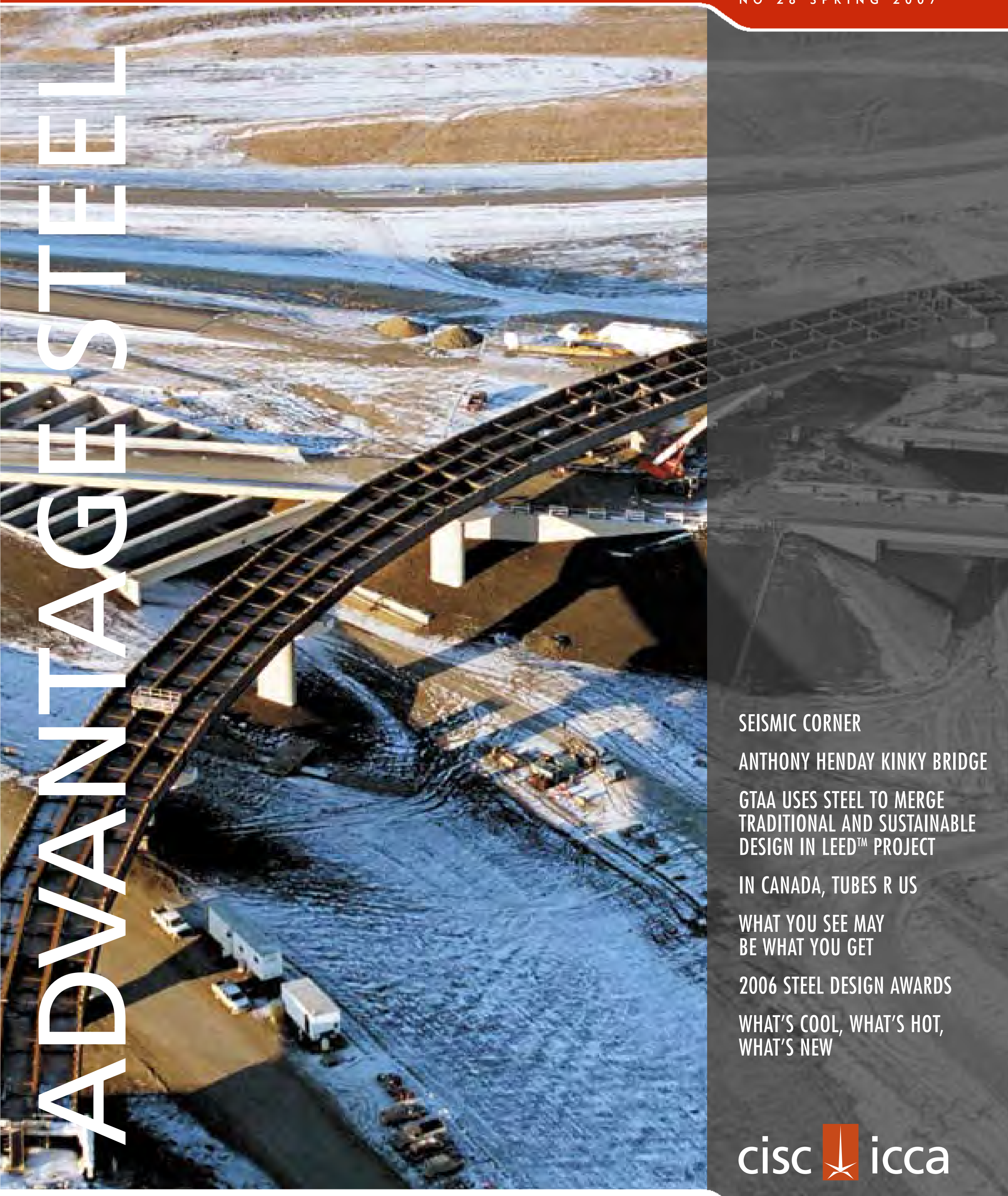
NO 28 SPRING 2007

ADVANTAGE STEEL



SEISMIC CORNER

ANTHONY HENDAY KINKY BRIDGE

GTAA USES STEEL TO MERGE TRADITIONAL AND SUSTAINABLE DESIGN IN LEED™ PROJECT

IN CANADA, TUBES R US

WHAT YOU SEE MAY BE WHAT YOU GET

2006 STEEL DESIGN AWARDS

WHAT'S COOL, WHAT'S HOT, WHAT'S NEW

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CANADIAN INSTITUTE OF STEEL CONSTRUCTION

FROM THE EDITOR

How many wrong turns do you take before consulting the road map? Well if you are like me, one too many. For designers faced with so many changes in Part 4 of the 2005 NBCC, CISC has developed a *"road map"* to assist designers of steel buildings in selecting the appropriate seismic force lateral-load resisting system. Alfred Wong explains the various terms and helps guide you to the most cost effective braced frame configuration.

In many cases, *"fly-over"* bridges have been built in concrete. The reasons for the use of steel for Structure 1.1 are convincingly laid out in John Leckie's article on the Anthony Henday *"fly-over"* bridge, recently completed as a 3P venture in Edmonton.

Canadians hold a commanding lead in the production and use of hollow structural sections (HSS), a lead first cultivated by Stelco more than 30 years ago. Thus, it was with pride that Canada hosted the 11th International Symposium on Tubular Structures last year in Quebec City. Dr. Sylvie played a significant part in helping host the event and, with Dr. Packer and Silke Willibald, reports on how, *"In Canada, Tubes R Us"*.

How can you achieve a 30% energy saving over the Model National Energy Code? Merge pre-cast concrete floors, *"breathable"* steel wall cladding, with structural steel framing, as in the new GTAA's Fire and Emergency Services Training Institute. Receive not only a project energy savings of 30%, but achieve a Silver LEED rating as well! Michelle Ponto explains in detail on page 12.

Toronto Star's urban affairs and architectural columnist, Christopher Hume, states, *"we now inhabit the Age of Steel"*. How so? Well, we will let him explain that to you on page 22.

Michael I. Gilmor
President CISC

IN THIS ISSUE

CORRECTION NOTICE: MBS Steel Ltd. and Skyhawk Steel Construction Limited are both sponsors of the Ryerson University Engineering and Architectural Student Award Scholarships in CISC's Ontario Region. This was inadvertently not communicated in the Fall 2006 issue of Advantage Steel.

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Professional engineers, architects, structural steel fabricators and others interested in steel construction are invited to enquire about CISC membership. Readers are encouraged to submit their interesting steel construction projects for consideration for inclusion in this publication by contacting CISC.

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Anthony Henday Bridge
photo by Supreme Steel Ltd.

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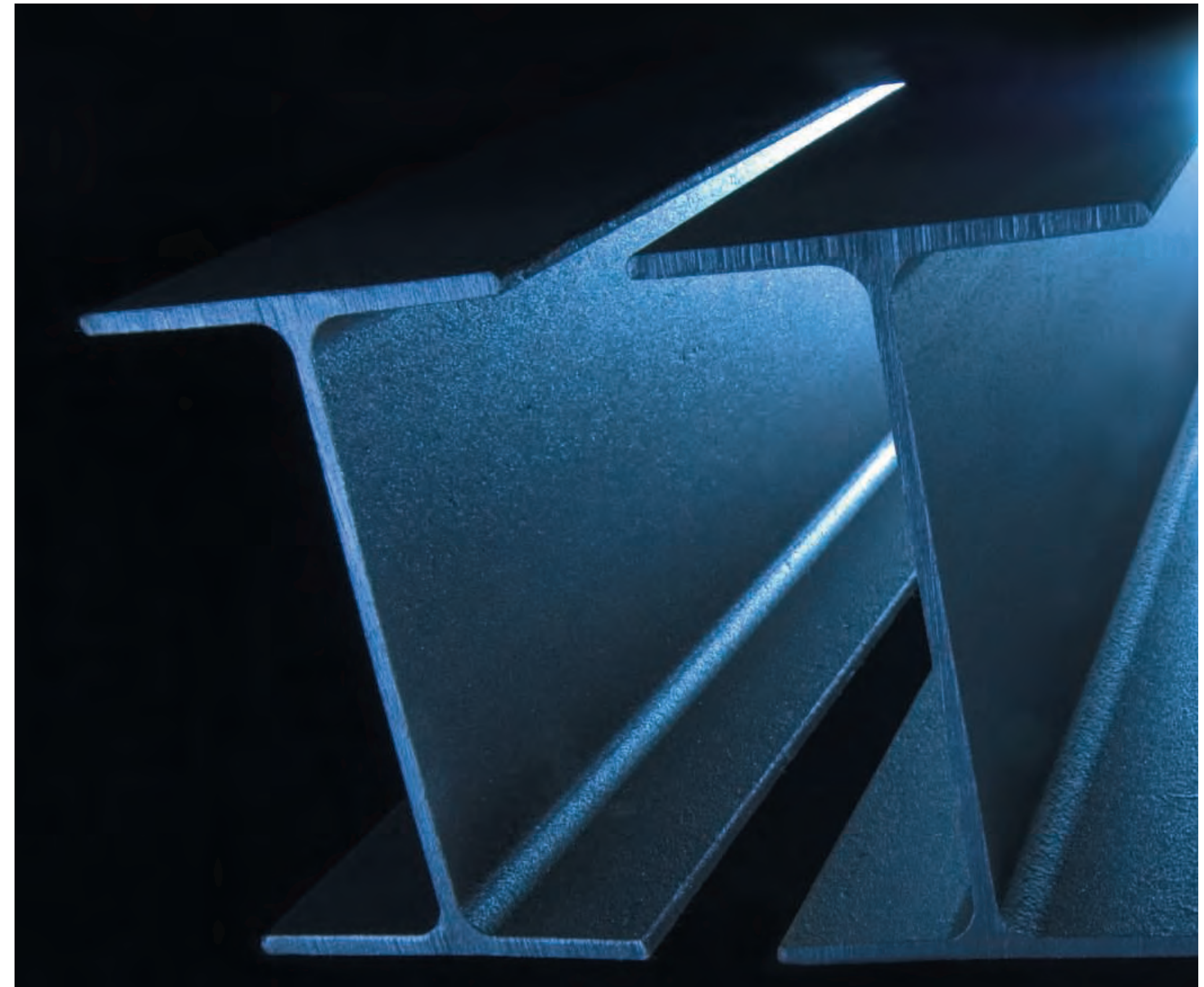

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SEISMIC CORNER

SEISMIC-FORCE-RESISTING BRACED FRAMES – CONFIGURATIONS

Alfred F. Wong

IN THIS ISSUE OF THE SEISMIC CORNER, A 'ROAD MAP' TO ASSIST DESIGNERS IS SELECTING AN APPROPRIATE CONFIGURATION FOR A SEISMIC-FORCE-RESISTING STEEL BRACED FRAME IS PROVIDED ALONG WITH THE KEY DEFINITION OF TERMS USED IN THE 2005 NATIONAL BUILDING CODE OF CANADA (NBCC) AND THE CSA STANDARD S16-01.

(NOTE: TERMS DEFINED IN NBCC 2005 ARE SHOWN IN ITALIC FONTS IN THIS ARTICLE.)

Steel braced frames are the most popular form of lateral-load-resisting steel structure. They offer structural efficiency and economical solutions. A braced frame is essentially a system of diagonal bracing that forms, with the beams and columns, a vertical truss (in the case of a multi-bay bent, a series of vertical trusses). *NBC 2005 describes four seismic-force-resisting steel bracing systems: moderately ductile and limited-ductility concentrically braced frames (MDCBF and LDCBF), ductile eccentrically braced frames (DEBF) and conventional construction of braced frames*. The Code assigns *force modification factors*, R_d and R_o, to each system and stipulates upper height limits where applicable. To make certain that these systems qualify for the respective *force modification factors* assigned, CAN/CSA S16-01 (and its supplement, S16S1-05) gives specific design and detailing requirements for these systems and their subsets. S16-01 also provides general geometric and configuration restrictions for *MDCBF, LDCBF* and *DEBF* to ensure that stable and balanced inelastic actions can be attained. This article aims to describe common bracing systems that meet these bracing configuration requirements.

