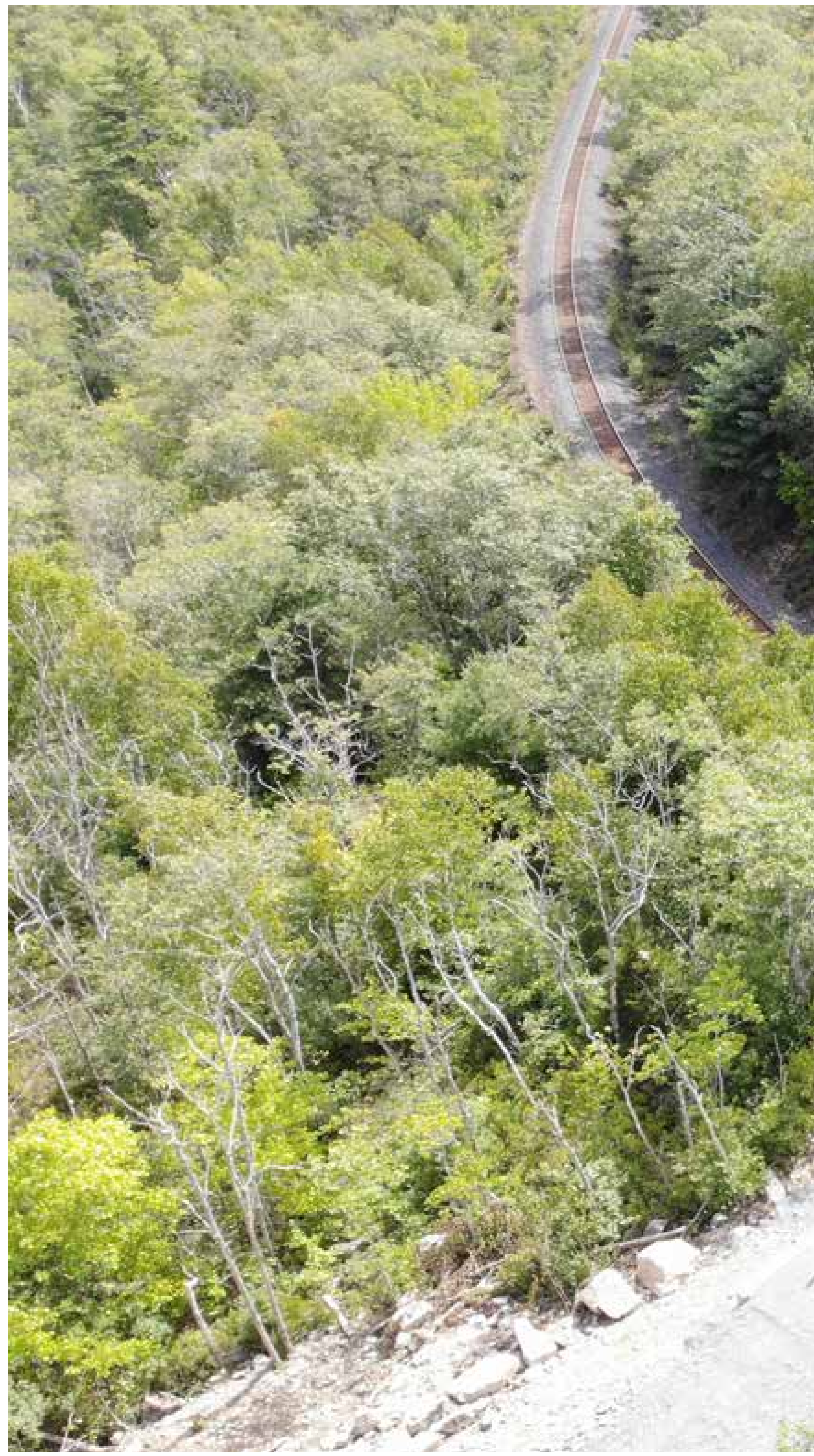
THE LAKE WILLIAM TRAIL SUSPENSION BRIDGE

A spotlight for repurposed steel

BY :: MATTHEW BRADFORD

A new pedestrian bridge in N.S. is giving the steel industry's reputation a lift. This October, residents of Waverley, Nova Scotia, celebrated the opening of the Lake William Trail suspension bridge, a cable-stayed structure that crosses Canadian National Railway (CN) tracks to connect Waverley to Dartmouth.



In addition to introducing a new, safer route for hikers, the bridge stands as a testament to the versatility of steel. Specifically, it was constructed using steel panels that were reclaimed during early work on Halifax's Angus L. MacDonald Bridge, which was originally built in 1955.

The Lake William Trail suspension bridge was envisioned by the Shubenacadie Watershed Environmental Protection Society (SWEPS) and entrusted to Dexter Construction Company. Cherubini Bridges and Structures was the firm tasked with installing the panels for the project. It was also the firm that tackled re-decking efforts at the Angus L. MacDonald Bridge.

"The panels were taken off the MacDonald bridge about five years ago," recalls Blair Nakatsu, Vice President and General Manager with Cherubini. "At the time, we built new panels which we used to replace the bridge's existing panels almost overnight. Some of the removed panels were set aside for reuse, and this is one of the projects that benefitted from them being saved."

After reclaiming and cleaning up the panels, Cherubini collaborated with the project's architect, Harbourside Engineering, to work the 10 3′ x 3′ components into the design.

Same material, new life

Incorporating previously used steel elements from the aging

Using reclaimed steel panels during the construction of the Lake William Trail suspension bridge highlights the material's versatility.

