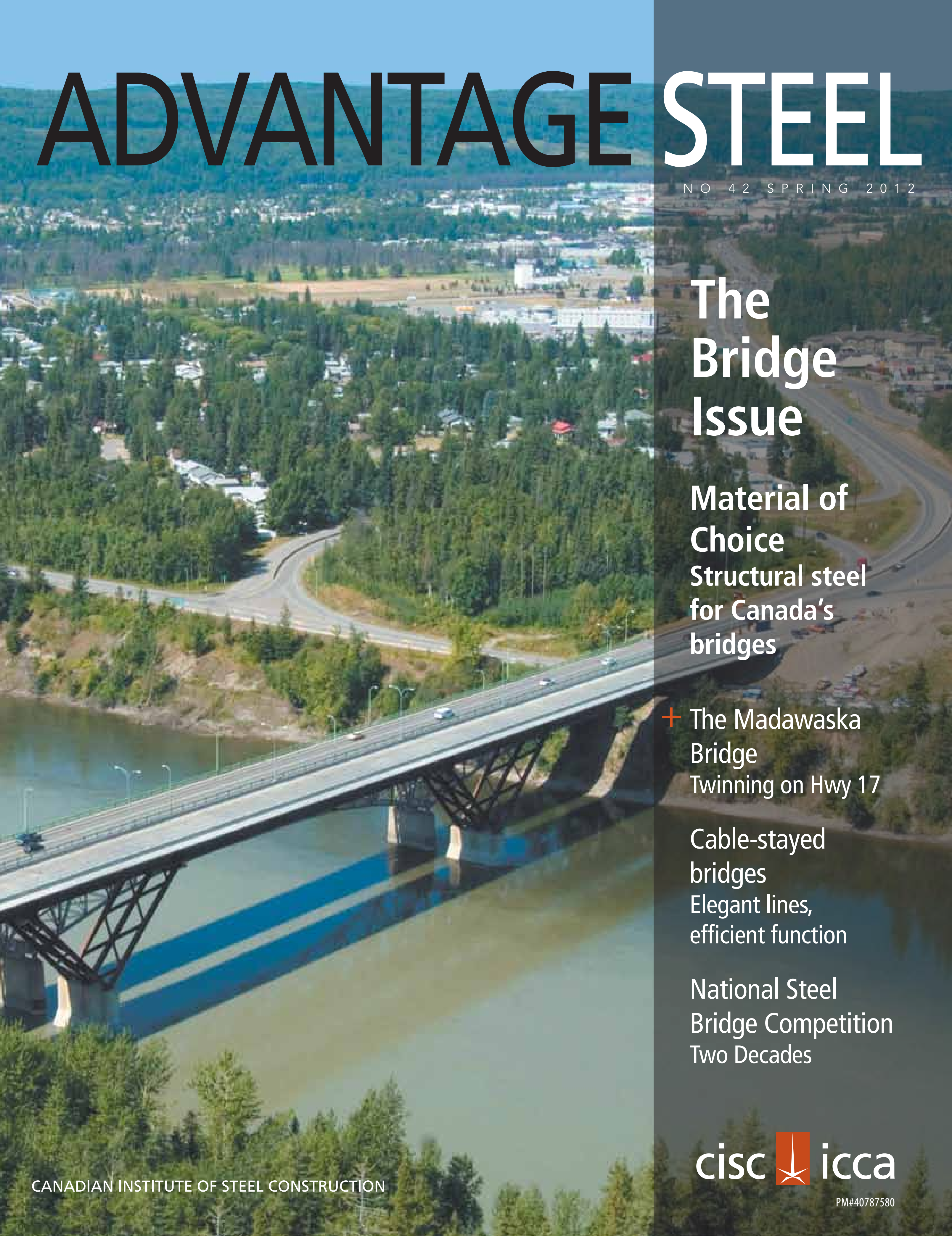

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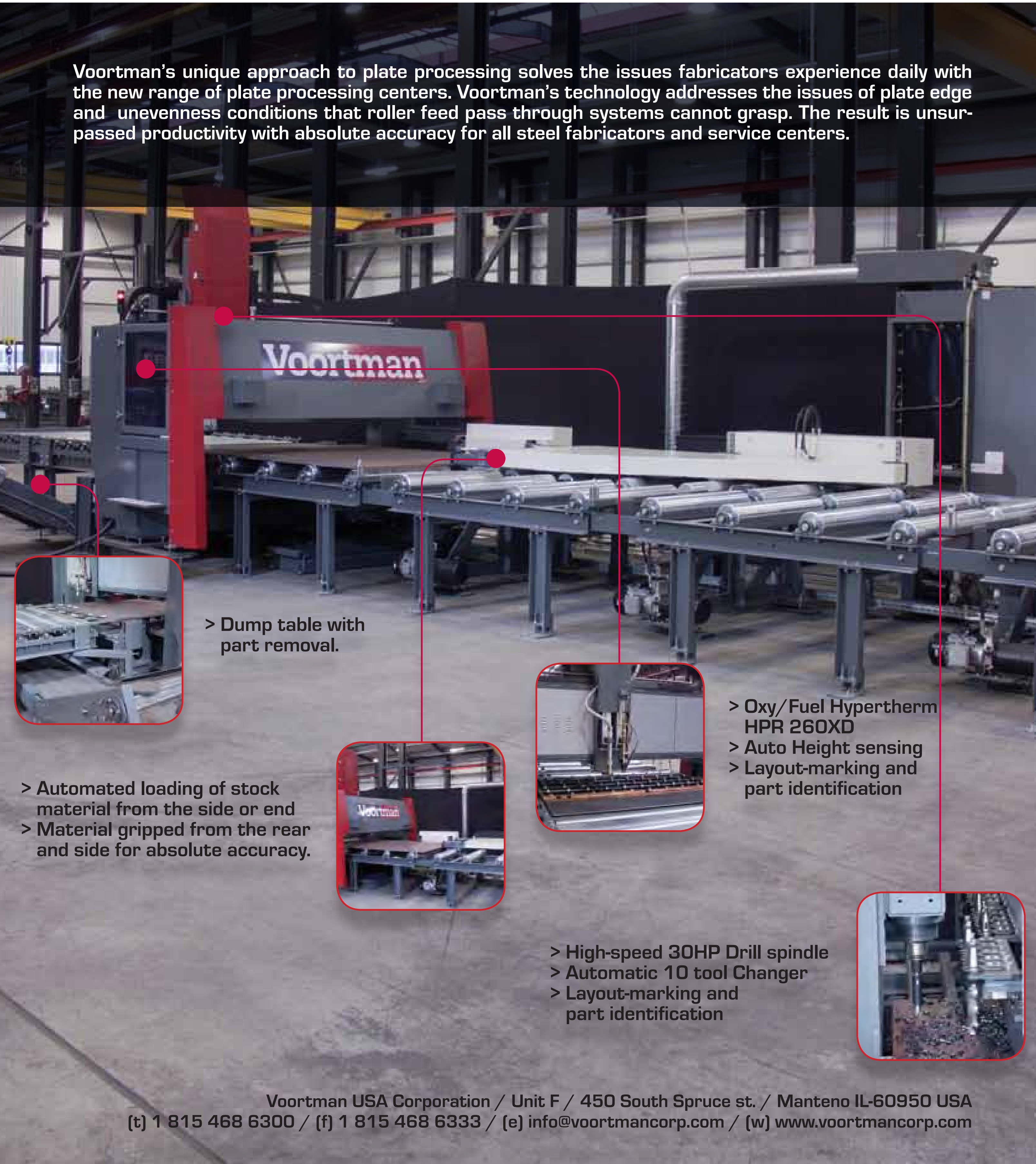