MDCBF **and** ***LDCBF*** **configurations**[1]		
steel bracing system		configuration
tension - compression	direct-acting[2]	single-brace panel family[3] X
	split-X[2]	split-X
	chevron	chevron V
tension-only[4]		single-brace panel family[3] X

[1] balanced tenion-brace requirement in **S16-01 Cl. 27.5.2.2** applies

[2] referred to in *NBC* as *non-chevron braces*

[3] see Figures 1(a) to 1(d)

[4] must be direct-acting

CONCENTRICALLY BRACED FRAMES

Concentrically braced frames (CBF) are those whose braces end where a beam meets a column or another brace such that an elastic analysis gives essentially axial member (seismic) forces only. *CBF* whose braces end at beam-to-column intersections are known as direct-acting bracing systems. They include a family of bracing configurations consisting of single-brace panels as shown in **Figures 1(a) to 1(d)**. Cross bracing, also referred to as X-bracing, (as shown in **Figure 1(e)**) is a common direct-acting system that consists of two braces per panel. Other common *CBF* are the split-X system and the chevron braced frames which include both the chevron configuration and the V-configuration. See **Figure 2**.

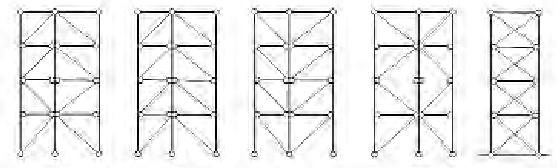


Figure 1
CBF - Direct-Acting Bracing Configurations

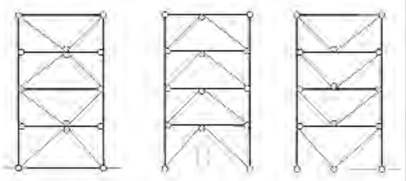


Figure 2
CBF - Split-X and Chevron Bracing Configurations

MODERATELY DUCTILE AND LIMITED-DUCTILITY CONCENTRICALLY BRACED FRAMES

Besides satisfying the above-mentioned requirements for *CBF*, these two types of frames must meet the requirement for balanced tension-brace resistance in accordance with Cl. 27.5.2.2 of S16-01. This Clause requires the ratio of the sum of the horizontal components of the tensile brace resistances in opposite directions to lie within the range of 0.75 and 1.33. Hence a braced bent consisting of single-brace panels must be a multi-bay bent. K-bracing and knee-bracing (**Figure 3** shows examples) are not permitted.

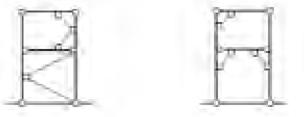


Figure 3
K-Bracing and Knee-Bracing Configurations

Clauses 27.5 and 27.6 of S16-01 stipulate many other specific requirements and height restrictions for *MDCBF* and *LDCBF* respectively. They are beyond the scope of this article. Both tension-compression systems and *tension-only* systems are permitted.

TENSION-COMPRESSION SYSTEMS

All configurations shown in **Figures 1 and 2** qualify for use as a tension-compression system. Direct-acting and split-X frames are referred to in *NBC 2005* as *CBF* having *non-chevron braces* whereas chevron frames and V-frames are referred to as CBF having *chevron braces*.

TENSION-ONLY SYSTEMS

In *tension-only* systems, the braces are designed to resist, in tension, 100% of the seismic forces and must be connected at beam-to-column intersections. In other words, they must be direct-acting braces. Lower maximum frame height limits apply to *tension-only* braced frames.

DUCTILE ECCENTRICALLY BRACED FRAMES

At least one end of each brace in a *ductile eccentrically braced frames* meets a beam at a small distance away from a point where another brace or a column meets the beam thereby creating a relatively short beam segment that is referred to as the link. **Figure 4** shows common *DEBF* configurations, namely: frames consisting of single-brace panels, chevron bracing and V-bracing. These configurations are more adaptable to the use of aisle space. They can accommodate doorways and other openings as shown.

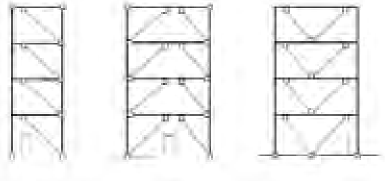


Figure 4
DEBF - Common Configurations

The above-mentioned requirement for balanced tension-brace resistance does not apply to *DEBF* because each link serves as a *"fuse"* protecting the brace from buckling.

DEBF are recognized as the most ductile bracing system. Cl. 27.7 of S16-01 stipulates many other specific requirements for *DEBF*. They are beyond the scope of this article.

CONVENTIONAL CONSTRUCTION

None of the above-noted configuration restrictions apply to *conventional construction of braced frames*.This system of braced frames is permitted for use in low-seismicity categories and low-rise structures in other seismicity categories. Cl. 27.10 of S16-01 covers connection and diaphragm design requirements for its applications in higher seismicity categories. *Conventional construction* is not permitted for *post-disaster* buildings.

Seismic Corner, usually featured as part of the Dr. Sylvie column in this magazine, has been featured as a full section in this issue. Dr. Sylvie will return in the Summer issue with the most popular and timely Q&As in the steel industry.

All photos in article by Supreme Steel Ltd.

ANTHONY HENDAY BRIDGE – A FIRST FOR ALBERTA

John Leckie

Alberta's first steel *"fly-over"* bridge, temporarily named structure 1.1, is one of 24 bridges on the 11-kilometre southeast leg of Anthony Henday Drive, part of the ring road that will eventually encircle Edmonton. Setting this bridge apart from the others is the 350-metre length and its curvature, a pair of challenges for the designers, fabricators and erectors.

Structure 1.1 is hardly alone at the interchange of Henday Drive and the north-south running Calgary Trail. There are 12 structures in total — two of which are below the fly-over. Six bridges (including Structure1.1) are part of the contract for the southeast leg, the first Alberta highway project undertaken as a public-private partnership (P3[i]). The other six were built under the contract for the southwest leg—a traditional design-bid-build contract—which was completed in October, but was still under way when work on the southeast portion began.

Access Roads Edmonton Ltd.[ii] was selected to design, build and finance the $493-million project, as well as operate and maintain the southeast leg of the ring road for 30 years after completion.

The P3 team showed no particular bias towards one material or the other for its structures. Of its 24 bridges, 10 were steel and the rest were precast concrete.

"Cost, scheduling and long-term maintenance are the key considerations," says Tom Beck, the project director and general manager for the project for PCL Construction Management Inc. (Beck is also vice-president, major projects for PCL Constructors Inc.)

"Both precast and steel have long-term operating and maintenance characteristics that are of high quality," he says. *"All of these bridges are operating in the same environment. They are all going over dry land or other structures so they can both handle the situation in this project. It becomes a question of straight dollars."*

For Structure 1.1, one thing tilting the balance toward steel was the need for a span of at least 56 metres.

"We could have gone with a concrete post-tensioned structure," says Tatiana Ojala, senior project manager for Marshall Macklin Monaghan, the bridge designers, *"but that would require construction of falsework and, because it was a third-level structure, the falsework would be really complicated."*

Andrew Hachborn, Marshall Macklin Monaghan's deputy manager, bridge engineering adds, *"It was further complicated because we wouldn't be constructing from a horizontal base. It would have to be going up and down slopes."*

Aside from cost, steel could be erected quicker, always a prime consideration in a fast-track project.

"We looked at the options and concluded that a steel structure would be the most economical for this location," Ojala says.

The fabricator for the project was Supreme Steel Ltd. of Edmonton, which supplied the steel for all 10 steel bridges on the southeast leg over a period of a year and a half. It was the company's first experience with a P3 project which meant the level of paperwork required sometimes felt overwhelming, said Todd Collister, Supreme's engineering manager.

Beck, an old hand at design/build and P3 projects, acknowledged that there is a lot of paperwork but not any more than most large, complex design/build projects. The fact that it was a fast-track, design-build project brought contractors and suppliers on board at an earlier stage than they would normally be involved, resulting in a lot of back and forth between them and the designers that would not take place on a traditional project.

That consultation can have a positive impact for the steel fabricators because the design can be tailored to the fabricator's plant.

"We worked to maximize the use of steel and minimize the wastage," says Hachborn.

The design for the 52 girders for Structure 1.1 was complicated because there was very little repetition and the tolerances were extremely tight.

"Everyone understood the complexities and the risks from the beginning, and thus, the standard of care was very high," Hachborn says. *"We were checking and double-checking everything and then Supreme Steel was checking independently. The dimensions were very critical."*

Ojala adds, *"Most of the members were different sizes. Supreme had to be very careful cutting the members and marking them so they would go in the specific location where they belonged."*

In total, Supreme supplied about 1,000 metric tonnes of steel for Structure 1.1. The girders ranged in weight from 10 metric tonnes to 27 metric tonnes. To create the curvature in the structure, the design used unique details, or *"kinks"*, rather than curving the steel.

Supreme brought in a surveying company while it was erecting the steel during the winter of 2005-6 to ensure each step was carried out in sequence and the members set in the proper position.

Dale Francis, the firm's general manager, ran the project until he died in March 2006. Collister joined Supreme in May 2006.

"He (Francis) was pretty instrumental in obtaining this project and establishing the foundation for all the design requirements for Structure 1.1 and all the other steel structures as well," Collister says.

In particular, Francis was able to provide input to the Ontario-based designers about the requirements of Alberta's Infrastructure and Transportation Ministry.

Having a design team based out-of-province might seem to cause potential problems but the current level of communication technology eliminates many difficulties.

Teleconferences replaced face-to-face meetings in many cases, but that did not mean they were any less detailed—or any shorter.

"Seven hours was our record," says Hachborn.

Even the cameras on cellular phones proved useful.

"The contractor had a problem on one of the other structures on the site and I couldn't be there to see what the problem was," says Ojala. *"So, they took a photo with a cell phone and sent it to me right away. It wasn't really precise or clear, but I could understand what they were talking about and we were able to work out a solution right away."*

To keep track of the vast amount of information generated for the project, Marshall Macklin Monaghan used eBuilder software on this project.

The software meant Supreme could post shop drawings and the designers could start checking them right away. If there were minor changes, Supreme could post them and they would be picked up without a problem.

"The biggest job on a project like this is keeping track of vast amounts of information," Hachborn says. *"Anything you can do to automate it or make easier to find information is a huge benefit to the project."*

The firm is using similar software on projects closer to home as well. Email also means documents can go back and forth much faster than they could have only a few years ago.

Still, there is an advantage to distance as well. *"There are not as many frivolous questions,"* Hachborn says.

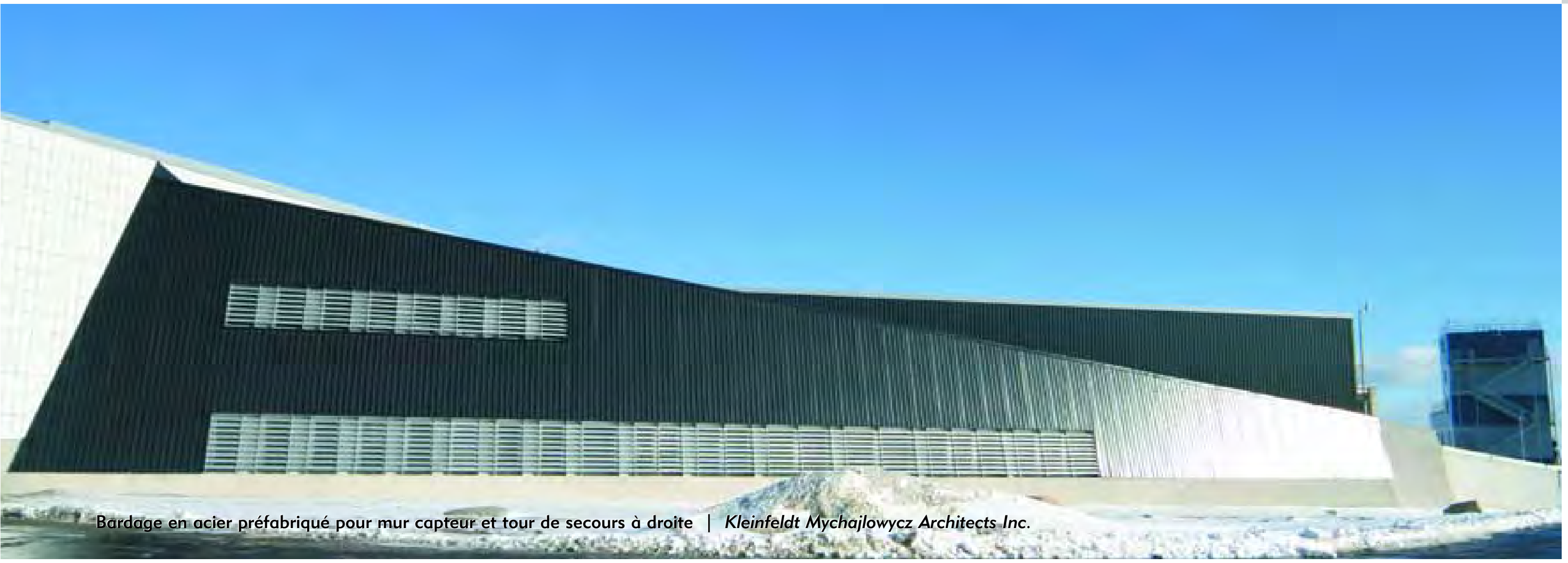
For the project, Supreme had a crew of about 24 in the shop working two shifts, six days a week. There were also a couple of draftsmen on the project and a field crew of 10 to 12 people putting the steel in place.