Angus L. MacDonald Bridge was a priority for the project's stakeholders. Thankfully, this proved to be a relatively straightforward task thanks to the panels' condition and steel's resilient qualities.

"Provided that the steel is not deteriorated or corroded and has not been subject to a large number of fatigue-inducing stress cycles, steel capacity does not decrease over time," explains Wade Pottie, Structural Engineer, Partner for Harbourside Engineering Consultants, which was brought on to the Lake William Trail suspension bridge later in the project to help see SWEPS' vision through.

Cherubini is also well acquainted with steel's advantages. Over the years, the firm has successfully reused the material for other projects and was confident it could do the same for the residents of Waverley.

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"As long as the steel coatings are intact and the coating hasn't rusted, you can weld to it, drill holes in it and work with it again," he says. "It's a very easy material to work with, and highly effective when it comes to repurposing."

There are several benefits to working with repurposed steel components. In addition to saving costs associated with purchasing or re-fabrication, finding new life for previously used steel has a direct impact on reducing a project's environmental footprint.

"Repurposing steel has considerable sustainability advantages," notes Pottie. "For one, it reduces the overall carbon footprint, as new steel does not need to be manufactured, fabricated and coated. Also, old steel also does not need to be recycled or scraped."

The use of steel benefitted the project in other respects. Specifically, new steel was used to construct the main support girders, including all diaphragms and plan bracing. The material is also used for the bridge's main pylon and the stay cables.

"The advantage to using steel on this project is that it is very lightweight when compared to concrete, hence minimizing the foundation sizes," says Pottie, adding, "As well, the difficult site access did not lend itself well to cast-in-place concrete trucks."

At final tally, 80 tonnes of steel components were used to create the bridge's lofty design.

A lofty design

Constructing a suspension bridge over an active railway was no small feat. Work required careful design and on-site collaboration to overcome the site's logistical problems.

To accommodate rail traffic, for instance, Pottie explains, "Harbourside developed an erection phasing strategy that consisted of multiple girder lifts, temporary stay cables and a temporary construction bent to support the superstructure until the girder bolted splices were fully connected and the final stay cables installed."

Elsewhere, he continues, splices were provided in steel members at critical locations to enable transport to the site, and erection was completed using a relatively small all-terrain crane.

These slight challenges notwithstanding, Nakatsu says the development was relatively straightforward and made successful thanks to consistent teamwork and careful design: "Really, the biggest consideration when it came to repurposing the steel was just designing around the fact that we already had pieces of materials in certain sizes and shapes that needed to be worked into the project."

Ready to hike

Waverly officials cut the ribbon to the Lake William Trail suspension bridge on October 20, 2022. Representatives from the community, project team and SWEPS were on-hand to applaud the project and speak to its importance for the region.

"This suspension bridge is more than a safe way to cross the busy rails," says SWEPS Project Manager Allan Billard. "Walkers will want to hike in just to see it and the wonderful views from the centre span."

"The bridge strengthens the region's trail infrastructure, supporting increased visitation that will benefit local communities and businesses, particularly in Waverley and Fall River," adds Darrell Samson, Parliamentary Secretary to the Minister of Veterans Affairs and Associate Minister of National Defence, and Member of Parliament for Sackville-Preston-Chezzetcook.

For its part, the Cherubini team is proud to have played a role in bringing SWEPS' lofty goal to life. Nakatsu believes the bridge will bolster safety in the area and give travellers a new way to enjoy their surroundings.

"Before this bridge, there was a level cross that bikers and pedestrians were using to get across those tracks, which is the main line into Halifax," he explains. "Now they have a safer way to cross and an interesting new landmark that gives people more reasons to get out and go for a walk." AS

Lake Williams bridge cross section.

TRIO OF TOWERS RISE HIGH IN TORONTO

Collaborative innovation pushes long-awaited project to the finish line

BY :: JULIA PRESTON AND DON NORMAN

On Bay Street in Toronto, a long-planned high-rise complex is finally complete. The Bay Adelaide Centre, composed of three towers, adds 127 floors of office space to Toronto's financial district.

The Bay Adelaide Centre was initially conceived in the 1980s. Construction on a first tower began in 1990 but soon stopped due the recession. Eventually, Brookfield Properties took over the site and in 2005 filed plans to construct three high-rises.

The first tower, Bay Adelaide Centre West, was completed in 2009. This 52-storey tower was the first steel-framed high-rise building to be constructed in Toronto in more than 10 years.

"Going way back to 1987, the original south tower had been a post-tensioned concrete building. There was concern that they wouldn't make the delivery date, so we switched to steel because steel was faster," explains engineer Barry Charnish of Entuitive.

The 44-storey Bay Adelaide East was built in 2016. The final tower, Bay Adelaide North, will be completed this year with 32 floors. All three structures use high-strength sections from ArcelorMittal.

In redesigning the west tower from concrete to steel, Charnish had specified 50 grade steel. However, during the bidding process, the possibility of using TradeARBED HISTAR 65 ksi steel arose.

Look up!
The Bay Adelaide Centre was fabricator Walters Inc.'s first foray into high-rise construction.

"I actually went to Luxembourg to look at the plant. I had a lot of questions about the 65 grade," says Charnish. "We did a lot of study, and it proved to be acceptable to us the way the steel came out. This wasn't done casually."

Bay Adelaide Centre West was the first tower in Canada to use 65 ksi steel.