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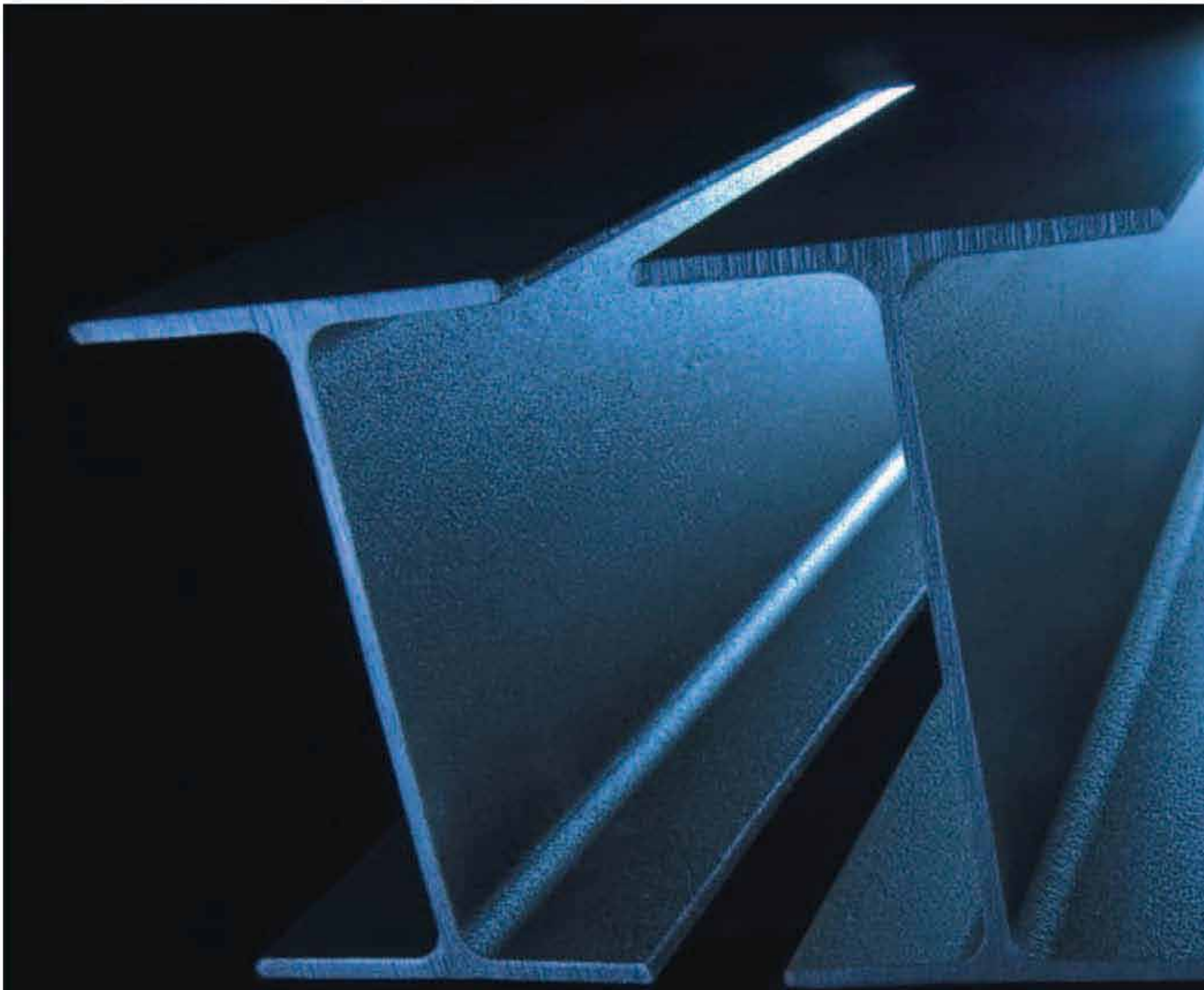

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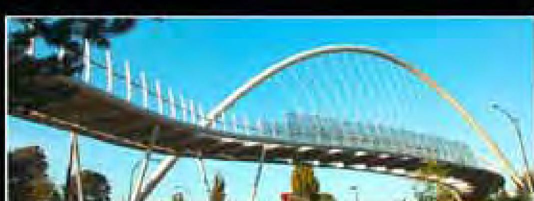

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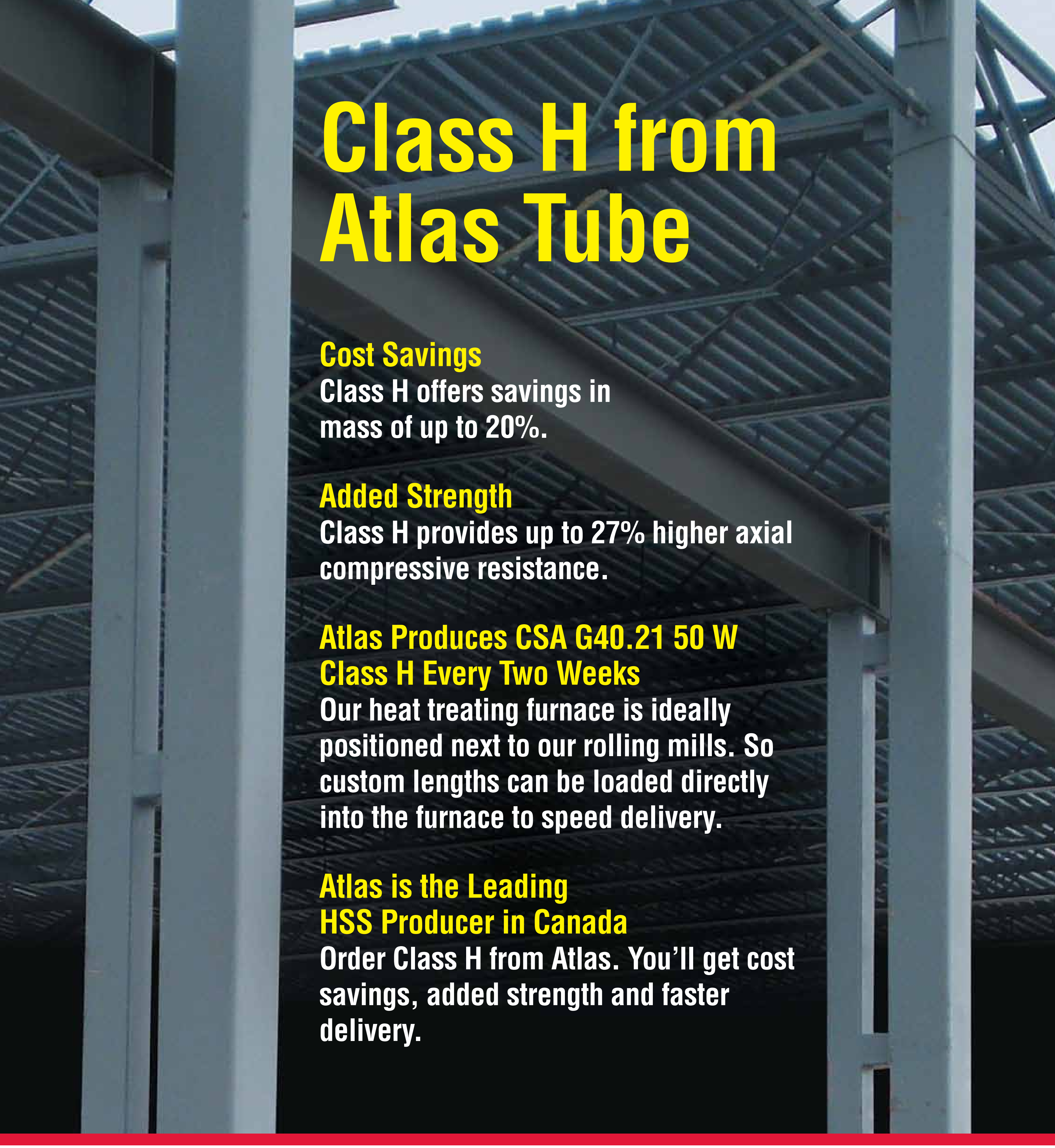
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ADVANTAGE STEEL

NO 42 SPRING 2012

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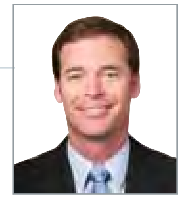

By Ed Whalen, P.Eng.