"Some of the jigging we did in the shop actually made things a lot easier," Collister says.

In fact, the shop did so well, it wound up creating a hole in the plant schedule that the firm was able to fill by fabricating the steel for the reconstruction of Edmonton's low-level bridge over the North Saskatchewan River. That project took top honours in the engineering category of the Canadian Institute of Steel Construction's Alberta Design Awards this year.

i PUBLIC-PRIVATE PARTNERSHIP (PPP) is a system in which a government service or private business venture is funded and operated through a partnership of government and one or more private sector companies.

ii ACCESS ROADS EDMONTON LTD. is a team that included PCL Construction Management Inc., PCL-Maxam, A Joint Venture, Sureway Construction Management Ltd., Lafarge Canada Inc., Marshall Macklin Monaghan, Stantec Consulting, Transportation Systems Management Inc., Macquarrie Essential Assets Partnership, and ABN AMRO Bank NV.



Bardage en acier préfabriqué pour mur capteur et tour de secours à droite | *Kleinfeldt Mychajlowycz Architects Inc.*

GTAA USES STEEL TO MERGE TRADITIONAL AND SUSTAINABLE DESIGN IN LEED™ PROJECT

Michelle Ponto

With the push towards energy efficiency, buildings are not only constructed with structure in mind, but with sustainable design features that lead to reduced construction costs and improved long term operating costs. The Fire and Emergency Services Training Institute located in Toronto, Ontario is one of these buildings.

Developed by the Greater Toronto Airport Authority (GTAA), the training institute is a campus of buildings that includes a 2,800 square metre administrative facility. The facility encompasses a gymnasium, shower/locker areas, classrooms, vehicle bays, and emergency training specific structures such as a steel frame rescue tower, a burn building for active burn training and a confined space building. The institute accommodates up to 160 students and staff and is constructed predominantly out of structural steel and precast concrete floors.

"Steel was chosen as the dominant architectural element for this project because it was the only material that would give the design a light and articulated counterpoint to the exposed, monolithic concrete core slabs and poured concrete elements of the building," says Carol Kleinfeldt, Kleinfeldt Mychajlowycz Architects Inc.

According to Kleinfeldt, the use of steel was considered integral to the design of the project. Because of its diversity, it was used on interior and exterior finishes – the exterior cladding, perforated acoustic interior panels, catwalks and railings. It also provided a number of sustainable design features which helped reduce energy costs. This allowed the facility to apply to become the GTAA's first LEED™ construction project.

LEED™ stands for Leadership in Energy and Environmental Design and is an initiative that provides a rating system for the construction industry to assess the environmental sustainability of building designs. At the moment, it's the most recognized green building rating system in North America and many developers, especially those involved in federal government and private-sector projects, are designing for LEED™ certification.

LEED™ operates on a point system. Points are earned for each attribute that the system considers to be environmentally beneficial. The maximum rating a project can achieve is Platinum (52-70 points), but developing a project that reaches that level is difficult. The Fire and Emergency Services Training Institute worked towards a LEED™ Silver certification with 33-38 points and according to Kleinfeldt, without the use of steel, this level of sustainable environmental design would not have been possible.

"Steel played a key role in the building's energy savings and in its LEED™ certification," says Kleinfeldt. *"It reduced the building's reliance on virgin construction materials and reduced the project's material transportation requirements."*

Jennifer Hum of Halsall Associates Limited worked on the LEED™ component of the project, and says one of the credits they focused on was the total material recycled content percentage of at least 15%. They were able to achieve this with the use of steel because of its high recycled content – which in some cases exceeded 90%.

"Steel was an excellent contributor to the total recycled content percentage," says Hum. *"Fifteen percent of the project's material costs represented non-virgin materials and steel represented about a third of that value."*

Steel's prominence is highly visual in the project. The focal point of the building is the cafeteria which contains a steel central spine and exposed ribs. The area is framed in structural steel and has a long angular shape. The steel angles support the mezzanine and are in turn supported by the spine.

"There was some shoring involved in the installation of the cafeteria, but the structure was basically self-supporting," says Matt Humphries, Halsall Associates Limited. *"This is because steel has simple, repeated elements that make it extremely usable and construction a lot simpler."*

Surprisingly, steel was not their first choice. According to Kleinfeldt, both steel and heavy timber framing options were evaluated during the preliminary design process, but the GTAA did not permit wood as a material option. Steel was ultimately selected because it could be tailored to support the irregular shape of the cafeteria roof structure and it provided an economical advantage.

"The choice of materials for the cafeteria came down to two things: one is cost and the other is flame spread," says Humphries. *"Timber is combustible construction so you have to make it non-combustible."*

Using timber would have required more fire protection which would have added to the cost of the project. The beams would have either been chemically treated so that they wouldn't burn or else sprinklered heavily. Using steel beams eliminated these concerns. However, the chosen materials were not the only factor that reduced costs in the cafeteria. The unusual shape also played a role in reducing energy use.

"The cafeteria's angular shape was designed to minimize building volume where we didn't need it," says Hum. *"Because of the shape we avoid spending energy heating and cooling big spaces that weren't required."*

While the steel-framed cafeteria is the main focus of the building, steel was used creatively throughout the structure. One significant way to improve the sustainable design of the project was through the use of SolarWall®, a solar air preheating system. Located on the south side of the building, the wall is constructed out of steel cladding. The dark-coloured steel operates organically by drawing air through perforations in the cladding.

"The air heats up as it's drawn into the building, so you can end up with air that has been heated by up to 17 °C," says Hum. *"It's a low-tech way to pre-heat air and can contribute to substantial energy savings."*

Vue des murs des salles de classe, de la passerelle et des terrasses de la cafétéria. *Kleinfeldt Mychajlowycz Architects Inc.*


A steel beam centred in the auditorium supports the moveable partition | *Kleinfeldt Mychajlowycz Architects Inc.*

The solar wall isn't the only way the building heats the air. Much of the energy savings comes from heat recovery systems that capture heat from building exhaust air to pre-heat intake air. The institute also uses a system called Termodeck® to radiate heat from the floors or ceilings. Termodeck® is a precast concrete system with hollow cores. The air for the building is circulated through the cores, which causes the concrete to heat up.

"The cost of the Termodeck® was less than the cost of all the ducts that it replaced," says Humphries. *"It ended up being a cost savings for the owner. In fact, we wouldn't have accepted it as a solution unless it was cheaper than an equivalent duct system."*

Because the entire building is constructed out of structural steel, it married well with the Termodeck® system. According to Humphries, when you combine the steel structure with the concrete Termodeck® floors, you have the advantage of using the efficient, quick construction of a steel and precast system while still gaining the benefits and cost savings from the thermal mass effects.

Technologies such as the Termodeck® system and SolarWall® helped the project achieve LEED™ certification, but it was combination of traditional and sustainable design features that made the institute a success. It was only through working with the architect, mechanical, electrical and structural engineers that Halsall Associates was able to incorporate the solutions that made the most sense for the entire project – and not just a couple of isolated areas.

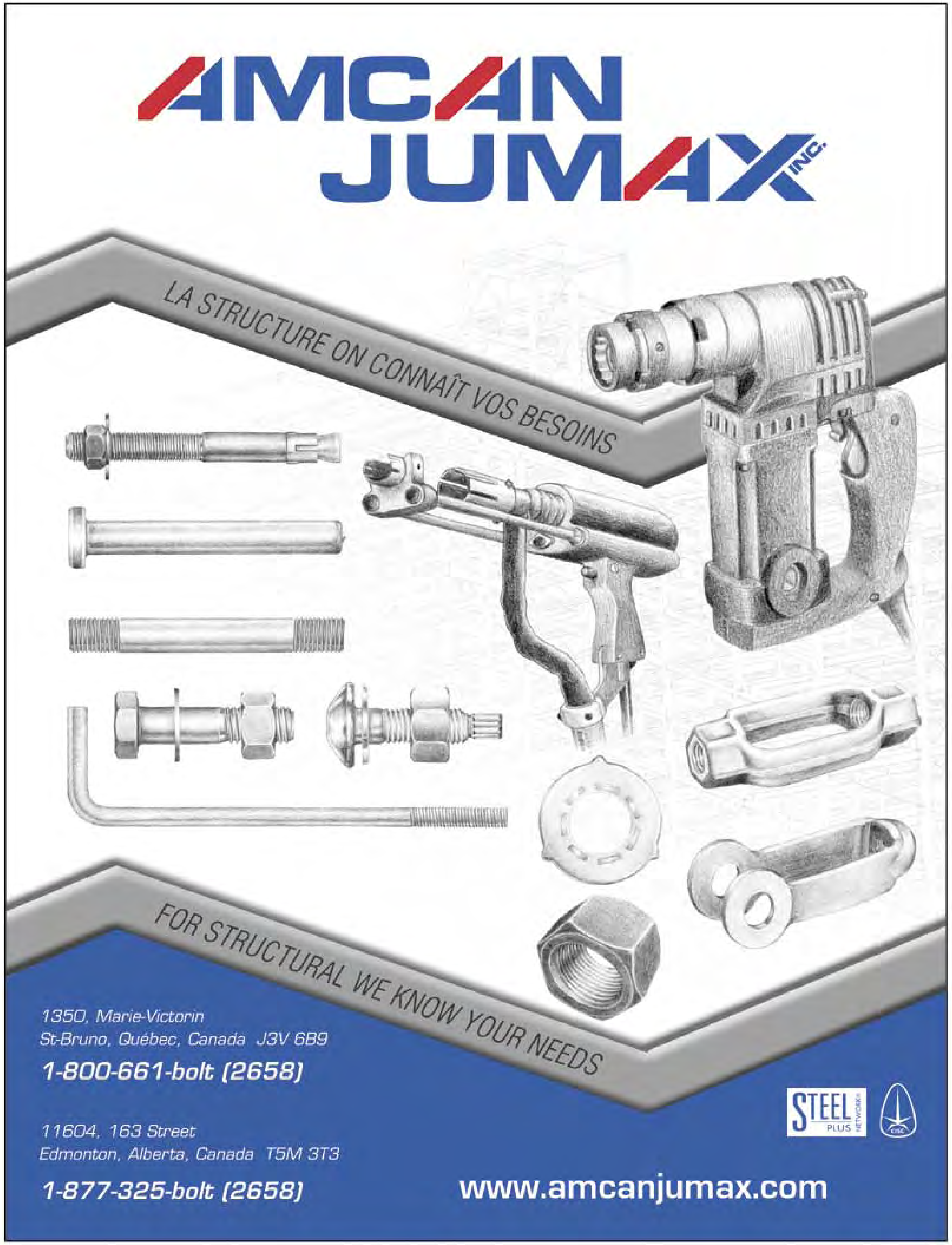
"People spend money on sustainable technologies, but learn later on that they don't work well together. Our role as an integrator is to understand the technologies and try to integrate the appropriate ones so clients gets the best performance for their money," says Humphries.

When developing the project, the GTAA was looking at the design of the Fire and Emergency Services Training Institute as a test case. As they've never implemented a LEED™ building before, they wanted to see if making it sustainable would cost more money or take more time to construct. They also wanted to know how much money they would save operating the facility after construction. Halsall Associates was able to analyze which technologies worked best and how they should be represented in the model.