"65 ksi steel was a huge breakthrough for our industry," says Tim Verhey, Executive Vice President, Engineering & Operations at Walters Inc., the company responsible for the detailing, fabrication and erection of the structural steel framing on all three towers. "That gives you 30 per cent more strength for the same cross-sectional area (compared to 50 ksi steel). Or conversely, you could do the same job with 30 per cent less steel if you look at a vertical tower column, which was a significant advancement that TradeARBED (now ArcelorMittal) brought to the market."

As the Bay Adelaide project progressed, the steel used for each tower continued to blaze the trail in terms of steel quality. Bay Adelaide East was originally designed with A992/350W, and the columns were converted to A913-70. On Bay Adelaide North, which was tendered with A913-65, the columns and transfer struts were converted to A913-80, which was just becoming available.

Ed Lacroix, Vice President of Projects for Walters, explains, "We were working directly with the general contractor to come up with solutions to make the [north] tower buildable… [and] discussing steel options."

At the same time, Walters had been working on a separate project with ArcelorMittal to develop welding procedures for higher-grade materials.

"We went fairly in-depth in terms of developing the procedures, doing the third-party testing, doing an extensive range of testing to make sure that the grade 80 columns were weldable," says Lacroix. "I don't think anyone in the industry had those welding procedures in place, [but] once complete, we knew we could actually perform. Going to the grade 80 material definitely helped to save some cost to the client and gave us a competitive advantage."

Verhey drills down a little further on the importance of the work they did with ArcelorMittal. "For welding, we are required under [CSA Standard] W47.1 to have certified welding procedure specifications, which define the background for our welding processes. Normally, for regular steel fabrication with normal steels, fabricators will have a healthy library of welding procedure data sheets that instruct their welders [on] how to weld different materials together," he explains. "With the higher-strength steels, because they're not widely used, we were developing those welding procedures alongside ArcelorMittal to establish appropriate heat inputs, pre-heat requirements, post-heat, wire-feed speeds, travel speeds, etc., to ensure we could

"WE WEREN'T SADDLED WITH POOR PRACTICES OR LEGACY HISTORY – WE HAD TO COME IN WITH OPEN MINDS TO UNDERSTAND HOW TO BUILD HIGH-RISE TOWERS WITH ALL OF THEIR INHERENT COMPLEXITY." **-TIM VERHEY, WALTERS INC.**

complete sound welds predictably that would fall within the W47.1 Quality Management System."

Grade 80 is a high-strength, low-alloy, quenched and self-tempered (QST) steel for structural shapes. The steel is produced from 100-per-cent recycled scrap using an electric arc furnace and a thermo-mechanical rolling process. The rolling and QST process results in a very fine grain material with superior toughness when compared to other structural steels. Grade 80 improves structural efficiency, simplifies fabrication and reduces costs.

As grade 80 was just coming to market during construction of the north tower, a lower range of section sizes were available. Charnish had to adjust the design to use what was available.

"We wanted to have at least one column with the 80 ksi because we were pushing the technology," he explains. "As soon as we confirmed what we had, we had to design to suit it. If they didn't have the heavier sections and there were only the lighter sections, we pushed it up higher in the tower."

Because higher grades were not available in the full range of column sizes, a small number of columns in all three buildings used lower grades (50 ksi for east and west or 70 ksi for the north). However, the majority were converted to higher-strength steel.

The changing grades required reanalysing the structure to adjust the super elevation. Super elevation describes how concrete and steel settle or compress differently. Usually, the variation is only a couple of millimetres per floor, but the difference is significant when added up over 30 or 50 storeys. On Bay Adelaide, the steel columns were three to six inches taller so, when under the force of thousands of tonnes of structural material, the steel and concrete would eventually compress to the same level at the top of the building. Mixing the grades of steel added another layer of complexity to this calculation.

Interestingly, the Bay Adelaide project was Walters' first foray into high-rise construction. "Sometimes what you don't know can't hurt you," says Verhey. "We weren't saddled with poor practices or legacy history – we had to

Photo by Corneil Byl @bylcj

Good Things Come in Threes

Bay Adelaide North is the third and final tower in the Bay Adelaide Centre complex in downtown Toronto. Walters Group is proud to have been a partner in building all three towers.

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come in with open minds to understand how to build high-rise towers with all of their inherent complexity." That's not to say they didn't come in with a plan; these are smart people, and they do their homework. "While we brought a lot of creativity to bear with our teams, we also have partners in New York City that really helped us figure out how to execute these projects efficiently," explains Verhey. "Understanding the optimal erection cycle time; determining the best strategy to efficiently hoist steel from the street to the working floor (and then from there, installing it); which cranes should be used and how to remove those cranes once the tower was completed, and so many other challenges. High-rise steel towers look quite straightforward; however, a significant amount of innovation was needed to construct these towers efficiently. That new knowledge has continued to improve through building the more than a dozen high-rise towers we've constructed since that first tower back in 2007."

Safety is always an important consideration, but in high-rise construction, it becomes ever more critical. "Steel construction is a high-risk industry and requires very safe work practices," says Verhey. "Back in the 1990s, steel erection moved to 100 per cent tie-off so ironworkers were at all times secured with a certified fall arrest system. This focus on safety must therefore always be top of mind. Every piece of structural steel is hoisted with rigging that's going to be connected by an ironworker, and that worker needs to access that rigging safely," he explains. "Ironworkers have to be able to safely walk the steel. Everything we plan on these projects is driven by safety, and high-rise construction, put that it into a whole new perspective for us."

Walters puts a similar premium on quality assurance. And once again, the importance of quality is amplified in high-rise construction where there is significant repetition. "If you have a poor detail or a difficult situation that makes it difficult to weld, you risk weld defects. On high-rise towers, the sheer number of conditions can quickly amplify, so now you have hundreds of difficult conditions to deal with," explains Verhey.