Occupy Canada!

So here we go again! Yet another U.S.-proposed "Buy American" bill designed to artificially protect and prop up a recession bound economy. What is CISC's response to this, you ask?

I say, get used to it! The U.S. culture is now engrained so heavily in the "Buy American" culture it would be political suicide for anyone in the country to stand up against this. Anyone remember the Dixie Chicks? After all, it is about putting Americans back to work and getting back to the good old days, right? What can be the harm in that?

Where does that leave Canada? Right where the Americans like us. Begging for an exception with the American negotiators who already believe they have full access to the Canadian market but are willing to listen to anything extra we would like to throw in.

Maybe we need to sweeten the pot with one Celine Dion, one Canadian Arctic and hell, we will even give them credit for inventing basketball if we have to. Yes, yes, yes, we will remove the Canadian personal income tax the NFL football players have to pay when they play here.

NAFTA, which is an agreement between countries, supposedly opens access to federal procurement, thus restricting protectionist policies. This agreement has actually been reported to have increased trade with the U.S. and is considered to be a model for future agreements with other trading partners.

The Americans' way to work around this is to hand money over to lower government authorities (like individual states), put restrictions on their use with "Buy American" clauses, and then claim they are meeting their trade obligations with agreements like NAFTA. If this were a hockey game, I can only guess what Don Cherry would have to say about it.

The Americans may not want to admit this, but they need Canada as a trading partner. We purchase much of what they produce and are responsible for the employment of millions of their citizens here and in their own country. We are a vital component for their recovery.

What they need is a little tough love. No longer should we sit politely at the bargaining table with little to offer and lots to lose. We need to use the same stick as is being used on us. Yes, this is the one use of wood products I would endorse. Remember, this is for professionals and should not be tried at home.

It is time that we realize where the real power lies in these negotiations. It is with the provinces and municipalities. The fear that Americans have is that we wake up, smell the Starbucks, McDonald's and yes, even the American-owned Tim's coffee and reciprocate.

Now hold on for those who want to stand up and say the path to a solution is through diplomacy and we shouldn't do anything negative because this would just upset them and result in disputes. What? Disputes? Oh yes, you're right.

ADVANTAGE STEEL NUMBER 42 SPRING 2012

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Professional engineers, architects, structural steel fabricators and others interested in steel construction are invited to inquire 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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COVER IMAGE: Simon Fraser Bridge
Photo courtesy of Buckland & Taylor Ltd.

The Americans came to Canada, told us they would slap yet another trade barrier on Canada, and we all said thanks for giving us the heads up. And oh, by the way guys, good luck with that!

No dispute here! In Canada we are all happy to have our trade access pulled out from under us. We are happy to tell our employees that they no longer have jobs. We are happy as Canadians to close our manufacturing industries. We are happy as Canadians to see our ownership of natural resources negotiated and pipelined away. We are happy to tell our kids that their future is one of low-paying jobs in the service sector. Will this country be a land of Walmarts?

The time has come for the provincial governments to forge new ground and fight for not only free trade but free and fair trade.

CISC is proposing a *Free and Fair Trade Act* where all government procurement at the provincial and municipal levels has the flexibility to re-calibrate bids from other countries based on the following:

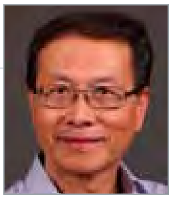
1) Dissimilar or non-existent environmental regulations;
2) Dissimilar or non-existent health and safety regulations;
3) Artificial currency valuation (artificial pegging below true floating value);
4) Dumping; and
5) Un-equal trade access for Canadian companies (reciprocity).

Having regulations like this provides governments with the flexibility and speed needed to automatically react to unfair and unequal trade.

I think that's fair. There is nothing non-free trade about it!

Ed Whalen, P.Eng.
President, CISC

Technical Column



By Alfred F. Wong, P.Eng.

CISC provides this column as a part of its commitment to the education of those interested in the use of steel in construction. Neither 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 professional engineer, architect or other licensed professional.

QUESTION 1: When CSA G40.21 300W steel strip is specified as the material for light braces in a building structure, can commercial grade steel products be used instead? What if they are supplied with a test report showing yield stress values matching or exceeding 300 MPa?

ANSWER: No. The reasons include:

a) Commercial grade steel sheet and strip are not produced to meet mandatory mechanical properties, such as minimum yield point, tensile strength and elongation; and

b) Strength levels reported on mill test certificates should not be used as the basis for design. See Clause 5.1.2 of CSA Standard S16-09.

QUESTION 2: The User's Guide – NBC Structural Commentaries provides external peak pressure-gust coefficient values, in Figures I-8 to I-14, for design of cladding and secondary structural members. Should these values or those tabulated in Figure I-7 be used for the design of a primary roof girder in a lowrise building?

ANSWER: The values tabulated in Figure I-7 apply to the design of lateral-load resisting systems for lowrise buildings when wind load acting simultaneously on all surfaces is considered. In the NBC Structural Commentaries, the wind effects in such loading conditions are termed "primary" structural actions whereas structural members subjected to local external pressure (or suction) are referred to as "secondary" members. Local peak gust pressure/suction values are significantly larger than the effective gust pressure acting on the whole building. Therefore, the coefficient values in Figure I-7 should not be used for the design of a roof girder unless it is a member of a rigid frame or a part of a braced frame and the effects due to "primary" wind actions govern the design.

QUESTION 3: There was once a traditional steel design provision that permitted moment resisting frames to be proportioned for lateral loads independent of gravity loads. Is this empirical method recognized by S16 Standard today?

ANSWER: No. Since the introduction of CSA Standard S16-01, all concurrent loads as specified in S16 and NBC load combinations must be considered to act simultaneously (except when a variable load counteracts the effect of the principal load then the variable load should be excluded in that load combination).

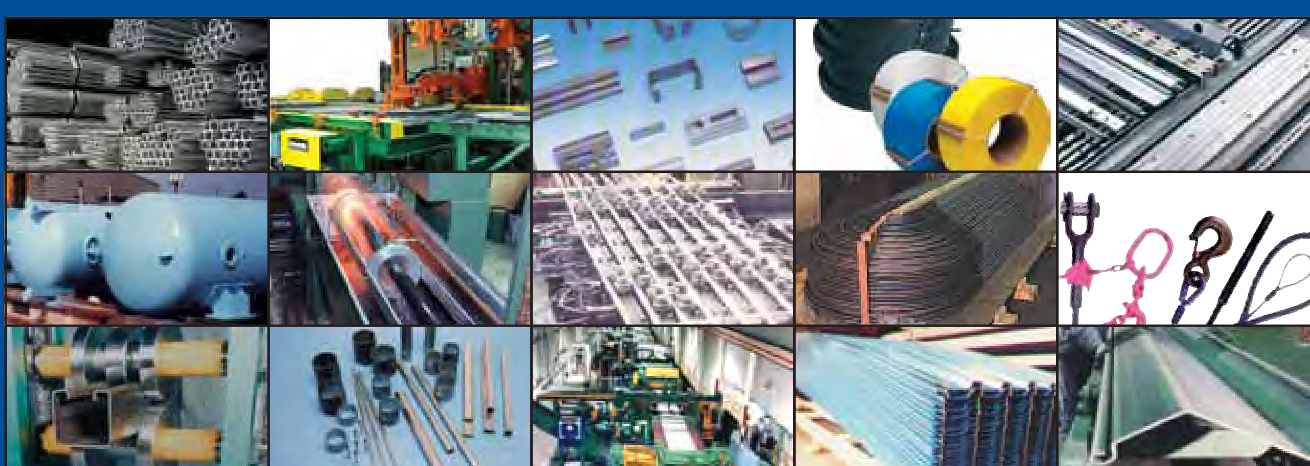
QUESTION 4: When I use the amplifier, U_2, to account for P-Δ effects in accordance with S16, should I apply U_2 to amplify the notional loads as well?