"We know what didn't work 20 years ago because it's being repaired right now, so we knew not to incorporate those details into our design. We are constantly learning from other people's mistakes and what's happening in the industry," says Humphries.

In the end, the sustainable design and LEED™ certification work that was implemented in the training institute made the grade. The project's total energy savings are 30% better than the Model National Building Code Standards.


Kleinfeldt Mychajlowycz Architects Inc.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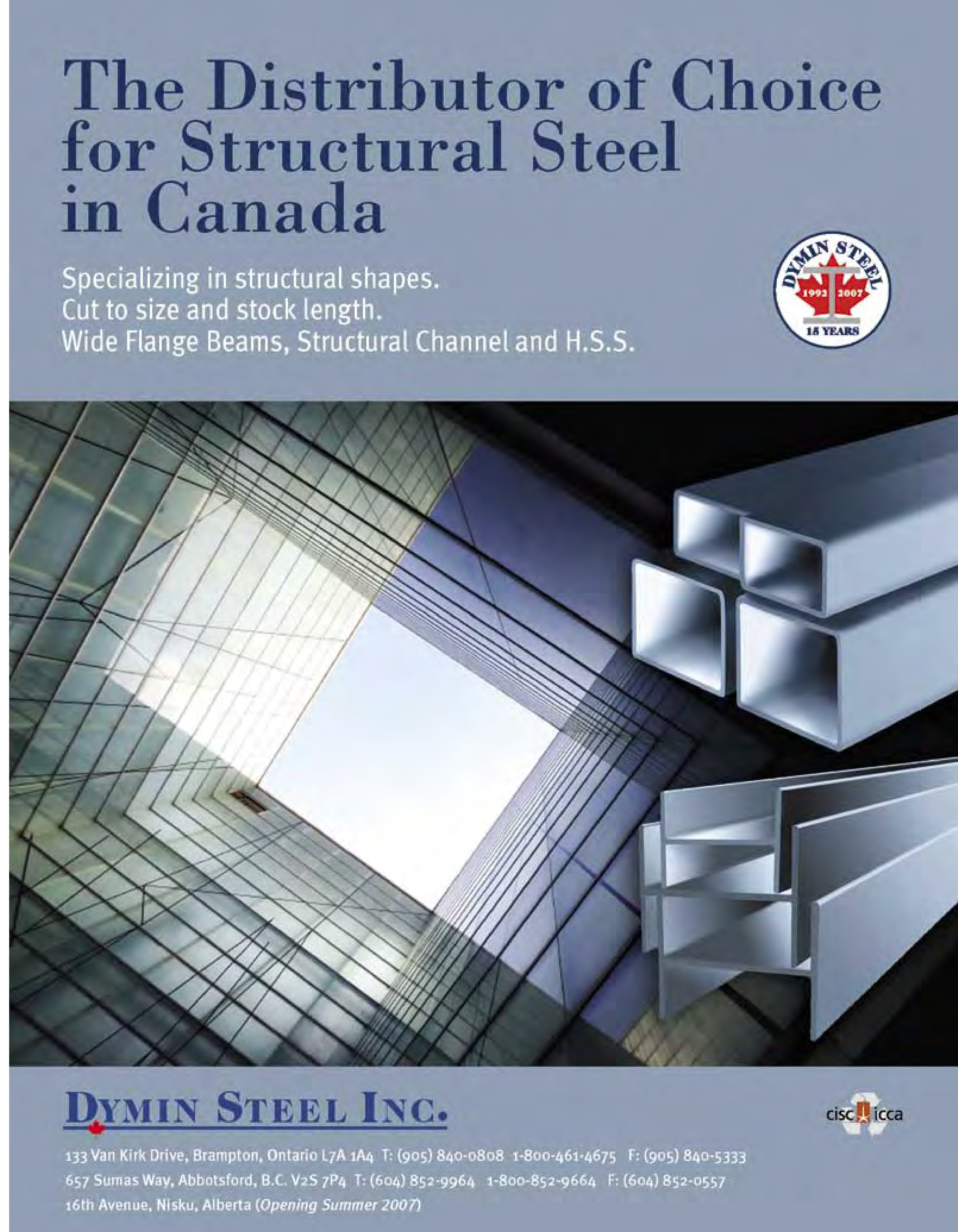
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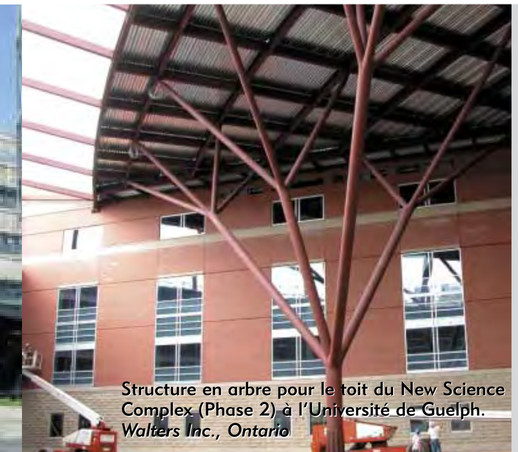
Pont pédestre sur Bayerstrasse à Munich, Allemagne, construit en profilés tubulaires de haute résistance.
Ackermann Ingenieure, Germany



Structure en arbre pour le toit du New Science Complex (Phase 2) à l'Université de Guelph.
Walters Inc., Ontario

Toit en acier tubulaire pour la gare Spencer Street à Melbourne, Australie.
P. Skene, Leightons Contractors Pty Ltd., Australia

IN CANADA, TUBES R US

RECENT RESEARCH, DEVELOPMENTS AND MANUFACTURING NORTH OF THE 47TH PARALLEL AND BEYOND

Jeff Packer, Silke Willibald, Sylvie Boulanger

Since Canada is very prominent in HSS research, development and manufacturing (see insets), it was little surprise that it played host to the international HSS forum, 11th International Symposium on Tubular Structures (ISTS11), held in Quebec City from August 31 to September 2, 2006.

To an outsider (like the third author), what stood out at this conference is its true international scope, the high quality of the technical presentations, the spectacular applications of tubular construction and recent innovation highlights. From cast nodes to truss members to telecommunication towers, from elliptical shapes to high-strength steel hollow sections, tubular structures are everywhere: Tubes R Us.

INTERNATIONAL SCOPE

With about 350 delegates from 34 countries, the conference deserves its international title.

The North-American market was well represented by several attendees from the USA and Canada. Strong interest was also prevalent from Europe (e.g. Germany, UK and The Netherlands), as well as Asia (Japan and China) and even Australia.

TECHNICAL CONTENT

This symposium series serves as the principal showcase for contemporary developments in manufactured tubing. A total of 83 presentations covering a wide range of topics were given: Applications and Case Studies, Code Development, Static Strength of Joints and Members/Frames, Fatigue and Fracture of Tubular Joints, Seismic Design, Composite Construction, Cast Steel Joints and Fire Protection.

The Symposium Programme also included two Keynote Presentations (the ISTS Kurobane Lecture by Prof. Peter Marshall from the USA and the IIW Houdremont Lecture by Prof. Jeffrey Packer), as well as a Student Papers Competition. The papers to all presentations, including the special lectures, can be found in the conference proceedings called *"Tubular Structures XI"* at **www.taylorandfrancis.com**.

CONSTRUCTION APPLICATIONS

The technical aspects of construction with tubular members were the main focus of the Symposium, but also numerous applications of tubular members in construction were presented. The high versatility of HSS as truss members in roof structures was shown in numerous examples (e.g. the tubular steel roof of the Spencer Street Railway Station or the *"liquid design"* architecture).

Hollow structural sections possess a very high aesthetic appeal, especially in combination with cast joints as shown in the example of the tree structure for the roof of the New Science Complex at the University of Guelph in Ontario. By using cast steel joints unsightly fabricated connections and sharp corners can be avoided, thereby giving the structure a natural flow. By placing material where the demand is highest and avoiding welds at positions of high strain, cast steel joints also significantly enhance performance under seismic or fatigue loading compared to regular fabricated connections.

HSS IN CANADA: A HISTORICAL OVERVIEW

Canada has long held a leading role in the technology of manufactured structural tubing, or Hollow Structural Sections (HSS). The world's first *"HSS Design Manual for Connections"* (familiarly known as the red book) was produced by Stelco in 1971, with Jim Cran as the lead author. Stelco championed the product through to 1990, during which time Canada developed a high utilization level of HSS compared to many other countries. Pushing the limits of design knowledge at the time, the world's largest retractable roof, with a span of 205 metres, the Toronto SkyDome (the Rogers Centre) was built with HSS and completed in 1989.

CISC picked up the mandate for HSS connection publications in the 1990s with the *"Design Guide for Hollow Structural Section Connections"* by Jeff Packer and Ted Henderson in 1992. This was followed in 1997 by a second edition with expanded scope, titled *"Hollow Structural Section Connections and Trusses – A Design Guide"*, by the same. These guides have served as a non-code recommended best practice in Canada, and also other countries. In the U.S., the AISC adopted the connection design principles from the CISC guide for its new Chapter K, titled *"Design of HSS and Box Member Connections"* in its 2005 edition of the national standard *"Specification for Structural Steel Buildings"*, ANSI/AISC 360-05. The *"Design Guide"* is available at **www.cisc-icca.ca/pubs**.

The superior performance as a compression element makes the Hollow Structural Section a perfect choice for telecommunication structures and bridges, or as support structures for wind turbines. Combining hollow structural sections with high strength material is shown in an example of a footbridge in Munich, Germany at the beginning of this article. The use of high strength circular hollow sections made it possible to design a gracefully curved structure and to minimize the dead weight.

INNOVATIONS

The technical papers at the International Symposium highlighted innovations such as elliptical hollow sections, the newest addition to the family of HSS. Elliptical hollow sections are made as hot-finished sections in France, UK and Germany to EN 10210. So accepted are these sections in Europe that their section properties are now published in the latest (2006) version of this EN specification. All elliptical sections manufactured for structural purposes have major-to-minor axis dimensions of 2:1.

The novelty of elliptical hollow sections makes them appealing to architects, particularly for AESS (architecturally exposed structural steel) projects. There are numerous applications of elliptical sections in Europe, but one recent example in Canada are the columns for a community centre in Oshawa, Ontario. Conference papers on elliptical hollow sections covered research on classifying them as Class 1, 2, 3 and 4, and attempts to adapt the existing design rules for circular and rectangular hollow section connections to those from elliptical tubes.

Presentations also covered: the use of high strength or stainless steel hollow sections; hollow sections in combination with other materials such as concrete or fibre reinforced polymers (FRP); and developments in the use of HSS for diagonal bracings in braced frames (under static or seismic loading).

We know many of you just couldn't be there with us so we thought you might appreciate this summary. Clearly, HSS construction has broadened its range over the past decade and Canada has been part of the solutions. The next Symposium in this popular series – ISTS12 – will be convened in Shanghai, China from October 8-10, 2008. For more information, see **www.ists12.org**.