While much of the focus for Bay Adelaide was above ground, there were challenges underneath as well. "Below the entire structure is a parking garage, retail space and the PATH system (an underground walkway) that is directly under where we needed to place the cranes," explains Lacroix.

The tight downtown city site also presented challenges. "They had to have a

BAY ADELAIDE CENTRE WEST

Owner: Brookfield Office Properties
Architect: WZMH Architects
Structural Engineer: Halcrow Yolles
Construction Manager: EllisDon Construction
Structural Steel:
Structural wide flange shapes (W) to conform to CAN/CSA-G40.20/G40/21 grade 350W or ASTM A992/A992M grade 50 (ksi)
**Originally designed/tendered with A992/350W, and the columns were converted to A913-65.*

BAY ADELAIDE CENTRE EAST

General Contractor: Brookfield Multiplex Construction Canada
Owner: Brookfield Office Properties
Architect: Adamson Associates Architects
Structural Engineer: Entuitive
Construction Manager: Brookfield Multiplex Construction Canada
Structural Steel:
Structural wide flange shapes (W) to conform to CAN/CSA-G40.20/G40/21 grade 350W, ASTM A992/A992M grade 50 (ksi)
**Originally designed/tendered with A992/350W, and the columns were converted to A913-70.*

BAY ADELAIDE CENTRE NORTH

Owner: Brookfield Office Properties
Architect: Adamson Associates Architects
Structural Engineer: Entuitive
Construction Manager: Brookfield Multiplex Construction Canada
Structural Steel:
Structural wide flange shapes (W) to conform to CAN/CSA-G40.20/G40.21 grade 350W, ASTM A992/A992M grade 50 (ksi)
Structural wide flange shapes (W) for use as columns and transfer struts shall conform to ASTM A913 grade 65 (449 MPA)
**Originally designed/tendered with A913-65 for the columns and transfer struts, many of which were converted to A913-80.*

lot of capacity, and they were also restricted as to where they could swing on site," says Greg Kern, Walters' Director of Sales.

Walters supplied the tower cranes

On the first tower, Walters' solution was to put the crane inside the building core. The company developed a crane climbing system specifically designed for the site logistics.

The third tower required two cranes, along with smaller mobile cranes. Walters sourced large diesel cranes that had a high capacity and also fit within the budget. One crane was cantilevered off the building using a girder system from the concrete core to the structure's exterior. The second crane was supported on a large steel frame that was built over existing concrete columns that went down through the underground retail and PATH areas. Temporary steel beams were installed over top of the PATH system to support the outriggers.

"By the time we got to the third tower, we knew the underground quite well, so we were able to navigate the various constraints a little quicker and more efficiently," says Lacroix.

Walters also developed a sequencing of the erection plan that tied into the schedule and broke the structure into work zones. "That was the key, to be able to build the structure in a staged and time-sequenced manner so that by the time you come back around the core… to where you initially started, you can progress. You're not stopped. It's a perfect choreograph of many different activities to make sure it works," says Lacroix.

Erection on the west tower started in late 2007 and was completed in a tight, 11-month timeframe. To meet the aggressive schedule, Walters worked closely with the concrete contractor to coordinate the pouring of concrete core ahead of steel erection so that teams could work simultaneously.

The west tower was constructed on the site of the former National Building, a designated heritage building. The 11-storey façade of the historic structure was carefully removed and reconstructed as part of the new tower. Cantilevered construction created eight corner offices on each floor.

For Walters, the relationship with ArcelorMittal is key to their success. "We've been front runners in the industry in terms of adopting a new grade," says Lacroix. "We're trying to be innovative and work with the industry to keep ahead of the curve."

That relationship is a testament to the important role collaboration plays in the steel construction industry. "Like in any industry, relationships are what it's all about," says Verhey. "We rely on the mills and key vendors to give us attractive pricing. We like to be aware of the innovations they're bringing to market so we can take advantage of that. So having a strong relationship with your key stakeholders is fundamental." But when a collaboration breeds success, companies will return to the source of that success, and Verhey says Walters' collaboration with ArcelorMittal has been very fruitful. "We've been a trailblazer alongside ArcelorMittal as they developed these new products. We've known them for decades, we've purchased many tens of thousands of tonnes of their steel, and it's located in buildings across Canada and in the U.S. in our projects. They're a fantastic partner."

The Bay Adelaide Centre represents a new standard for AAA-class office buildings due to the innovative design and technology incorporated into construction and day-to-day operations and its integration with the heritage and community of the financial core.

Kern concludes, "We've proved that these composite or all-steel towers are a cost-effective way to go, [and that they're] very predictable and go up quickly." AS

Images courtesy of Westbank, photography by Graham Handford

DELOITTE SUMMIT TAKES STEEL TO NEW HEIGHTS

Experience and technical knowledge the keys to success

BY :: MATTHEW BRADFORD

A new office tower is set to bring Eastern style to Vancouver's West Coast skyline. Deloitte Summit, a 24-storey workspace project in the centre of downtown features a cluster of stacked, steel-framed cubes affixed to a central concrete core that creates the appearance of a traditional Noguchi Japanese lantern.