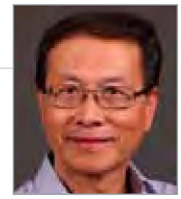
ANSWER: Yes, notional loads should also be amplified when U_2 is used to account for P-Δ effects.

QUESTION 5: When wide-flange purlins are also subjected to significant axial tension, which is transmitted by connecting the bottom flange to the supports with two transverse lines of high strength bolts, how do I account for shear lag? Specifically, should the effective net area, A_{ne}, be taken as $0.75A_n$, as provided in Clause 12.3.3.2 (c) (ii) of S16-09?

ANSWER: The approach as you described is unconservative. In this situation, the effect of shear lag is more severe than the case for angles connected by one leg with two transverse lines of fasteners. Hence $A_{ne} < 0.60A_n$. On the other hand, the lower bound for A_{ne} may be taken as A_{nf}, where A_{nf} is the net area of the connected flange alone. Therefore, A_{ne} should lie somewhere between A_{nf} and $0.60A_n$.

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





By Alfred F. Wong, P.Eng.

Bolts and welds in combination?

Common types of connection where the nature of load sharing is tough to determine

Research studies conducted at the University of Alberta since the 1990s have advanced the knowledge of load-sharing characteristics for lap joints in which high-strength bolts and welds are placed in a common shear plane. Based on these findings, Clause 13.14 has been introduced in CSA Standard S16-09 to address the design of connections using welds and pretensioned bolts in combination.

Now, is load sharing in mixed connections permitted for seismic applications?

Clause 27.1.6 of S16-09 addresses the use of bolts in the seismic-force-resisting system. With the exception of certain applications of conventional construction for which Clause 27.1 does not apply, Clause 27.1.6 precludes the use of bolts and welds to share load. In fact, the implication of Clause 27.1.6 goes beyond the preclusion of such application in a common lap joint. In this article, we briefly examine some common types of connection for which the nature of load sharing may not be obvious at a glance.

Braced frame connections

The most common connections in a concentrically braced frame are located at the intersection of three key members: a brace, a beam and a column. Figure 1 shows a common configuration in which double angles are welded to both the gusset plate and the beam and bolted to the column. The bolts in these connections resist vertical forces in a common shear plane. Typically, these forces include the vertical component of the brace forces and the beam end reaction due to gravity loads. A portion of these concurrent forces passes to the column through the upper connection while the rest of it passes through the lower one.

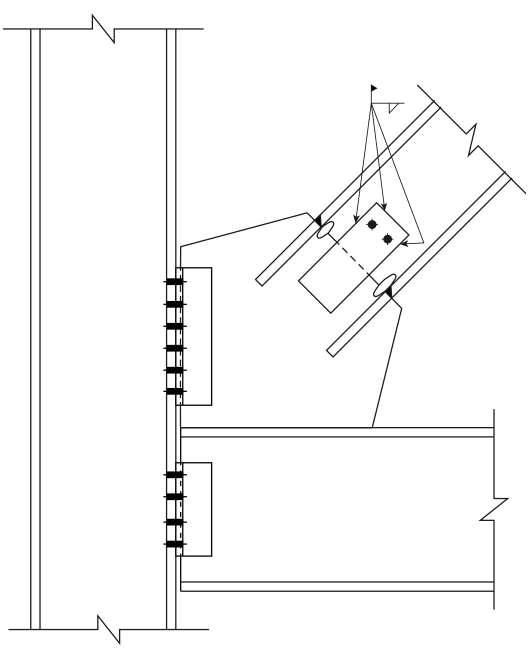


Figure 1. A sample for common braced frame connections

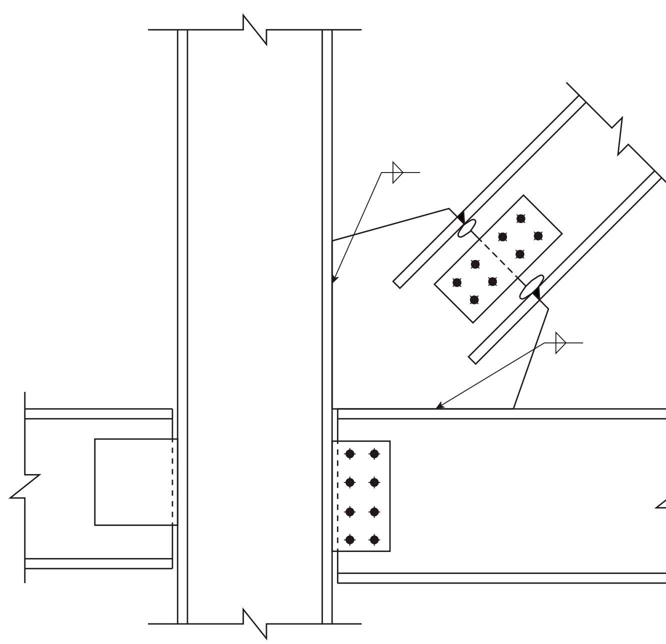


Figure 2. A variation of braced frame connections (not recommended)

Figure 2 shows a connection variation in which the beam is bolted to a fin plate at the column face but the gusset plate is welded directly to the column. In this arrangement, the design calls for load sharing between the bolted and welded joints. However, due to the stiffer path, the welded joint attracts a much larger share of the load until it has undergone sufficient deformation to mobilize a significant portion of the shear strength of the bolted joint below. Moreover, the bolts' participation prior to weld fracture depends on the bearing condition of the bolts before the upper connection is welded. Hence load reversal complicates the prediction of the degree of load sharing and the overall connection behaviour.

Similarly, the pass-through forces transmitted between the collector beam and the braced frame are also attracted to the stiffer welded connection, bypassing the bolted beam-to-column connection. This horizontal path creates a more undesirable condition because transversely loaded fillet welds are less ductile.

Figure 2 also shows a brace-to-gusset connection that features both welds and bolts. The flanges are welded to the flange extension plates in the gusset whereas the web is connected to the gusset using a bolted splice. This design also violates Clause 27.1.6 of S16-09. Either an all-welded connection, such as the one shown in Figure 1 (bolts shown are erection bolts), or a bolted splice should be considered for this application.

Moment connections

S16-09 requires that the adequacy of moment connections for use in ductile moment-resisting frames and moderately ductile moment-resisting frames be demonstrated by means of physical testing. Provided that the connection prototype satisfies the test requirements, the standard waives the requirements of Clause 27.1.6 and hence load sharing in mixed connections, if any, is permitted.

Moment connections in limited-ductility moment-resisting frames may be designed in accordance with the prescriptive requirements stipulated in Clauses 27.4.4.2 to 27.4.4.6. When this prescriptive design alternative is selected Clause 27.1.6 applies.

By Geoff Weisenberger, LEED GA

Let engineers be engineers

LEED may change over time, but the structural engineer should be a design expert, not just a material selector

This article originally appeared in Modern Steel Construction*, a publication of AISC. It has been revised and appears here with permission and our thanks.*

For many in the construction industry, the LEED (Leadership in Energy and Environmental Design) program is the face of the green buildings movement, and many tend to think of it as a static thing. But it's not.

As a matter of fact, the next U.S. version of the system, LEED 2012, has already been through two rounds of public comments. And it's worth noting that in the second draft, the Materials and Resources section — the one that most directly relates to steel — looks quite different than the first draft… which looks quite different than LEED 2009.