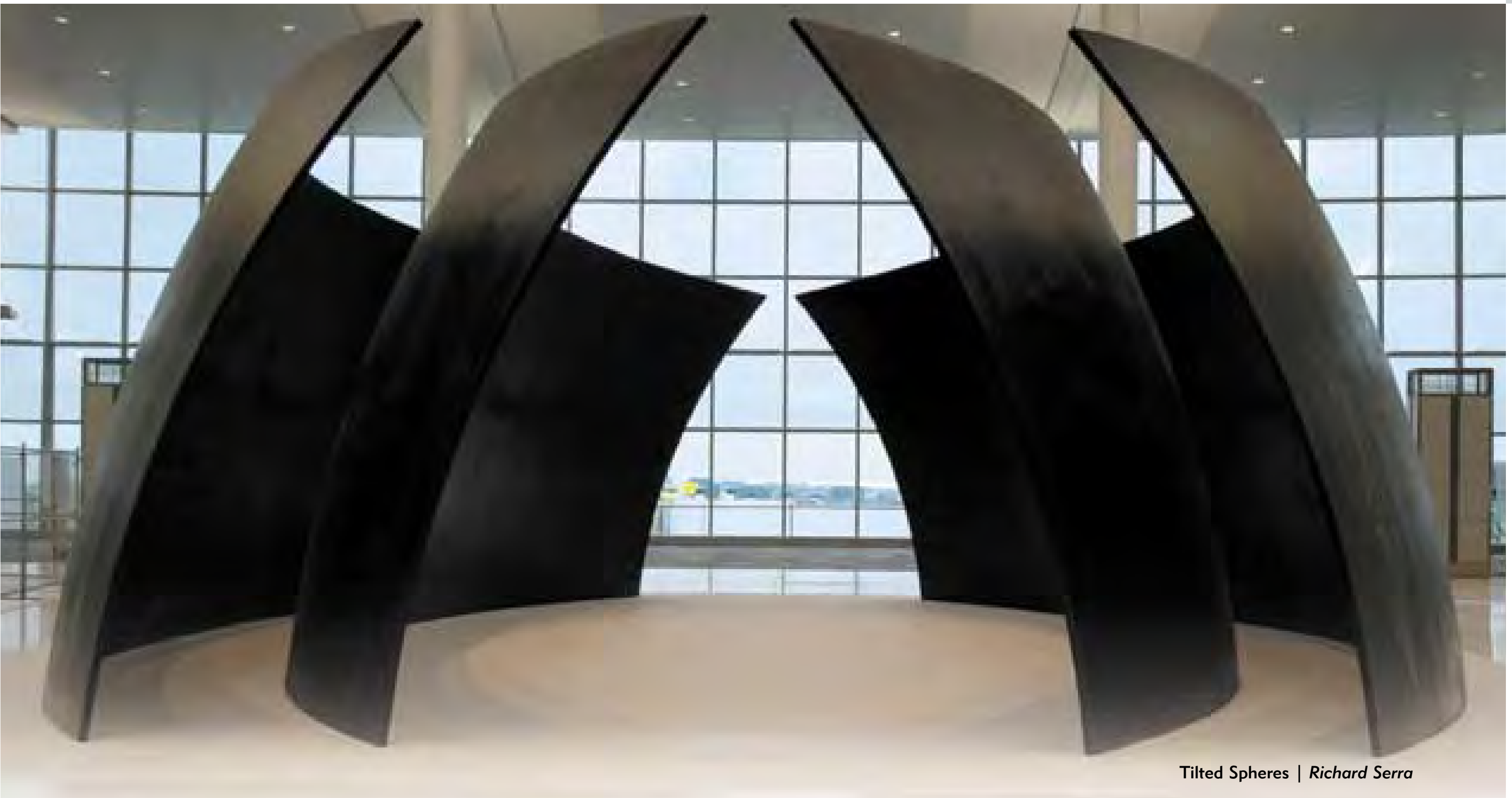
ATLAS TUBE

Along with Canada's HSS design expertise, a pre-eminent position has also resulted in HSS manufacturing. The production of HSS in North America still shows growth and the forecast mill shipments for 2006 total 3 million tons. Atlas Tube Inc., based in Harrow, Ontario (near Windsor) has grown to become the largest producer of structural tubing in not just North America, but the world. In a reflection of the strong export market, Atlas Tube produces cold-formed HSS to both CAN/CSA G40.20-04/ G40.21-04 (in Classes C and H) and ASTM A500-03. In October 2006 Atlas Tube announced a merger with John Maneely Co.

For more information on Atlas Tube, see their web site: www.atlastube.com.

Jeff Packer and Silke Willibald are researchers at the Department of Civil Engineering, University of Toronto. Sylvie Boulanger is CISC staff.


NUCOR-YAMATO
STEEL



Tilted Spheres | *Richard Serra*

WHAT YOU SEE MAY BE WHAT YOU GET, BUT FOR MANY, IT'S WHAT YOU DON'T SEE THAT MATTERS MOST

Christopher Hume

These are the people who stood in their hundreds, day after day, to watch the construction of the steel-box-on-stilts we know as the Sharp Centre at the Ontario College of Art and Design. They are the ones who lined Bloor St. to ogle the erection of the inordinately complicated steel structure that forms the skeleton of the Michael Lee-Chin Crystal at the Royal Ontario Museum.

It's not unusual for building sites to draw an audience, of course, but the sheer complexity – not to mention, novelty – of these projects has moved the construction process into new territory. This is building as theatre, and though it's the architect that gets most of the glory, it's the structural engineers and ironworkers who have the starring roles.

In the case of OCAD, this was obvious from the moment work began. Crowds gathered on the east side of McCaul St. to watch as a series of 12 enormous steel legs were inserted into caissons dug 12 to 18 metres deep in the ground. The columns were manufactured in Pittsburgh and then taken to Hamilton where they were tapered and painted. After that, they were shipped to the site on a truck so long it had dual control, one in front, the other at the rear.

The action started with the placement of the brightly coloured *"stilts,"* each of which weighed 20 tonnes. They support the now famous *"tabletop"* that hovers 15 storeys above the college. Inside are two floors of classrooms and offices.

The idea, as English architect Will Alsop explains, was to provide the extra room the school needed but also to open up space at ground level and connect Grange Park to the west with McCaul. Though Alsop's design struck many observers as literally over the top, it was also extremely practical, if not down to earth.

Once the stilts arrived on site, they had to be inserted into the ground. This is easier described than done; two cranes were required to hoist the columns and then lower them into place. The process was painstakingly slow, but intense and very dramatic. The audience held its collective breath as the columns were inched into the earth, with virtually no room to error. The job completed, applause would erupt; and then work on the next one began.

With all 12 supports in place, a temporary steel cage appeared on top; its function was to hold up the legs while the final structure was built. After that, it was a relatively simple matter of adding floors, ceilings and the distinctive back-and-white steel cladding.

Alsop's airborne pavilion, which opened officially in 2004, has already achieved iconic status. It is one of those powerful buildings that help define Toronto. And really, it is as much about structure as architecture; the Modernists' insistence that architecture must be *"truthful,"* that it should honestly reflect the facts of its structure, has never been more relevant.

If anything, Daniel Libeskind's addition at the ROM made even greater demands on its ironworkers. As project director, John Martin of Vanbots, points out, *"The structural steel is the key to the project. It's a very complicated building. The detailing is exceptional. All the drawings are on computer but the structure is put together by hand."*

Indeed, the job was so difficult, each of the ironworkers had to be issued with a laptop to help visualize in three dimensions how the beams connected. The addition is comprised of five *"crystals"* that involve an astounding variety of shapes and angles. For workers who spend much of their professional lives assembling boxes, Libeskind's multiplanar architecture was wildly challenging, but also deeply rewarding. No one involved in the project had done anything remotely like it.

"I feel very lucky to be working here," Martin admits. *"It'll be a hard act to follow. I'll have to find another museum to work on somewhere."*

Even then, he might have a hard time finding something equally stimulating. The use of steel may be ubiquitous, but so is the reliance on the traditional geometry of straight lines, squares and right angles.

However, as architects such as Libeskind, Frank Gehry and Zaha Hadid have made clear, the possibilities now go well beyond these conventions. In the 21st century, there are few, if any, limits. Architecture has never been more 'sculptural'. It twists, turns, curves and cantilevers in a way that defies expectations as much as gravity.

How appropriate, therefore, that steel has now become an artistic medium in its own right. Almost single-handedly American sculptor, Richard Serra, has made Cor-Ten steel the stuff of major artworks around the world. Toronto has had its own Serra since last year when his monumental piece, Tilted Spheres, was unveiled at the new wing, Pier F, of Pearson International Airport. The vast artwork, which is so large it had to be installed before the pier was built, consists of four gently curving steel plates, each torqued to Serra's exacting specifications.

Normally, this kind of steel is used to form hulls of ocean-going ships. Serra, a former steelworker, transforms a remarkable but strictly industrial material into something decidedly poetic. Wandering through the piece, which serves as an interior landmark at the airport, a place-marker, one enters into a mini-environment in which one's very voice is altered. Sound seems amplified as it bounces between Serra's spheres. The effect is magical.

Toronto-born artist John McEwen is also famous for his use of Cor-Ten. His 1998 work, Search Light, Star Light, Spot Light, stands on the west side of Air Canada Centre. It consists of three steel cones, their surfaces punctuated with hundreds of stars. McEwen's internally illuminated piece is at its finest at night, when it comes alive.

The Bronze Age is over, the Iron Age has passed, but truly we now inhabit the Age of Steel. Whether we know it or not – and probably most of don't – it's what makes our lives possible. These words may be strong, but then, so is steel.

Christopher Hume is the urban affairs columnist and architecture critic at the Toronto Star. He can be reached at chume@thestar.ca.

2006 CISC STEEL DESIGN AWARDS

BRITISH COLUMBIA REGION AWARDS

John Cripps, Duke Energy Gas Transmission

ENGINEERING CATEGORY WINNER
Pine River Crossing
OWNER: Duke Energy
STRUCTURAL ENGINEER: Buckland & Taylor Ltd.
GENERAL CONTRACTOR: Ruskin Construction Ltd.
CISC STEEL FABRICATOR AND DETAILER: Solid Rock Steel Fabricating Co. Ltd.

Built over the Pine River crossing at White Rock, this unique bridge was designed to carry and support two of Duke Energy's gas pipes. The bridge solution was created as a result of the river's flow suddenly exposing the previous gas pipes. The bridge had to be designed, tendered, supplied, fabricated, painted and erected over five winter months beginning in 2005. The judges noted: *This project was awarded for its beauty, simplicity and elegance. Everything is constructed of lightweight, easily transported, ductile steel. Even the foundations, which consist of standard pipe section pilings, were constructed of steel. The judges felt that this project presents a wonderful example of a simple and beautiful engineering solution to a very complex problem, executed in the traditional Canadian style of teamwork and cooperation.*

Peter Buchanan, Stantec

ARCHITECTURAL CATEGORY WINNER
YVR West Chevron Expansion
OWNER: YVR Airport Authority
ARCHITECT: Stantec Inc.
STRUCTURAL ENGINEER: Bush Bohlman & Partners
GENERAL CONTRACTOR: PCL Constructors Westcoast Inc.
CISC STEEL FABRICATOR, DETAILER AND ERECTOR: Empire Iron Works Ltd.

The West Chevron Expansion at Vancouver's International Airport was designed to incorporate and showcase the ocean and features nautical inspired structural components. The use of exposed structural steel helped to achieve the design goals through the use of 'tree-like' roof supporting structures and 'boat trusses' that appear in a ship shape formation. The terminal design is both simple and exciting, and creates a remarkable welcome for visitors coming to Vancouver. The judges commented that it is a remarkable showpiece for the very high level of design and engineering that Vancouver has become famous for around the world.

ONTARIO REGION AWARDS

Chris Maves at Barry-Bryan Associates (1991) Limited

ARCHITECTURAL CATEGORY WINNER
Legends Centre
OWNER: City of Oshawa
ARCHITECTS: Barry Bryan Associates & Hughes Condon Marler Architects – Architects in Joint Venture
STRUCTURAL ENGINEER: Read Jones Christoffersen Ltd
GENERAL CONTRACTOR: Maystar General Contractors Inc.
CISC STEEL FABRICATORS: Benson Steel Ltd. and MBS Steel

The Legends Centre recreation facility in Oshawa, Ontario acts as a civic and community hub and features a swimming pool, fitness centre, gymnasium, library, administrative support areas, a suspended running track and 4 hockey arenas. Steel was the best choice for this project for both practical and aesthetic reasons, based on the architectural design requirements. A system of light steel joists and joist girders were used for the arena framing, while the aquatic centre was spanned with exposed curved steel trusses supported on elliptical hollow steel columns – a first in Ontario.

Foster Architects

ENGINEERING CATEGORY WINNER
University of Toronto Leslie L. Dan Pharmacy Building
OWNER: University of Toronto
ARCHITECTS: Foster & Partners / Cannon Design – Architects in Joint Venture
STRUCTURAL ENGINEER: Halcrow Yolles
GENERAL CONTRACTOR: PCL Constructors Canada Inc.
CISC STEEL FABRICATOR, DETAILER & ERECTOR: Walters Inc.

The Leslie L. Dan Pharmacy building stands 13-storeys high and houses two large lecture theatres, a student lounge, resource centre and specialized teaching and research labs. The most extraordinary structural component in this facility are the two circular pods, that are literally suspended in mid-air in the main lobby's five-storey atrium. The larger, and lower pod houses a 60-seat lecture theatre and reading room, and the higher pod houses a smaller classroom and faculty lounge.