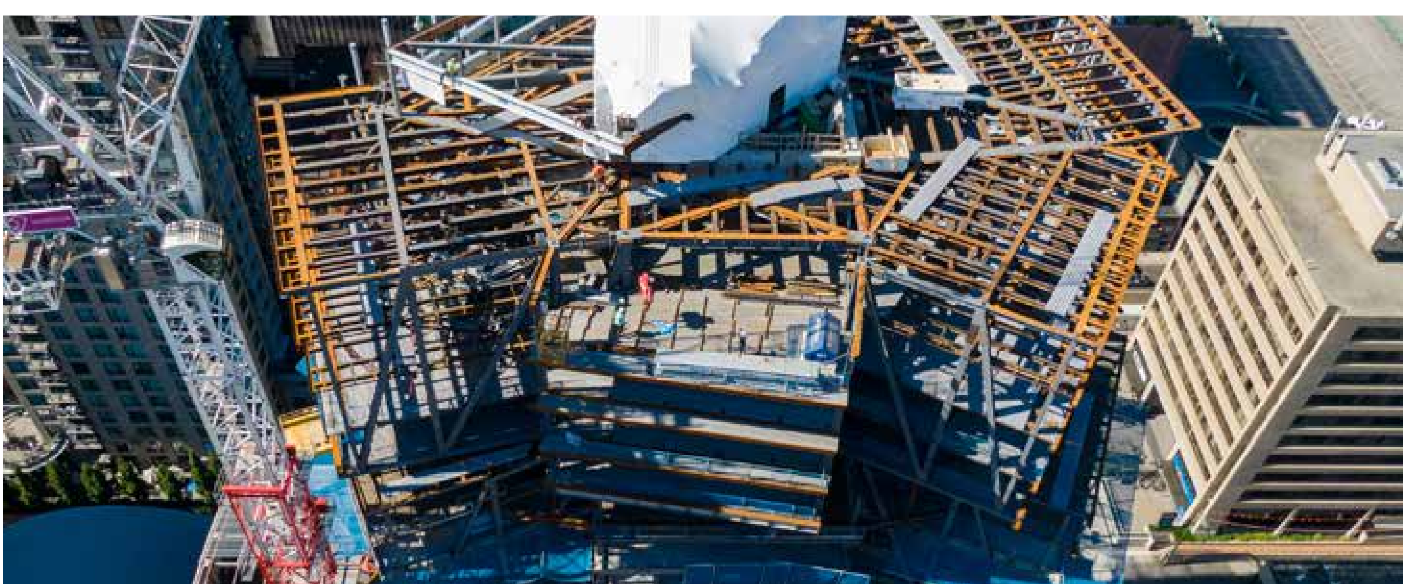
The eye-catching project is the vision of developer Westbank and is designed by Tokyo-based OSO with local architect Merrick Architecture. Deloitte Summit is being led by EllisDon Construction with engineering expertise from Glotman Simpson and extensive steelwork provided by Quebec-based fabricator Supermétal.

"The geometry of this design made it a highly challenging project, but we were lucky to have the experience and team behind us to take it on," says Dario Espi-Fournier, Engineer with Supermétal.

Once complete, the commercial tower will serve as the headquarters for Deloitte Canada, as well as tenants including Boston's Northeastern University and a host of co-working spaces.

In a statement to the press, Etienne Bruson, Managing Partner of the B.C. division of Deloitte Canada, praised the look and feel of the company's new home, noting, "[Deloitte Summit] pushes the traditional boundaries of the office design to create something truly distinctive and innovative. We're looking forward to moving in."

Distinct may be an understatement when describing Deloitte Summit. Rising at the corner of Vancouver's Homer and West Georgia streets, the building is comprised of a steel frame suspended by six mega columns that hold clusters of offset, four-storey cubes in place. The cubes' triple-glazed exteriors reflect the living walls and water features that have been installed between the cubes with the intent to reflect the region's natural



surroundings. Up top, the building is capped with a landscaped roof designed for use by its occupants.

Inside, the tower will feature floor-to-ceiling glazed, large open spans, and sections of glass flooring that will offer lofty views of Vancouver's downtown core.

"The boxes create natural compartments within a continuous floor plate, allowing offices to be variously partitioned while also staying close to the façade," Westbank explains, adding, "The floors and ceilings of the cantilevering portions are glazed to visually link the garden, the offices and the street below."

A landmark for steel

Beyond bringing a unique new typology to Vancouver's downtown area, Westbank's new tower stands as a testament to the versatility of steel.

"It's a very unique and complex building due to the rotating block pattern," says Pier-Luc Napert, Project Manager with Supermétal. "The design intent was to have each block appear like it's floating above the lower one. Having a continuous concrete column that transferred all gravitational loads was not feasible, but steel made it possible to have trusses to hang that cantilever, giving the impression that a block was floating above the one below it."

OSO's design also required the tower's core to accept significant axial and vertical loads. As such, Supermétal collaborated with Glotman Simpson, the project's engineer of record, to design steel nodes measuring 750mm x 750mm that would accept the forces from the mega-columns and multi-storey trusses.

"There were so many loads going in all directions that a bolted-on welded connection would have been tricky to pull off," adds Espi-Fournier. "[Glotman Simpson] recognized that this needed to be resolved with something out of the box, which led us to the nodes."

Out-of-the-box thinking was par for the course during Deloitte Summit's construction. Another example is the use of an intricate crane tieback steel system that Supermétal created to ease the erection process.

"There were some trenches in the floors where the actual loads from the trusses were transferred to the core. Those floors were already highly solicited with loads, so it did not make any sense to transfer crane tie loads on top of the existing building loads on the structural steel floor," says Napert, explaining, "That's why the crane tying system had to be built completely separately to enable the release of the existing floor from crane tying loads."