When the first draft came out, some engineers thought the changes diminished the role of the structural engineer in sustainable design. However, in the second draft some of those changes have reverted back… sort of. (I suggest you download a copy of the current draft and see the changes for yourself; get the "redlined" copy, which shows how much different the current draft is from the last draft). And who's to say what will make it into the final draft of LEED 2012?

Regardless of what transpires in the world of LEED, it's important to remember that structural engineers are able to have a far greater impact on the sustainability of a building without worrying about the specific details of a point-based system.

For example, the recently completed St. Vincent Mercy Medical Center in Toledo, Ohio, is a great illustration of the positive impact a structural engineer can have on a project. By substantially reducing material quantities, the designer not only reduced the cost of the project but also the embodied carbon. And since the design also minimized fabrication activity, the carbon reduction was even greater (more on this project later).

Also, keep in mind that we're talking about the U.S. version of LEED. But while LEED Canada and the U.S. version are not exactly the same, there are areas that are quite similar. In other words, changes made to the U.S. version are likely to influence future iterations of the Canadian version.

Points taken

Let's take a quick look at three significant changes, directly related to steel, between LEED 2009 and the first draft of LEED 2012.

1. All projects must have a mandatory recycled content of 10 per cent.
2. Structural materials were removed from the Recycled Content credit.
3. Structural materials were removed from the Regional Materials credit.

You can see why some structural engineers may have felt that they'd been removed from the LEED picture. However, here's what happened to these changes in the second draft of LEED 2012:

1. This prerequisite of 10 per cent recycled content has been removed.
2. There is now an "Environmentally Preferable Structure and Enclosure" credit that incorporates recycled content, albeit as just one option for compliance for new projects (the other option for new buildings is to perform a life-cycle assessment). However, this Structure and Enclosure Product Attributes option lumps attributes together and requires 50 per cent of all structural materials to meet recycled content, "local economy" (regional), or bio-based requirements.
3. The Regional Materials credit is now gone altogether, but again, there is a regional component in the new credit mentioned above.

There are also a handful of new Materials and Resources credits in the second draft, most of which have little to nothing to do with structural materials. A "Design for Flexibility" credit has been introduced — which is great! — but it currently only applies to healthcare projects. Also, the Environmentally Preferable Structure and Enclosure credit applies to both new and renovation projects (the building reuse credit has now been incorporated into this credit) and puts a major emphasis on renovating old buildings. And the second draft also includes a "Responsible Sourcing of Raw Materials" credit.

All in all, the Environmentally Preferable Structure and Enclosure credit is a bit confusing and raises several questions.

For example, there is an overall philosophic assumption being made in this section: that it is sustainably preferable to rehabilitate old structures as compared to constructing new structures. AISC does not believe that this assumption has been fully examined from an environmental, economic and societal perspective. It is certainly beneficial to evaluate the benefits of reusing or rehabilitating a structure. However, it seems presumptuous to provide actual credit for reuse or rehabilitation without any analytical basis to determine if it is a) economically more feasible than new construction and b) truly more environmentally beneficial (including impacts during long-term operation), and also without evaluating the impacts on local employment and societal needs as compared to the societal/employment benefits of new construction.

All in all, the Environmentally Preferable Structure and Enclosure credit is a bit confusing and raises several questions

In terms of the Structure and Enclosure Product Attributes option, the methodology for arriving at a 50 per cent composite total of all attributes is not appropriate. In two cases the basis is weight, and in the other case the basis is cost (local economy). The lack of consistency will result in misleading results. There is no definition of how the calculation will be performed. Do products add together? (Structural steel is 70 per cent recycled, so would you add 70 per cent to the total or is it 70 per cent of the percentage of the weight of the structural elements, the frame or the overall building?) If concrete is considered local and therefore measured by cost, is the weight of the concrete subtracted from the weight of the structural frame (or whatever) for the other calculations being performed by weight? In effect what this section creates is a meaningless metric of adding apples to bananas to oranges and expecting to get avocados.

Additionally, this draft reintroduces and redefines the attribute of regional materials now called "Support Local Economy" to apply to structural materials. The Regional Materials credit has always been a source of confusion in that it is based on that portion of a material that is both recovered and manufactured within 500 miles of a project site (the Canadian version of LEED does allow a radius of 1,500 miles for materials transported by rail or barge). Putting structural materials back into this credit means reintroducing concerns over the lack of distinction between cradle-to-grave materials and cradle-to-cradle materials, the lack of clarity regarding the identification of the manufacturing site and (in the U.S. version) the lack of consideration of different modes of transportation and equivalent utilization of lighter materials.

This has been particularly confusing when steel of all types was evaluated. Was the recovery site the location of scrap generation, scrap collection, scrap processing or where the material would ultimately be recycled at the end of life (steel is a closed-loop cradle-to-cradle material where 98 per cent of structural steel will be recycled in the future)? Was the site of final manufacture the mill producing material (30 per cent of the cost and five per cent of the labour) or the shop fabricating the material (70 per cent of the cost and 95 per cent of the labour)? Why wasn't credit provided if rail or water transportation was used rather than truck (a significant amount of steel is shipped by rail and barge, which is four times as energy-efficient as trucking)? And how do you compare the transportation impacts of a material if significantly less of the material is required compared to an alternative material? And now the 500-mile consideration is replaced by products manufactured and purchased within the project's "Core Based Statistical Area" as defined by the U.S. Office of Management and Budget.

AISC has submitted these concerns to the USGBC during the second public comment period and also submitted relevant comments during the first public comment period.

Again, though, this is not a final draft and there will likely be further changes and refinements to LEED 2012 before it is released. As such engineers should be prepared for a final version that ranges from LEED 2009, to draft one of LEED 2012 to draft two to… something else.

Beyond mere selection

The point is that regardless of what the final draft of LEED 2012 looks like, the structural engineer should move away from seeing sustainability as merely a material specification exercise to seeing it as a design optimization process, regardless of structural material used.

AISC's recent LCA study comparing a concrete building with a steel building indicates that the environmental and energy impacts based on a structural framing system's primary material typically fall into a relatively narrow range, varying by only about 10 per cent, which is considered to be a wash in such comparisons (see "And the Winner is…" in the August issue of *MSC*, available online at www.modernsteel.com/backissues). At times, steel framing systems may outperform concrete framing systems, and at other times concrete may outperform structural steel systems. But in nearly every case and impact category, the difference between the impacts of the two materials is relatively small.

The structural engineer should move away from seeing sustainability as merely a material specification exercise to seeing it as a design optimization process

On the contrary, the savings on the St. Vincent Mercy Medical Center were big: a 14 per cent reduction in cost, a 15 per cent reduction in material quantity and a 25 per cent reduction in the embodied carbon of the structural system. While not diminishing the value of recycled content or regional manufacturing, these savings — which were design-driven and based on the decision to go with integrated design process instead of a traditional design-bid-build construction methodology — are far more significant than the savings associated with the mere selection of a framing material based on those two parameters.

Both the first and the current draft of LEED 2012 address this with the inclusion of Integrated Process credits, which encourage collaboration among all of the disciplines involved in the project.

Above and beyond

In other words, as the green buildings movement has in some ways evolved from LEED, LEED is maintaining its continued importance in the movement by evolving itself. One major, long-term complaint of LEED is that it's "all about chasing points." And while structural engineers should certainly do their best to assist in achieving Materials and Resources credits — currently and under forthcoming versions of LEED — for their clients, they can also increase the green prowess of their projects by focusing their skills, attention and design decisions within a truly sustainable, collaborative design process and see their contribution recognized and rewarded.

Keep in mind that the current version of LEED (2009) is still being used, and again, it's difficult to say what the final version of LEED 2012 will look like. But all changes are being seriously considered, a sign that the U.S. Green Building Council (the creator of LEED) is clearly devoted to continually improving its system while at the same time improving the environmental aspects of the buildings that use it.