QUEBEC REGION AWARDS

Dan S. Hanganu arch.

COMMERCIAL/INSTITUTIONAL PROJECTS CATEGORY WINNER
Salle de spectacles de Rimouski concert hall
OWNER: Ville de Rimouski
ARCHITECT: CONSORTIUM: Dan S. Hanganu; Proulx et Savard; Gagnon Letellier Cyr, architectes
STRUCTURAL ENGINEER: Roche ltée Groupe-conseil
GENERAL CONTRACTOR: Les Constructions Binet inc
CISC STEEL FABRICATOR AND DETAILER: Les Constructions Beauce-Atlas inc.
CISC SUPPLIER: Acier Leroux

The approach proposed for this highly significant project consists of installing an open building, both in terms of appearance and use. In accordance with its mission of regional cultural diffusion, the Salle de spectacles de Rimouski concert hall finds its expression in a flexible building integrated into the urban fabric. The structure holds a significant presence in the heart of the institutional district. It offers great transparency from the interior of the double-height lobby, while allowing great openness from the exterior to the interior. The building's main façade is s-curtain wall, supported by veil-open sections, so as not to obstruct the view of the St. Lawrence River and Place des Vétérans, while respecting the structural requirements. The insertion of an outdoor public passage in this *"thick"* façade required such a technological *"effort"*. The steel structure, composed of connections with thermal barriers and flexible assemblies, allows dimensional movements. These details made it possible to meet the highest requirements for the envelope's performance and esthetic expression.

Lapointe Magne & assoc.

RESIDENTIAL/RENOVATION PROJECTS CATEGORY TIE WINNER
Résidence Jean-Placide-Desrosiers, Montreal
OWNER: Office municipal d'habitation de Montréal
ARCHITECT: Lapointe Magne et associés
STRUCTURAL ENGINEER: Les Consultants Gemec inc.
GENERAL CONTRACTOR: Consortium M.R. Canada ltée
CISC STEEL FABRICATOR AND DETAILER: Quirion Métal inc.

Part of a residential development in Ville Saint-Pierre, constructed on behalf of the Office municipal d'habitation de Montréal (OMHM), the Jean-Placide-Desrosiers housing project is located on the site of the former Saint-Pierre-aux-Liens Church, which burned down in March 2001. The project provided for construction of 83 low-rent housing units for seniors with slight loss of autonomy. The challenge initially focused on the development of a construction system, which would reconcile a modest development budget ($100/ft^2) and tight construction deadlines. The volumetric concept of two long parallel caissons (75m x 9m) was adopted. A systematic structure of steel beams and posts assembled with prefabricated honeycombed concrete slabs, thus echoes the chosen architectural method.

S. Boulanger

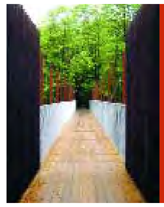
RESIDENTIAL/RENOVATION PROJECTS CATEGORY TIE WINNER
Les Brises du Fleuve V, Verdun
OWNER: Syndicat des Propriétaires
ARCHITECT: Beauchamp et Bourbeau
STRUCTURAL ENGINEER: Teknika HBA inc.
GENERAL CONTRACTOR: Roche Construction inc.
CISC STEEL FABRICATOR AND DETAILER: Structures Yamaska inc.

This twelve-storey residential concrete building was constructed in 2001, and unfortunately saw the collapse of its peripheral parking garage roof on the ground level November 7, 2001. Following this collapse, it was concluded that the building was not in compliance to withstand an earthquake according to the current standard. The reinforcement project was complex due to structural restrictions in all of the building's 83 occupied units, as well as having to account for the feasibility and cost of the work. The construction scheduled was accelerated, and the solution consisted of steel supporting walls, which added 1" of thickness to the wall separating two units and intervening only on one side. A concrete solution would have added 10" of thickness, involving intervention in two condominiums at a time.

M. Brunelle

GREEN BUILDINGS CATEGORY WINNER
Centre Professionnel Beaumont, Montréal
OWNER: Groupe Accueil International
ARCHITECT: Les architectes Desnoyers Mercure et associés
STRUCTURAL ENGINEER: Bureau d'études spécialisées inc.
GENERAL CONTRACTOR: Construction C.G. Beaulieu
CISC STEEL FABRICATOR AND DETAILER: Structures Yamaska inc.

The Centre Professionnel Beaumont project is the result of the conversion of an obsolete one-storey steel shopping centre into a centre for health professionals and other businesses in the paramedical field. Groupe Accueil decided to enlarge the existing one-storey building, about 70,000 ft^2 and 600 feet long, by adding a storey or by completion demolition of the existing building. Given that the roof structures had slopes for drainage basins and that its posts could not support an additional storey, the engineers proposed to reuse the steel structure by raising the existing roof to its final thirty-foot level, ten feet higher than the initial level, and building a new storey under the raised roof.

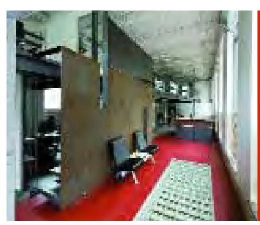


Croft Pelletier arch.

JURORS' FAVOURITE CATEGORY WINNER

Suspension Footbridge over the St-Charles River in Quebec City
OWNER: Ville de Québec
ARCHITECT: Croft Pelletier architectes
STRUCTURAL ENGINEER: BPR inc.
GENERAL CONTRACTOR: Constructions BSL inc.

The Pincourt Footbridge is part of the new Saint-Charles River linear park in Quebec City. This pedestrian park, extending from downtown to the Quebec municipal limits, allows people to discover the river in a natural landscape outside inhabited areas. Architectural, environmental and structural aspects were taken into consideration for the footbridge's design. A simple, transparent, almost immaterial rectangular volume is deposited delicately on both shores and integrated into the site to minimize its impact. It was agreed to design an easily transportable footbridge, which could be erected easily while limiting restrictions in the natural setting. The structural response is a suspension footbridge. The concern for compliance with a strict budget framework while limiting maintenance costs led to the use of Corten steel as the principal material, since it does not require any maintenance. The result clearly reflects a good engineer-architect relationship in a field (bridges) from which architects are often absent.



ABCP arch.

YOUNG ARCHITECTS/ENGINEERS CATEGORY WINNER

Dany Blackburn – Bureaux ABCP, Québec
YOUNG ARCHITECT: Dany Blackburn, ABCP architecture + urbanisme
SPONSOR: Bernard Serge Gagné, Arch., ABCP architecture + urbanisme
STRUCTURAL ENGINEER: Nicol Girard, Eng., Genivar Consulting Group

Dany Blackburn did an outstanding job on the project for the new ABCP office in Quebec City. He showed great mastery of the project, developing original, economical and esthetically harmonious construction solutions. His refinement of the project's steel details, from the raw structure that involved most of the intervention to functional use of the intrinsic properties of materials, such as acoustic decking and the esthetic qualities of the material in its natural, primed and galvanized forms, made it possible to deliver a sober, functional and striking environment. This has resulted in a luminous, spacious, user-friendly, green-oriented building in which each occupant operates in an environment offering exterior views, thanks to the delicacy of the details marrying glass and steel. Due to his architectural sensitivity, his attention to detail and his team building qualities, Dany Blackurn was able to lead this project to success.

AWARDS OF MERIT AND HONOURABLE MENTIONS

BRITISH COLUMBIA REGION

Westmar Engineering Consultants Inc.

ENGINEERING CATEGORY AWARD OF MERIT

Texada Quarrying Shiploader
OWNER: Texada Quarrying Ltd.
STRUCTURAL ENGINEER: Westmar Engineering Consultants Inc.
CISC STEEL FABRICATOR, DETAILER AND ERECTOR: Canron Western Constructors Ltd.

Musson Cattell Mackey Partnership

ARCHITECTURAL CATEGORY AWARD OF MERIT

Electronic Arts Phase 2 - Studio Building
OWNER: Electronic Arts Canada
ARCHITECT: Musson Cattell Mackey Partnership
STRUCTURAL ENGINEER: Glotman-Simpson
GENERAL CONTRACTOR: PCL Constructors Westcoast Inc.
CISC STEEL FABRICATOR AND ERECTOR: Empire Iron Works Ltd.
CISC STEEL DETAILER: ProDraft Inc.

ONTARIO REGION

Stephanie DeGasperis,
Ted Handy & Associates Inc., Architect

ARCHITECTURAL CATEGORY HONOURABLE MENTION

The Emmanuel Baptist Church
OWNER: Emmanuel Baptist Church
ARCHITECT: Ted Handy & Associates Inc.
STRUCTURAL ENGINEER: Meades Engineering Ltd.
GENERAL CONTRACTOR: Bertram Construction & Design
CISC STEEL FABRICATOR & DETAILER: ACL Steel
CISC STEEL ERECTOR: Spencer Steel

QUEBEC REGION

Cima+

COMMERCIAL/INSTITUTIONAL PROJECTS CATEGORY HONOURABLE MENTION

Expansion of Pierre-Elliott Trudeau International Airport, Phase 2
OWNER: Aéroports de Montréal
ARCHITECT: CONSORTIUM PCJA: Provencher, Roy; Cardinal et Hardy; Jodoin Lamarre Pratte; Arcop
STRUCTURAL ENGINEER: Consortium: SNC-Lavalin; Cima+
GENERAL CONTRACTOR: CONSORTIUM DVPT: Decarel; Verreault; Pomerleau; Tecsult
CISC STEEL FABRICATORS: Supermétal Structures, Canam Group
CISC STEEL DETAILERS: Techdess, Supermétal Structures, Canam Group

SDKLBB

COMMERCIAL/INSTITUTIONAL PROJECTS CATEGORY HONOURABLE MENTION

Expansion of the Jewish General Hospital, Montreal
OWNER: Sir Mortimer B. Davis Jewish General Hospital
ARCHITECT: CONSORTIUM: Ibghy; NFOE; Lemay, Architectes
STRUCTURAL ENGINEER: Saia, Deslauriers, Kadanoff, Leconte, Brisebois, Blais
GENERAL CONTRACTOR: Pomerleau-Verreault Coentreprise
CISC STEEL FABRICATOR AND DETAILER: B.K. Fer Ouvré inc.

Axor

INDUSTRIAL PROJECTS/BRIDGES CATEGORY HONOURABLE MENTION

Maintenance Hangar, Aéroports de Montréal, Dorval
OWNER: Aéroports de Montréal
ARCHITECT: Provencher Roy et Associés architectes
STRUCTURAL ENGINEER: Axor Experts-Conseils inc.
GENERAL CONTRACTOR: Axor Construction
MANUFACTURER AND DESIGNER: Les Charpentes d'acier Sofab inc.

BPR inc.

INDUSTRIAL PROJECTS/BRIDGES CATTEGORY HONOURABLE MENTION

Temporary Structure over the Chaudière River at Lévis
OWNER: Ministère des Transports du Québec
STRUCTURAL ENGINEER: BPR inc.
GENERAL CONTRACTOR: Groupe CRT inc.
CISC STEEL FABRICATOR: Les Constructions Beauce-Atlas inc.
CISC STEEL DETAILER: GENIFAB

Rubin + Rotman Assoc.

GREEN BUILDINGS HONOURABLE MENTION

Hagen Head Office, Baie d'Urfé
OWNER: R.C. Hagen Inc.
ARCHITECT: Rubin et Rotman Associés
STRUCTURAL ENGINEER: BCA Consultants
GENERAL CONTRACTOR: Broccolini Construction Inc.

THANK YOU TO THE 2006 DESIGN AWARD JUDGES

BC REGION
ARTHUR BUSE, Boldwing Continuum Architecture
DAVID WILKINSON, Cannon Design
RICHARD IREDALE, Iredale Group Architecture
GREG SMITH, Weiler Smith Bowers Consulting Engineers
DUANE PALIBRODA, Fast + Epp Structural Engineers

ONTARIO REGION
MICHAEL BUCKLEY, Halsall Associates
ALAN MUNN, Zeidler Partnership Architects
BILL RUTH, aTRM Architects
DAVID TAY, Morrison Hershfield
DAVE TIPLER, Banerjee & Associates
CARSON WOODS, Carson Woods Architects Limited

QUEBEC REGION
GILLES BOUCHARD, RSW inc.
PIERRE CORRIVEAU, Les architectes Corriveau et Girard
ANIK GIRARD, Journal Constructo
RICHARD KLOPP, Julia Bourke Architecture inc.
SYLVAIN PINEAU, P.Eng. D'Aronco, Pineau, Hébert, Varin inc.