Overall, Craig Enns, Vice President with EllisDon Construction, says the use of steel was central to making the ambitious project feasible: "Not only did the use of structural steel allow us to realize the unique structure of the building, but it also allowed for an additional floor to be introduced, as the structural build up has less depth than if it was a concrete structure."

"The use of structural steel also provided a much lighter structural solution, as compared to a cast-in-place concrete superstructure," he continues. "The design team was able to achieve their vision with greater flexibility for open floors and a lower profile structure that could achieve the building's cantilevers."

In total, Supermétal fabricated 5,000 metric tonnes of steel to complete the project. The material was fabricated throughout the company's factories in Sherbrooke and Levis in Quebec, and Leduc, Alberta.

Bringing experience to the fold

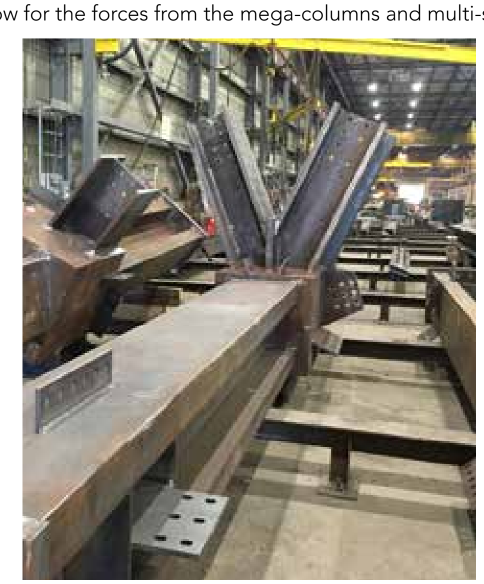
With a unique design comes unique challenges. And with over 60 years in the industry, Supermétal was up to the challenge.

"We have the advantage of lots of experience and technical knowledge, as well as highly specialized teams," says Espi-Fournier. "So, while it was a very challenging project, I think the experience of our company and the whole project team was key to its success."

Part of that success is owed to Supermétal's Canadian base, which gave it the ability to respond quickly to changes as they arose through the project.

Says Enns, "There were quite a few structural modifications made during the construction phase, and having someone local

These special steel nodes were fabricated to allow for the forces from the mega-columns and multi-storey trusses in this uniquely designed building.



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meant that any additional steel required was close by and didn't have as large of an impact on schedule as could be expected with foreign suppliers."

Working with Canadian-made steel also offered advantages throughout the pandemic, as it enabled EllisDon and its crews to know exactly where its components were in the development cycle and mitigate delays more common with sourcing product outside the country.

"The biggest benefit of a local fabricator is that we were able to accurately know where the steel was at all times," adds Enns. "In most situations, EllisDon's project team was confident that as soon as the steel was finished fabrication, it would be on site in less than two weeks. There was less worry that something would be held up in customs or waiting on space opening up on cargo ships, for instance."

Moving in

At last check, the tenants of Deloitte Summit are working to complete the interior finishes of their spaces within the building and are on track for final occupancy in March 2022. The whole team is looking forward to opening the doors on Vancouver's newest workspace and showcasing the benefits of marrying inspired design with industry-leading steelwork.

"Deloitte Summit represents our latest effort in our ongoing fight for beauty. We hope the project is seen in this context and that, on completion, it will form a new, beautiful contribution that will help our city realize its full potential," said Westbank in a written statement.

Adds Espi-Fournier, "This is an incredible building, both from a design and fabrication perspective. It was challenging because it was innovative, but we take great pride in what we have achieved with this project." AS

"THIS IS AN INCREDIBLE BUILDING, BOTH FROM A DESIGN AND FABRICATION PERSPECTIVE. IT WAS CHALLENGING BECAUSE IT WAS INNOVATIVE, BUT WE TAKE GREAT PRIDE IN WHAT WE HAVE ACHIEVED WITH THIS PROJECT." **– DARIO ESPI-FOURNIER, SUPERMÉTAL**

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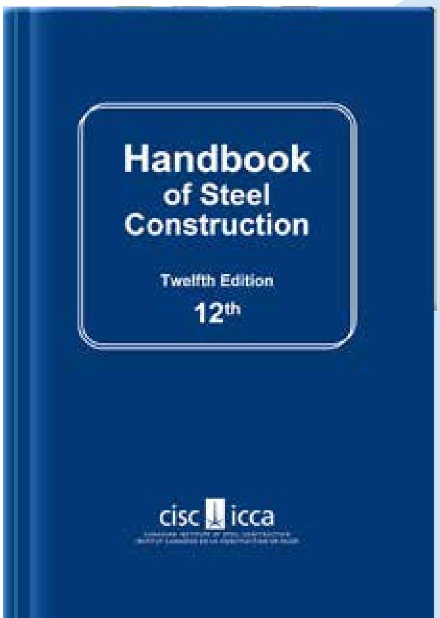
The NEW 12th Edition of the Handbook of Steel Construction

Published by the CISC since 1967, the Handbook of Steel Construction is the standard reference for the design and detailing of structural steel in Canada. The 12th Edition, intended to be used in conjunction with the National Building Code of Canada 2020, includes the new CSA S16:19 and the steel section data.



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Major Changes in this NEW 12th Edition

▶ **PART 1 - Includes CSA S16:19**
New provisions for built-in cantilevers, single angles used as beams, beams with flange holes, new seismic systems including moderately ductile plate walls and truss moment-resisting frames, inelastic analysis, and third-party inspection.

▶ **PART 2 - Includes the CISC Commentary on CSA S16:19**
Updates cover new provisions and new systems.