To see the current draft of LEED 2012 and its schedule, go to www.usgbc.org, click the LEED drop-down menu, select Rating Systems, and on the resulting page click Rating System Development.

Geoff Weisenberger, LEED GA, is AISC's Director of Industry Sustainability. You can reach him at weisenberger@aisc.org. Learn more about steel and sustainability at www.aisc.org/sustainability.

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Construction on a bridge crossing the Rivière des Prairies on Autoroute 25 in Montreal

Structural steel for Canada's bridges

Why structural steel was selected as the building material of choice for four major bridge projects

By Peter Taylor & Andrew Brooks

Canada's urban infrastructure growth is creating significant demand to increase the capacity of our major waterway crossings, either by widening or replacing existing bridges, or by building on new alignments. Here, we look at four major bridge projects over water in Quebec and British Columbia.

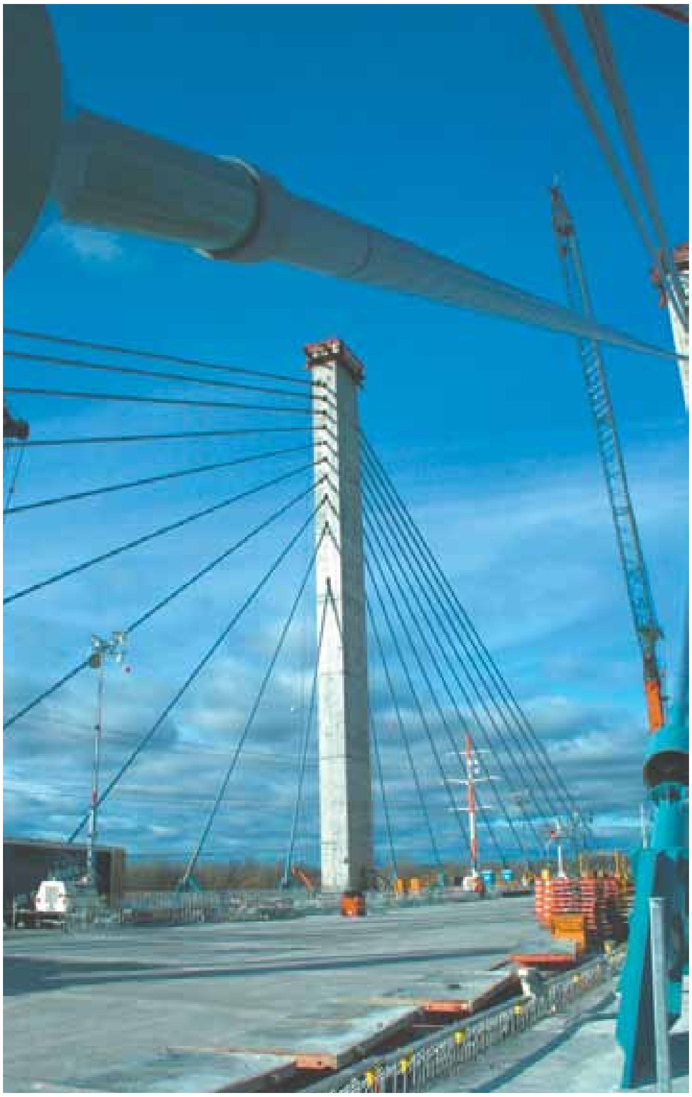
Canada has an extensive bridge infrastructure, but our population is relatively small. We are therefore accustomed to designing and building bridges which are not overstated, but which are constructible in our climate and cost effective. The growing use of design-build delivery methods meets these criteria and adds the discipline of tight schedules.

Structural steel was selected for all of the four bridges described below because it enabled design solutions that best met the above criteria.

Autoroute 25 completion project in Montreal

This $485-million PPP project comprises 7.2 kilometres of highway, ten grade separation structures and a 1.3-kilometre bridge crossing the Rivière des Prairies.

The river at the crossing location has environmental constraints in the shallow water at the south side and protected sturgeon habitat in the main channel. Innovative design and construction were necessary to deal with these constraints plus difficult river conditions and an aggressive project schedule.



The bridge comprises an innovative steel framing system

The selection of structural steel framing for the 632-metre south approach permitted girder fabrication to proceed during the winter shutdown of the site. The concrete deck was supported by five steel plate girders 3.7 metres deep, which were continuous over seven spans. The length, height and weight of the girder segments were optimized for over-land shipping and erection efficiencies, and the shear studs were shop installed to minimize fieldwork.

Girder erection was with a gantry travelling along falsework trestles on each side of the approach spans. Each girder is supported on lead core rubber bearings, which through their deformation accommodate the thermal movements of the continuous girders and distribute the horizontal loads uniformly to each pier.

280-metre mainspan

The bridge over the main channel is cable-stayed, similar to the Pont Papineau bridge a few kilometres upstream, with a span of 280 metres and two sidespans of 116 metres. The bridge towers consist of twin concrete columns 70 metres high with a single cross strut beneath the deck. For simplicity, the cables and edge girder are aligned on the tower centreline. The tower columns obstruct the in-line continuity of the edge girders, which is necessary for transferring the girder thrust.

The solution was an innovative steel framing system designed to provide continuity with an offset edge girder just inboard of each tower column. This unique framing system includes a 1.9-metre wide, nine-metre long steel transition box girder used on the main and sidespan sides of each tower column. In the transition zone, the outside web of the box girder also serves as the web of the "I" shaped edge girders and the inside web of the box serves as the web of the offset "I" girder passing between the tower legs. Trial assembly was used for these complex girder elements in order to assure field fit up.

As with typical composite cable-stayed construction, the concrete deck is fully composite with all steel framed elements and is supported by the total of 80 stay cables.

Statistics: Bridge on Autoroute 25	
Project completed	In 42 months
Steel tonnage	> 7,000 tonnes
Project cost	CAD$485 million
Owner	Ministry of Transport Quebec (MTQ)
Bridge Design	Parsons Transportation Group
Concessionaire	Kiewit-Miller-Parsons-McQuarrie
Fabricator	Structal
Detailer	Kiewit
Erector	Kiewit

The concrete deck is fully composite with all steel framed elements

Port Mann Bridge in Vancouver

Unlike the A25 project in Montreal, which is an entirely new section of infrastructure, the $1.9-billion Port Mann Bridge/Highway 1 Project will construct a new 10-lane bridge across the Fraser River and upgrade the capacity of 37 kilometres of the Trans Canada Highway. Undertaken to relieve traffic congestion, the project will be financed publicly but will be paid for by tolls and is being built under a design-build contract.

The bridge over the Fraser River is a three span composite cable-stayed structure with spans of 190-470-190 metres and twin decks approximately 23 metres wide, each side of 158-metre-high slip formed concrete pylons where the four planes of cable stays are anchored. Steel tie boxes cast into the upper pylons incorporate

The $1.9-billion Port Mann Bridge project in Vancouver

the upper stay anchors. The lower stay anchorages are attached to brackets cantilevered out from the girder webs.

The twin decks are separated by pin-ended struts and will be supported by 288 cable stays having 23 to 73 strands per cable. The superstructure is being erected by deck-mounted derricks.

The twin deck concept with a single central pylon and four planes of cables was first used at Ting Kau Bridge in Hong Kong. Like Ting Kau Bridge, the new Port Mann Bridge has outriggers below the deck at each pylon to support bracing cables for the upper pylon.

Statistics: Port Mann Bridge	
Steel Tonnage	11,800 tonnes
Owner	British Columbia Ministry of Transportation and Infrastructure
Bridge Design	T.Y. Lin International International Bridge Technologies
Design-Build Contractor	Kiewit - Flatiron Joint Venture
Fabricator	Canron
Detailer	Canron
Erector	Kiewit – Flatiron

Simon Fraser Bridge – Prince George, BC

The existing two-lane truss bridge at Prince George also crosses the Fraser River, but more than 500 kilometres upstream of Port Mann Bridge. It also was experiencing traffic congestion and the Ministry of Transportation and Infrastructure of British Columbia decided to commission a design for the addition of two more lanes of traffic.