Watch for the 2007 Alberta and Ontario Region's Steel Design Awards in the next issue of Advantage Steel!

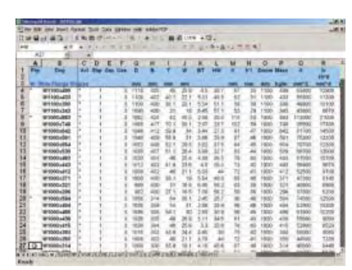
WHAT'S COOL, WHAT'S HOT, WHAT'S NEW

LIMIT STATES DESIGN IN STRUCTURAL STEEL

G.L. Kulak and G.Y. Grondin, 8th Edition (November 2006)

The Eighth Edition reflects significant changes that have been made in the National Building Code of Canada. Additional design examples have been added to Chapter 8 to illustrate various analysis procedures for multi-storey frames. The design examples in that chapter have been adapted to the 2005 edition of the National Building Code. Additional design examples were added to Chapter 9 to illustrate the use of weld symbols and to emphasize some design aspects of rigid beam-to-column moment connections.

This textbook serves as a comprehensive teaching text for universities, and technical institutes, and also as a valuable reference document for practising engineers. The textbook offers an explanation of the philosophy and practical application of limit states design procedures and provides comments on design requirements contained in the Standard S16-01, "*Limit States Design of Steel Structures*". Divided into 11 chapters, the book covers tension members, flexural members, columns, beam-columns, stability, fatigue behaviour, connections, plate girders, composite construction, torsion, welding processes and procedures, stability analysis of frames, beam-column design as well as types and grades of structural steel.



STRUCTURAL SECTION TABLES - FREE DOWNLOAD!

The CISC Structural Section Tables (SST) is the electronic database containing the steel sections listed in the Handbook of Steel Construction, 9th Edition. It is now available in Excel spreadsheet format as a free download from the CISC website www.cisc-icca.ca/publications/software/sst/

Metric dimensions and section properties for design and detailing are provided for the following structural steel shapes: W, S, M, HP, WWF, C, MC, L, WT, WWT, 2L short legs back-to-back, 2L long legs back-to-back, 2L equal legs back-to-back, WRF, HSS square, HSS rectangular, HSS round and SLB (super-light beams).

The database includes two sets of HSS sections: those produced in accordance with CSA G40.20/21 and those produced in accordance with ASTM A500.

CHANGE IN AVAILABLE W-SHAPE SECTIONS

Algoma Steel, located in Sault Ste. Marie, Ontario, stopped rolling W- and H-shapes in 1999. Many of the nine W-shape sections that were exclusively rolled by Algoma were "picked up" and produced by two foreign producers. The availability of these sections has changed. For the current status, please see the following.

IMPORTANT NOTICE

The availability of W-shape sections formerly produced exclusively by Algoma should be checked with local suppliers. Currently, the status of these sections is as follows:

- ☐ *W530x82 and W530x72: produced by Nucor-Yamato and Steel Dynamics.*
- ☐ *W610x91, W610x84, W460x67 and W460x61: produced only by Nucor-Yamato.*
- ☐ *W310x31, W250x24 and W200x21: no longer listed by any producer.*

Even if produced, these sections may be subject to rolling schedules and may not necessarily be stocked by steel service centres or available to fabricators in your area. In the design tables of the Ninth Edition of the CISC Handbook of Steel Construction, these nine sections are denoted by grey font so as to caution users regarding their restricted availability.

COURSES

The 2005 National Building Code of Canada (**http://www.nationalcodes.ca/nbc/index_e.shtml**) introduces very substantial technical changes, and to reconcile the new NBCC requirements, CSA issued S16S1-05, Supplement #1 to CAN/CSA-S16-01 (CSA S16). All of these changes necessitate a fresh look at the underlying framing decisions to be made by designers.

Not only do the changes affect the load assessment and design of the building structure, but designers should not rely solely on past experience in the search for the most economical solution. In response, CISC is offering two, one-day courses intended to provide understanding on design theory and the rationale behind code provisions as well as the application of specific Code formulae and requirements.

Steel Framed Commercial Building Design

This course will be offered in major centres across Canada and will focus on practical and economical solutions for framing a six-storey building. Practical steel framing concepts and integration with architectural and mechanical features will be discussed. The course notes will include design solutions for the wind resisting system as well as typical members and components of the gravity frame. In seismically low regions, a component has been added to the program to introduce designers to static methods for evaluating the lateral force resisting system for earthquake loads and effects.

The course is being offered on the following dates and locations:

St. John's, NL – May 3, 2007,
St. John's Convention Centre

Moncton, NB – May 7, 2007,
Holiday Inn Express

Toronto, ON – May 23, 2007,
Premiere Convention Centre, Richmond Hill

Seismic Design of Steel Framed Buildings

This course will be offered in seismically active centres in Canada and will cover the design of various categories of braced frames and moment frames to the requirements of NBCC 2005 and CSA S16-01(S16S1-05) incorporating design examples for buildings ranging from one to ten storeys in height.

The courses are being offered on the following dates and locations:

Moncton, NB – May 8, 2007
Holiday Inn Express

Toronto, ON – May 24, 2007
Premier Convention Centre, Richmond Hill

An interactive online registration form is available at **http://www.cisc-icca.ca/courses/**.

Bolting and Welding for Design Engineers

This course is designed to provide an introduction to the basics of bolting and welding steel structures with emphasis on practical and economical solutions. Although not a connection design course per se, participants will come away with a solid understanding of the materials, products, specifications, installation, field challenges and design methodologies for connecting structural steel components.

Vancouver, BC* – May 15, 2007
Downtown Vancouver Location TBD

**CISC is pleased to offer this course in partnership with the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC). Register online at www.apeg.bc.ca.*

Fort McMurray, AB – May 17, 2007
Sawridge Inn and Conference Centre

Register online at **www.cisc-icca.ca/courses**.


CANstruction NOVA SCOTIA TEAM

CANSTRUCTION® NOVA SCOTIA 2006

CISC's Atlantic Region Members and a group of civil engineering students from Dalhousie University, Team Paragon were excited to receive the Structural Ingenuity award for their entry known as 'Three Graces' in the 3rd annual CANstruction® Nova Scotia competition in November 2006.

CANstruction® Nova Scotia invites teams of designers, architects and engineers to create extraordinary structures entirely out of canned food that are put on display in various public facilities and malls in Nova Scotia, that are eligible to win an award in a number of categories. In 2006, the structures were built at Halifax Shopping Centre, MicMac Mall, Sunnyside Mall and St. Francis Xavier University and remained open to the public from October 26-28. For a $2 donation, spectators were invited to vote for their favourite structures, which are all later judged by a panel of objective peers from the engineering, design and architecture communities.

The winners were announced at an awards ceremony held November 9, 2006.

When the structures were disassembled October 28th, the food was donated to FEED NOVA SCOTIA to help the 40,000 Nova Scotians who rely on agencies across the province for a portion of their monthly grocery support.

Canstruction® Nova Scotia 2006 was an outstanding success! In addition to an extraordinary public display of talent, and a lot of fun, the event generated 22,113 kg (or 55,000+ cans) of food and over $34,000.00 in cash.

Congratulations to CISC's Atlantic Region and Team Paragon from Dalhouse University!


Courtesy of the The United States Air Force Website

MARIANI STEEL WAR MEMORIAL

Mariani Metal Fabricators has completed the fabrication on the U.S. Air Force Memorial, which was unveiled by U.S. President Bush, U.S. Secretary of Defence, Donald Rumsfeld, and H. Ross Perot Jr. in October 2006 in Arlington, Virginia.

The United States Air Force Memorial was designed by the late architect James Ingo Freed, who was inspired by watching bomb blast contrails. Soaring 270 feet into the air, The United States Air Force Memorial's three spires symbolize the conquest of flight over gravity. To honour the fifty four thousand air force personnel who paid the ultimate price, the surface of the memorial was designed to withstand corrosion for more than 200 years.

On October 15, 2006, the 60th anniversary of its founding, The United States Air Force Memorial was unveiled to a stellar audience of veterans, servicemen and women, and their families.


Place Ville Marie, Montreal

HAPPY 50TH ARCOP

In the late 1950's an American developer and their young architect, I M Pei, interviewed a number of Montreal firms to select one as the local Associate Architect - Architect-of-Record - for what was to become Place Ville Marie. They chose the young, loosely-associated partnership of Affleck, Desbarats, Dimakopoulos, Lebensold and Sise, now known as ARCOP. Fifty years later, ARCOP still rhymes with design quality, with their work on the Trudeau International Airport and the Canada Aviation Museum. Happy 50th anniversary to the architects of ARCOP. All the best with your steel structures.

EVENTS

2007 CISC Annual Convention
June 6 – 9, 2007
Grand Okanagan Lakefront Resort
www.cisc-icca.ca

9th Canadian Conference on Earthquake Engineering
June 26 – 29, 2007
Fairmont Château Laurier, Ottawa, ON
www.carleton.ca/9ccee

IABSE Conference – Information and Communication Technology (ICT) for Bridges, Buildings and Construction Practice
June 4 - 6, 2008
Helsinki, Finland
www.iabse.org/conferences/helsinki20008

Legend: *sales office only B-buildings Br-bridges S-structural P-platework J-open-web steel joist

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* Mount Pearl, Nfld. (709) 745-8060
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Ste-Thérèse, Québec (450) 971-5995
www.steltec.ca

Les Dessins Trusquin Inc. B,Br
Laval, Québec (450) 688-7336

Maximum Steel Detailing Inc. B
Langley, B.C. (604) 514-1474

M & D Drafting Ltd. B,Br,P
Edmonton, Alberta (780) 465-1520
Langley, BC (604) 513-4210
www.mddrafting.com

MHM Drafting Inc. B
Wellesley, Ontario (519) 656-2059

M-Tec Drafting Services Inc. B
Sherwood Park, Alberta (780) 467-0903
www.mtecinc.ca

ProDraft Inc. B,Br,P
Surrey, B.C. (604) 589-6425
www.prodraftinc.com

Ranmar Technical Services B,P
Mt. Pearl, Nfld. (709) 364-4158
www.ranmartech.com

Saturn Holdings Limited B
Winnipeg, Manitoba (204) 663-4649

SDI Structural Drafting Inc. B,Br,P
Edmonton, Alberta (780) 463-2140
www.sdiinc.ca

TDS Industrial Services Ltd. B,P
Prince George, B.C. (250) 561-1646
www.tdsindustrial.com

Techdess Inc. B
Saint-Jérôme, Québec (450) 569-2629
www.techdess.com

Tenca Steel Detailing Inc. Br
Charlesbourg, Quebec (418) 634-5225
www.tensorengr.com

ASSOCIATE - ERECTOR

E.S. Fox Limited B
Niagara Falls, Ontario (905) 354-3700
www.esfox.com

K C Welding Ltd. B
Angus, Ontario (705) 424-1956

Montacier Plus Inc. B,Br
Boisbriand, Québec (450) 430-2212
www.montacier.com

Montage D'acier International
Terrebonne, Québec (450) 965-7360

Supermétal-Mojan Inc. B,Br,J
St-Romuald, Québec (418) 834-1955
www.supermetal.com

Legend: *sales office only B-buildings Br-bridges S-structural P-platework J-open-web steel joist

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Advanced Bending Technologies Inc.
Langley, B.C. (604) 856-6220/ 1-800-563-2363
www.bending.net
(Rolled or bent structural sections)

AIR LIQUIDE CANADA INC.
Vanier, Québec (418) 683-1917
www.airliquide.com
(Industrial gases, welding materials & equip.)