▶ **PART 3 - High-strength and twist-off bolt grades:**
Referenced in accordance with ASTM F3125/F3125M.

Range of eccentricities in tables for eccentrically loaded bolt groups has been extended.

Net section calculations for framed beam shear connections are based on updated bolt hole diameters in S16:19.

Additional details are provided to explain how tabulated resistances were calculated.

▶ **PART 4 - Tables of factored axial compression** resistances are now based only the effective area method, for consistency with the intent of S16:19.

▶ **PART 5 - The Beam Selection and Beam Load Tables** include shear resistances for beams subject to combined shear and moment. A new design table is introduced for beams with flange holes.

▶ **PART 6 - New W-shape sections listed** in the latest ASTM A6/A6M standard.

38 new large (jumbo) hollow structural (HSS) sections produced to CSA G40.20 and ASTM A500 have been added to the tables of properties and dimensions.

Tables have been expanded to include the new asymmetry parameter (βw) for laterally unsupported unequal-leg angles and detailing dimensions (a, k, k1) for structural tees.

▶ **PART 7 - M/D ratios for contour protection** of both beams and columns are now provided for all member sizes.

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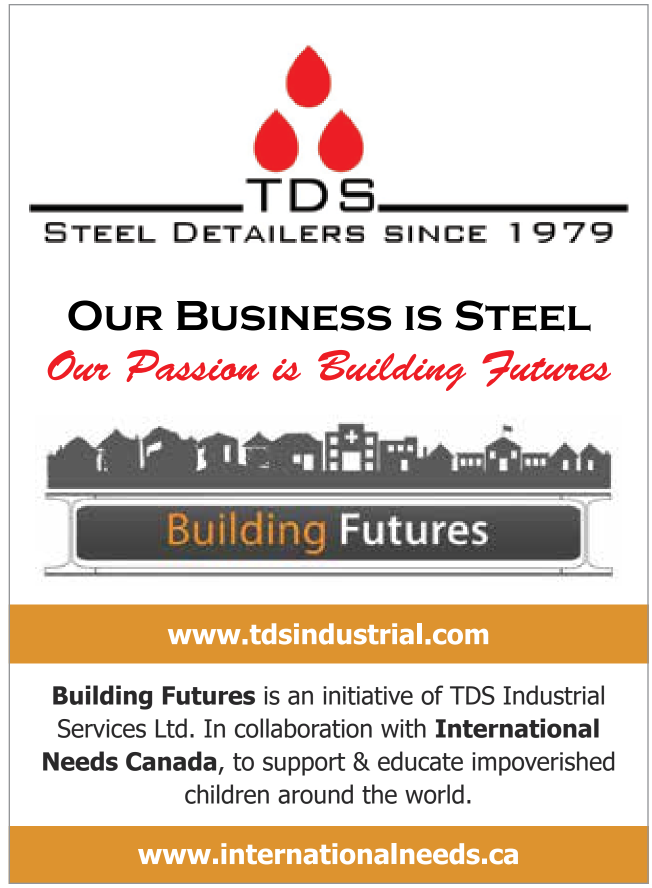
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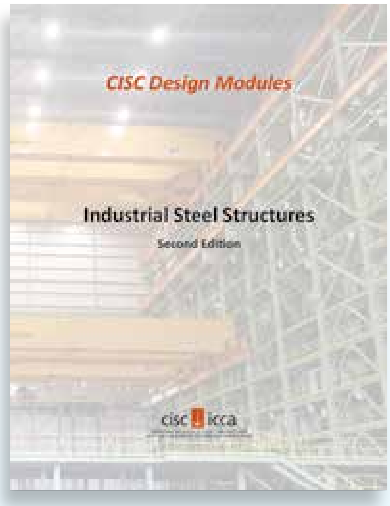
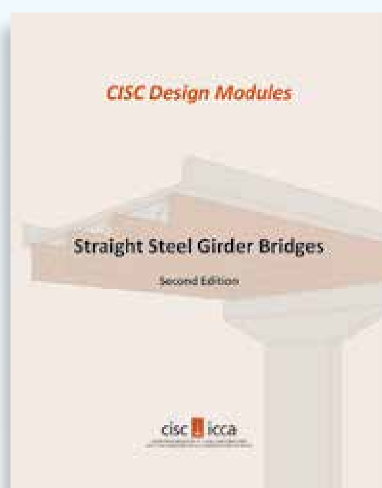
NEW ON THE CISC STEEL STORE

Technical information on the design and construction of crane-supporting steel structures according to Canadian codes and standards and in limit states format, including a design example. It is intended to be used in conjunction with the National Building Code of Canada (NBC 2020) and CSA S16:19, Design of steel structures.



Features the design of a typical mill building carrying two 40-tonne cranes. The example frame consists of stepped columns with a 24-m-span Pratt truss supporting the roof and lateral loads. Included are many detailed Structural design aspects and standard code provisions. This publication is based on the National Building Code of Canada (NBC 2015) and CSA Standard S16:19 (Design of steel structures).

Illustrates the design of a six-storey commercial building, including common structural steel components used in floor and roof framing such as composite girders and open-web steel joists. The lateral load-resisting system is designed for both wind loads and seismic loads. This publication is intended to be used in conjunction with CSA Standard S16-14 and the National Building Code of Canada 2015.



This publication illustrates the design of composite, continuous multi-span steel bridges following a straight roadway alignment; includes detailed calculations of a 3-span plate girder bridge and a 2-span box girder bridge. This publication is based on CSA Standard S6:19, Canadian Highway Bridge Design Code. Structural steel plates conform to CSA G40.21 grades 350A and 350AT.