The existing truss spans 127 metres between piers and it was clearly desirable to match pier locations for the new twin two-lane structure. Plate girders offered the most economical solution, but very deep girder sections would be necessary to match the existing span. The height of the bridge deck above the Fraser River permitted the insertion of steel delta frames below deck level, which in effect reduced the span of the girders. This innovative solution had two benefits. Firstly, it permitted the twin structure to share the same pier spacing as the existing bridge, and secondly it permitted the use of economical plate girders only 2.7 metres deep. Heavy shop welding was necessary to achieve load transfer into the delta legs and they were trial assembled to assure field fit up.

The new twin bridge has a total length of 400 metres and supports a concrete deck with two traffic lanes and a wide sidewalk on three composite plate girders, giving it structural redundancy. Each

The new Simon Fraser Bridge has a total length of 400 metres

plate girder is supported by a steel delta frame that sits on one of the new concrete piers, which are in turn supported by steel pipe piles drilled into the riverbed.

The total weight of structural steel amounts to 344 kilograms per square metre of deck area.

The Simon Fraser Bridge supports a concrete deck with two traffic lanes

Statistics: Simon Fraser Bridge	
Steel Tonnage	1,864 tonnes
Owner	British Columbia Ministry of Transportation and Infrastructure
Bridge Design	Buckland & Taylor Ltd.
General Contractor	Surespan
Fabricator	Structal
Detailer	Surespan
Erector	Surespan

Autoroute A30 Project – Montreal

The $1.5-billion A30 Project is a new 42-kilometre section of urban infrastructure that completes the urban highway connection along the south shore of the St. Lawrence River to the westbound Highway 20 leading to the Ontario border. The terms of the PPP were signed in 2008 and construction is now well advanced towards completion in 2012.

The most difficult component of this project is the 2,550-metre highway bridge at Beauharnois. At this location the power canal carrying water to the Hydro Quebec Generating Station immediately downstream and the Beauharnois Lock of the St. Lawrence Seaway are side by side and the bridge crosses both waterways.

The project design criteria penalize flow obstruction by bridge piers or construction activities in the power canal. Also, a high 38-metre clearance box is required over the Seaway, and span erection there is only permitted during the short mid-winter closure to shipping.

Both of these design challenges have been met with the use of structural steel.

Long spans of 81.9 metres with few piers have been achieved in the power canal by the use of composite trapezoidal box girders. Each girder supports three lanes of traffic and is 3.7 metres deep and 7.2 metres wide at the top flange. The steel boxes weighed up to 300 tonnes each and were shipped to the site by barge. Erection of the box girders is by push launching from the east abutment, which means no erection equipment is required in the channel.

The mainspan crossing of the Seaway at 150 metres is longer than the typical east approach span and the navigation clearance box extends close to the piers, which are sited beside the lock. This geometry does not permit delta frames, as were used at Simon Fraser Bridge, nor does it permit normal girder haunch profiles without significant elevation of the highway grade, with resulting increase in approach bridge length.

The design has resolved the geometric challenge by adding triangular reinforcing elements at each main pier. These are field connected beneath each typical box after the box girder has been launched over them, using a temporary cable stay for the 150-metre launch.

Statistics: Bridge on Autoroute A30	
Steel Tonnage	15,500 tonnes
Owner	Ministry of Transportation of Quebec
Bridge Design	Arup Canada
Concessionaire	Acciona-Iridium
Contractor	Dragados
Fabricator	Structal
Detailer	NA30 CJV
Erector	NA30 CJV

Work on the $1.5-billion A30 bridge project


Our flagman

Bridge twinning on Highway 17

A summary of the challenging construction on a 310-metre twin bridge on Highway 17 over the Madawaska River

By Nicolas C. Theodor, P.Eng.

Over the last few years, the Ontario Ministry of Transportation (MTO) has been expanding Highway 417/17 east of Ottawa to accommodate current and future traffic volumes. Highway 417/17 forms part of the Trans-Canada Highway and is a strategic link in the provincial highway system.

Early in 2009, MTO awarded Contract No. 2009-4009 to Thomas Cavanagh Construction Limited. This project consists of the construction of 10 kilometres of new westbound lanes, which will become the 417, the reconstruction of Hwy 17 (future 417 EBL), the new construction of six structures and the rehabilitation of two existing structures.

An aerial view of the existing Highway 417/17 Madawaska River Bridge, with twinning location shown

One of the major challenges of the contract included the design and construction of the twin of the Madawaska River Structure just downstream of the Ontario Power Generation Hydro Dam. Twinning the bridge presented the design team with unique challenges due to the length of the bridge, the transportability of its fabricated sections, potential structural fatigue due to its size, its proximity to the Ontario Power Generating (OPG) station near Arnprior, and its location in Ontario's highest seismic zone.

The contractor came up with an innovative assembly scheme to field splice the entire 97-metre mid-section of the structure on a nearby barge

Design

The existing bridge structure is a three-span concrete deck on steel I-girders. The twin bridge was designed to match the original bridge both structurally and aesthetically. Similarly, its pier footings are located on the shore of the Madawaska River's wide watercourse.

Construction began on the twin structure in spring 2009 and was completed in the summer of 2011. The resulting structure is a three-span concrete deck on haunched steel I-girders with a main span of 130 metres and end spans of 90 metres for a total length of 310 metres. The length of the main span makes this one of the longest, if not the longest, bridge of this type in Canada.

Typically, for haunched I-girder bridges, a span-to-depth ratio of 20 is used to establish the depth of the girder at the piers, and a span-to-depth ratio of 40 to establish the depth at mid-span. Following this formula, the resulting girder depths would have measured 6.5 metres at the pier and 3.25 metres at mid-span, making transporting the haunched segments of girders to the bridge location after manufacturing impossible by any standard means. Consequently, the design team decided to reduce the depth to 5.5 metres at the piers and 2.9 metres at mid-span, giving the fabricator the option to transport these girders, by railroad, with the webs in a vertical position.

Reducing girder depths usually results in higher fatigue stress ranges due to live loads. To satisfy the structural requirements and to avoid the fatigue issues, the design team decided to bolt, rather than weld, all the gusset plates connecting the structure's diaphragms and wind bracing.

The new Madawaska River Bridge location also presented the MTO design team with unique challenges. The structure is located in an area with a seismic zone rating of 4 and an associated zonal acceleration ratio of 0.2g – the highest seismic rating in Ontario.

Typically, provisions are made to allow a structure to expand and contract as required by various effects such as creep, shrinkage and temperature changes. This is accomplished by restraining the movement at the pier closest to the point of the theoretical zero movement, while allowing longitudinal movement to occur freely over the remaining supports. At the ends of the bridge, the longitudinal movements are accommodated with expansion

Haunched pier segments over the piers

joints. For the Madawaska River Bridge, the large vertical reaction eliminated the option to use standard laminated elastomeric bearings at the piers. Pot bearings would have accommodated the loads and thermal movements, but would not absorb any longitudinal earthquake loads.

During the analysis of the Madawaska Bridge structure, the various factors specified in the Canadian Highway Bridge Design Code were combined with the zonal acceleration ratio to define the structure's response spectrum. A dynamic analysis of a three-dimensional computer model was then carried out and seismic responses were obtained. These responses showed that the horizontal forces transferred to the substructure were extremely large and could not be practically and economically accommodated. Based on the results of the analysis, the design team determined that seismic isolation would be used.

Seismic isolation accomplishes a number of objectives. It distributes the horizontal forces to multiple substructure elements, dissipates energy through increased damping and, most importantly, lengthens the natural period of the structure, moving it to a much less damaging part of the response spectrum.