Altitube Steel Inc./Acier Altitube Inc.
Lachine, Québec (514) 637-5050
www.altitube.com
(Specializing in tubes (HSS), structural pipe)

Amcan Produits Filetés Inc.
Saint Bruno de Montarville, Québec (450) 441-6011
www.amcanfasteners.com
(Bolts)

Amercoat Canada
Montréal, Québec (514) 333-1164
Oakville, Ontario (905) 847-1500
www.amercoatcanada.com
(Protective paints and coatings)

American Iron & Metal Inc./
La Compagnie Américaine de Fer et Métaux Inc.
East Montréal, Québec (514) 494-2000
www.scrapmetal.net

Amcan Jumax Inc.
Ste-Julie, Québec (450) 922-1987
www.jumax.net
(bolts, Nelson studs, anchors, hot-dip galvanization)

Atlantic Industries Limited
Dorchester, NB (506) 379-2428
www.ail.ca
(galvanizing)

Blastal Coatings Services Inc.
Brampton, Ontario (905) 459-2001
www.blastal.com
(Wheelbrating, blasting, glass bead services, epoxy coatings, enamels, zinc rich primers, metalizing, plastic flame coating)

Blastech Corporation
Brantford, Ontario (519) 756-8222
www.blastech.com
(Abrasive blasting, glass bead blasting application of liquid coatings, baked on coatings and powder coatings of metalizing)

Borden Metal Products (Canada) Limited
Beeton, Ontario (905) 729-2229
www.bordengratings.com
(Aluminum, Stainless Steel, Steel Grating)

Brunswick Steel
Winnipeg, Manitoba (204) 224-1472
www.brunswicksteel.com
(Steel - Structures plate bars hss)

Canadian Galvanizing Ltd.
Edmonton, Alberta (780) 479-5547
(Hot dip galvanizing)

Cloverdale Paint Inc.
Edmonton, Alberta (780) 453-5700
www.cloverdalepaint.com
(Specialty hi-performance industrial coatings and paint products)

Commercial Sandblasting & Painting Ltd.
Saskatoon, Saskatchewan (306) 931-2820
(Sandblasting and protective coating applications)

CMC Steel division of Crawford Metal Corp./
Acier CMC division de Crawford Metal Corp.
Longueuil, Québec (450) 646-6000
(Angles, channels, hss, beams, plates)

Custom Plate & Profiles
Delta, B.C. (604) 524-8000
www.customplate.net
(Cut to size steel plate in various grades to 12" thick. Stock size sheets of plate to 12")

Daam Galvanizing Inc.
Edmonton, Alberta (780) 468-6868
www.daamgalvanizing.com
(Hot dip galvanizing)

Devoe Coatings
Edmonton, Alberta (780) 454-4900
www.devoecoatings.com
(Coating, paint)

Distribution d'Acier de Montréal
St-Hyacinthe, Québec (450) 771-7101
(Steel tubes (HSS), round, square and rectangular)

EBCO Metal Finishing L.P.
Richmond, B.C. (604) 244-1500
www.ebcometalfinishing.com
(Hot dip galvanizing)

EDVAN Industries Inc.
Nisku, Alberta (780) 955-7915
www.edavancan.com
(Shear & form of steel plates & coil, supply of safety grating – grip strut, pert-o grip, traction, tread))

Endura Manufacturing Co. Ltd.
Edmonton, Alberta (780) 451-4242
www.endura.ca
(Paint and Coating Materials)

Fisher & Ludlow,
A Division of Harris Steel Limited
Longueuil, Québec (450) 670-5085
Edmonton, Alberta (780) 481-3941
Surrey, B.C. (604) 888-0911
www.fisherludlow.com
(Welded steel /aluminum/stainless steel grating, "Grip Span" and "Shur Grip" safety grating)

Frank's Sandblasting & Painting
Nisku, Alberta (780) 955-2633

General Paint/Ameron Protective Coatings
Vancouver, B.C. (604) 253-3131
www.generalpaint.com
(Shop primers, protective coatings, paint)

ICI Devoe Coatings
Vancouver, B.C. (604) 637-1152
www.devoecoatings.com
(Paints, Linings, Protective Coatings)

Industrie Dry-Tec Coating inc.
Terrebonne, Québec (450) 965-0200
www.drytec.ca
(Grating, metallizing, paint)

Jet de Sable Houle Sandblasting Ltee
Montréal, Québec (514) 881-2400
www.houlesandblast.com
(Preparation et finition de surface metallique par projection d'abrasif et rejetement anti corrosif liquide)

La Corporation Corbec
Lachine, Québec . (514) 364-4000
www.corbec.net
(Supplier of hot dip galvanizing only)

Lincoln Electric Company of Canada LP
Toronto, Ontario (416) 421-2600
www.lincolnelectric.com
(Welding equipment and welding consumables)

Marmon Keystone Canada Inc.
Langley, B.C. (604) 857-9844
www.marmonkeystone.com
(Hollow Structural Sections, A106 Seamless Pipes)

Micron Coatings Inc.
Edmonton, Alberta (780) 432-4519
www.microncoatings.ca
(Protective coatings)

Midway Wheelabrating Ltd.
Abbotsford, B.C. (604) 855-7650
www.midwaywheelabrating.com
(Wheelabrating, sandblasting, industrial coatings)

Peinture Internationale
(une division de Akzo Nobel Peintures Ltée.)
Dorval, Québec (514) 631-8686/1-800-361-2865
www.internationalpaints.com
(Protective coatings, corrosion-resistant paints)

Pipe and Piling Supplies Ltd./
Tuyaux et Matériel de Fondation Ltée.
St. Hubert, Québec (450) 445-0050
www.pipe-piling.com
(Hot Roll-Wide-Flange-Bearing Pile Beams)

Price Steel Ltd.
Edmonton, Alberta (780) 447-9999
www.pricesteel.com
(Structural, plate, bars, HSS tube, grating, pipe)

Pure Metal Galvanizing,
Division of PMT Industries Limited
Rexdale, Ontario (416) 675-3352
www.puremetal.com
(Custom 'Hot-Dip' Zinc Galvanizing; Pickling and Oiling)

Red River Galvanizing Inc.
Winnipeg, Manitoba (204) 889-1861
www.redrivergalvanizing.com
(Supplier of hot dip galvanizing only)

Reliable Tube (Edmonton) Limited
Spruce Grove, Alberta (780) 962-0130
www.reliable-tube.com
(HSS Tubing, ERW Tubing, CDSSM Tubing)

Reliable Tube Inc.
Langley, B.C. (604) 857-9861
www.reliabletube.com
(Hollow structural steel tube)

R.P. Richmond Industrial Contractors
New Westminster, B.C. (604) 521-7922
(Wheelabrating & Priming)

Samuel, Son & Co. Ltd.
Chomedey, Québec (514) 384-5220
Winnipeg, Manitoba (204) 985-6600
www.samuel.com
(Structural Sections incl. Bar, angle, shapes and plate)

Selectone Paints Limited
Weston, Ontario (416) 742-8881
www.selectonepaints.ca
(Paint primers, fast dry enamels, coatings)

Sherwin-Williams Canada
Ville d'Anjou, Québec (514) 356-1684
www.sherwin.com
(Specialty industrial coatings)

Silver City Galvanizing Inc.
Delta, B.C. (604) 524-1182
(Custom 'Hot-Dip' Zinc Galvanizing; Pickling and Oiling)

S.N.F. Quebec Metal Recycling (FNF) Inc./
S.N.F. Québec Métal Recyclé (FNF) Inc.
Laval, Québec (514) 323-0333
www.snf.ca
(Ferrous and nonferrous metal recycling)

Tri-Krete Coatings Company
Bolton, Ontario (905) 857-6601
(Sandblasting; protective coatings; metallizing)

VARSTEEL Ltd.
Lethbridge, Alberta (403) 320-1953
Delta, B.C. (604) 946-2717
www.varsteel.ca
(Beam, angle, channel, HSS, plate, Sheet, Grating, expanded metal, pipe, flats, rounds, etc.)

VICWEST Corporation
Oakville, Ontario (905) 825-2252
Edmonton, Alberta (780) 454-4477
Surrey,B.C. (604) 590-2220
Moncton, N.B. (506) 857-0057
www.vicwest.com
(Steel Metal floor/roof deck, wall and roof cladding)

Vixman Construction Ltd.
Milton, Ontario (905) 875-2822
www.vixman.com
(Roof and Floor Deck)

Western Industrial Services Ltd. (WISL)
Winnipeg, Manitoba (204) 956-9475
www.wisl.ca
(Abrasive Blasting & Painting Services)

Western Studwelding Supply
Edmonton, Alberta (780) 434-3362
(Stud Welding Equipment and Supplies; Sales, Service, Rental)

Wilkinson Steel and Metals,
A division of Premetalco Inc.
Edmonton, Alberta (780) 434-8441
Vancouver, B.C. (604) 324-6611
www.wilkinsonsteel.com
(Misc. structural shapes, hot rolled bars and plates)
(Structurals - angles, flats, beams, channel, plate)

MILL MEMBERS

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Sault Ste. Marie, Ontario (705) 945-2351
From Ont., Atlantic & Qué. 1-800-387-7850
* Calgary, Alberta (403) 263-4102
* Burlington, Ontario (905) 331-3400
www.algoma.com 1-800 387-7850

Atlas Tube
Harrow, Ontario (519) 738-0000
* Niagara-on-the-Lake, Ontario (905) 468-4972
www.atlastube.com

Dofasco Inc.
Hamilton, Ontario (905) 544-3761
www.dofasco.ca

IPSCO Inc.
Regina, Saskatchewan (306) 924-7700
* Surrey, B.C. (604) 596-3361/1-800-644-3361
* Scarborough, Ontario (416) 321-4949/1-888-576-8530
* Calgary, Alberta (403) 543-8000
www.ipsco.com

STEEL SERVICE CENTRES

Acier Leroux Boucherville, Div. De Métaux Russel Inc.
Boucherville, Québec (450) 641-4360
www.acier-leroux.com 1-800-241-1887

Acier Pacifique Inc.
Laval, Québec (514) 384-4690
www.pacificsteel.ca 1-800-361-4167

A.J. Forsyth, A Division of Russel Metals Inc.
Delta, B.C (604) 525-0544
www.russelmetals.com

Dymin Steel Inc.
Brampton, Ontario (905) 840-0808
Abbotsford, B.C. (604) 852-9664
www.dymin-steel.com

Russel Metals Inc.
Lakeside, N.S. (902) 876-7861
Mississauga, Ontario (905) 819-7295
Edmonton, Alberta (780) 439-2051
Winnipeg, Manitoba (204) 772-0321
www.russelmetals.com

Salit Steel (Div. of Myer Salit Ltd.)
Niagara Falls, Ontario (905) 354-5691
www.salitsteel.com

York-Ennis, A Division of Russel Metals Inc.
Mississauga, Ontario (905) 819-7297/1-800-387-3714
* Port Robinson, Ontario (905) 384-9700/1-800-471-1887

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Arcelor International Canada
Burlington, Ontario (905) 634-1400/1-888-634-1471
* Port Moody, B.C. (604) 461-6714/1-888-464-6714
www.arcelor.com

Chaparral
Midlothian, Texas 1-800-779-1291
www.chapusa.com

Corus International Americas
Schaumburg, Illinois 1-847-619-0400

Nucor-Yamato Steel Company
Blytheville, AR (870) 762-5500
www.nucoryamato.com

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Les Consultants GEMEC inc., Montréal	514-331-5480
Magnate Engineering & Design Inc., Brampton	905-799-8220
Mardon Engineering Ltd., London	519-659-2264
McCavour Engineering Limited, Mississauga	905-629-9934
Morrison Hershfield Limited, North York	416-499-3110
Morrison Hershfield Limited, Vancouver	604-454-0402
MPa Groupe Conseil inc., Richelieu	450-447-4537
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N.L. Sobey & Associates Limited, Truro	902-895-2790
Pomeroy Engineering Limited, Burnaby	604-294-5800
Pow Technologies, Div. of PPA Engineering Technologies Inc., Ingersoll	519-425-5000
R.J. Burnside & Associates Ltd., Collingwood	705-446-0515
Read Jones Christoffersen Ltd., Vancouver	604-738-0048
RSW Inc., Québec	418-648-9512
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Stantec Consulting Ltd., Mississauga	905-858-4424
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Totten Sims Hubicki Associates, Whitby	905-668-9363
UMA Engineering Ltd., Mississauga	905-238-0007
Valron Engineers Inc., Moncton	506-856-9601
VanBoxmeer & Stranges Engineering Ltd., London	519-433-4661
Weiler Smith Bowers, Burnaby	604-294-3753
Westmar Consultants Inc., N. Vancouver	604-985-6488

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