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ERRATA

In the last issue of the magazine, we featured the Innovation Centre project (subsequently renamed Manitou a bi Bii daziigae) at Red River College Polytechnic. We quoted former RRC Polytech CEO, Paul Vogt, but neglected to note he is no longer CEO. Please accept our apologies if the error caused any confusion.

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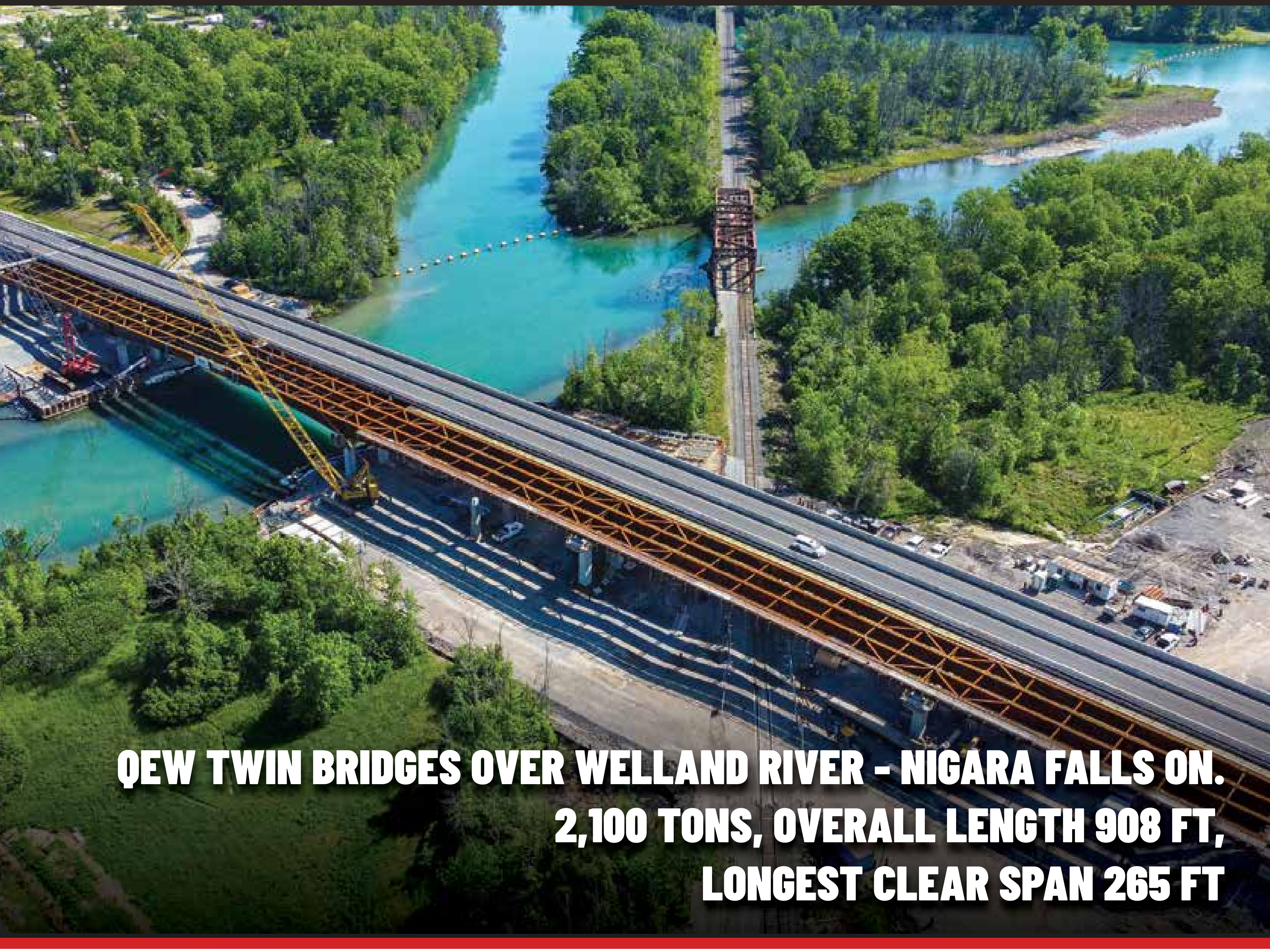

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OSHA's Subpart CC requires signal person qualification by a third-party qualifier.

MEET DEMAND

While an OSHA letter of interpretation recognizes apprenticeship programs that train and assess riggers and signal persons as third-party qualified evaluators, many contractors, states and municipalities require a Qualified Rigger and Signal Person Certification.

REDUCE COST

Third party certification comes with a hefty price tag without input on testing from subject matter experts, ironworkers and their contractors. The Iron Workers' certification eliminates the recertification cost of $500 per person.

IMPROVE SAFETY

Ensuring that only trained, skilled and competent ironworkers complete rigging and signaling tasks elevates workplace safety standards and reduces risk.

WHAT IS IT?

Iron Workers International Certification Board's (I.I.C.B.) Rigging & Signalperson Certification Program is accredited by the National Commission for Certifying Agencies (NCCA), the accrediting body of the Institute for Credentialing Excellence. The I.I.C.B. joins an elite group of more than 130 organizations representing over 315 programs that have obtained NCCA accreditation.

HOW IS IT DONE?

- 6,000 HOURS OF HANDS-ON EXPERIENCE
- 3-PART EXAM
- TESTING & RECERTIFICATION EVERY 5 YEARS
- IRON WORKERS RIGGING & CRANE COURSE