Fabrication

In the spring of 2009, Central Welding & Iron Works (CWIW) was awarded the structural steel fabrication and erection part of the contract for Hwy 17 WBL Bridge over the Madawaska River. This contract represented the largest single bridge fabrication contract in CWIW's history. The total tonnage was 1,463 tonnes consisting of four lines of girders spanning 310 metres from abutment to abutment. The plate girders are prismatic over the mid and end spans and haunched over the piers to a maximum depth of web of 5.5 metres. There were 10 field splices per girder line (40 in total) and 11 girder segments in each line (44 separate girders in total).

Picture showing the transportation rig with the special stiffening frame

Aerial view of the centre span segments being assembled on the barge

The largest single girders are the eight haunched pier girders each weighing approximately 52 tonnes each and 33 metres long.

The structure is located in an area with a seismic zone rating of 4 and an associated zonal acceleration ratio of 0.2g – the highest seismic rating in Ontario

The fabrication of the structural steel was accomplished in approximately five months. The size and weight of these girders produced many challenges for the fabricator and tested the limits of their material handling equipment. These challenges were quickly overcome and the fabrication was executed in an efficient and safe manner with continuous regard for quality.

Transportation

Typically, MTO requires the girders to be transported with the webs in the vertical positions. The transportation of the large girders presented its own challenges and the fabricator chose to transport the haunched girder segments (by truck) with the webs in the horizontal position. Note in the picture on page 31 showing the transportation rig, the special stiffening frame that was designed and fabricated by Central Welding & Iron Works to ensure that the constant amplitude fatigue threshold stresses, as specified in the Code, were not exceeded during the transportation of the segments. A dynamic load allowance of 100 per cent was used in the calculations.

Construction

The construction of the Madawaska substructure was quite challenging. The design called for the pier footings to be placed on mass concrete extending 300 mm beyond the perimeter of the footings and with side slopes of 45 degrees to intercept the bedrock. Dowels between the mass concrete and the bedrock surface were also specified. Deep water pools, sloping rock surfaces and fissures in the rock made placing the mass concrete in the dry and to the requirements of the contract very difficult.

Consequently, the mass concrete area and the mass concrete had to be redesigned on the fly as reinforced concrete with vertical walls on the river sides. The mass concrete also had to be placed using tremie concrete techniques. Working downstream of a power generating dam meant fluctuating water levels, therefore working hours and schedules needed to be coordinated with the dam operators. Working with rock drills, wet suits and wet socks was the norm for the duration of the mass concrete placement.

limited "no-flow" conditions during construction, the contractor came up with an innovative assembly scheme to field splice the entire 97-metre mid-section of the structure on a nearby barge. For installation of the mid-section, the barge was manoeuvred into place so that the entire mid-section could be jacked-up in one continuous operation. This method has not been used anywhere else on a bridge section of this size.

The erection of the girders was based on a very specific process. Side spans (in between abutments and piers) were erected from the ground with usual equipment (cranes). The centre span girders

The length of the main span makes this one of the longest, if not the longest, bridge of this type in Canada

The West pier had to be constructed on a smooth slanted rock face; the foundation consultant recommended that steps be cut into the rock surface to prevent any chance of slippage failure. In total over 1400 cubic metres of concrete were placed in the entire substructure of the Madawaska river structure. The contractor is proud to say that the substructure on which these girders sit will be supporting them for a long time.

Adhering to Department of Fisheries, Ontario Power Generation and Ministry of Natural Resources time restrictions and dates for in-water work brought further challenges during assembly of the Madawaska River Bridge girder segments.

To reduce the number of requests made to Ontario Power Generation to grant

Assembly of the central span segments on the barge completed

were assembled in their entirety on a barge that was moored to the river shore, just downstream of the existing and new structure on the Madawaska River. Once the centre span girders were assembled, the barge was moved into place with the help of tug boats under an OPG no flow condition. The OPG no flow condition was only valid for a 23-hour period therefore time was of the essence.

The centre span girders were then connected to sixteen hydraulic lifters sitting on the extremities of the pier girders that were previously erected. The lifting of the centre span block (450 T) then started moving the centre girders from the barge level to the final deck level approximately 30 metres above the water level.

Mid-section fully connected

It is important to note that the erector recognized that lifting the entire central span from the ends of the cantilevers would result in rotations of the central span ends that would hinder the splicing of the girders. Consequently, a complicated scheme to lift up the girders at the abutments and rotate the ends of the cantilevers to facilitate the field splicing had to be carried out. Everything was ironed out and the erector (Montage d'Acier International) completed successfully this very complicated erection scheme.

Finally, the bridge structure has been completed and the bridge is now carrying two-way traffic while the original Madawaska River Bridge is being rehabilitated.

The Madawaska Bridge

DESIGN TEAM: Bridge Office, MTO; Nicolas C. Theodor, P. Eng., Design Engineer; Magdy Meleka, P. Eng., Design Checking Engineer
CONTRACTOR: Thomas Cavanagh Construction Limited
FABRICATOR: Central Welding and Iron Works Group
ERECTOR: Montage d'Acier International

The Coast Meridian Overpass in Vancouver is an excellent example of a cable-stayed bridge

A span for all reasons

New cable-stayed bridges in Western Canada highlight the elegant lines and efficient function of classic bridge form

By Andrew Brooks

As a structural form, the cable-stayed bridge seems to have it all: economy, simplicity, relative ease of construction and a graceful soaring appearance that uniquely and beautifully marries form and function. Simply put, a cable-stayed bridge looks like a bridge.

In fact, when you talk to the pros, it is clear that the physical profile of the cable-stayed bridge has much to do with its recent resurgence in Canada, although at the end of the day cost savings, simplicity and ease of construction undoubtedly seal the deal.

Experience helps too. With more examples appearing on the landscape, what was once seen as a somewhat risky structural form is becoming more familiar. This is certainly the case in the Vancouver area, where geography has created plentiful opportunities for the bridge builder's talents.

Two recent examples of cable-stayed bridges in the Greater Vancouver area are the Pitt River Bridge and the Coast Meridian Overpass, also known as the Coquitlam Rail Yard Bridge. The Pitt River Bridge was officially opened in October 2009 after two years of construction, and replaced two swing bridges that spanned the Pitt River in Port Coquitlam. The swing bridges had a total of four

Coast Meridian Overpass

OWNER: City of Port Coquitlam
STRUCTURAL ENGINEER: International Bridge Technologies Inc.
PROJECT MANAGER/GENERAL CONTRACTOR: SNC Lavalin Constructors (Pacific) Inc.
DETAILER: Associated Engineering

lanes, which operated in a counterflow pattern to accommodate commuter rush hour traffic. The new 500-metre, three-span bridge has seven lanes, with provision for an eighth to accommodate rapid transit or high-occupancy vehicle traffic.

The cable-stayed form was selected on the basis of economy after the project manager, Peter Kiewit & Sons, had the design team look at a number of alternatives. Speed of construction and space limitations were also factors. "The project was in a highly congested site," says Paul King, Vice President, Engineering, for Rapid-Span Structures Ltd., who did the fabrication of the 2,600-ton steel structure in a joint venture with Structal Bridges. "The existing bridges on either side of the new bridge had to be kept open during construction. Also, the Pitt River had to be kept open for boat and barge traffic during construction."

The fact that construction was to take place in the narrow space between two operating swing bridges, while boats and barges navigated beneath, was also a factor in favour of a cable-stayed structure, since it meant that most of the construction could take place at deck level and with smaller equipment. The main girders and floorbeams are of structural steel, under a deck of stay-in-place precast concrete form panels topped with a cast-in-place concrete deck slab. The pylons are cast-in-place concrete.

Some notable challenges were the softness of the soils, the depth of the Pitt River – 16 to 18 metres – and the very real danger

Pitt River Bridge

OWNER: BC Ministry of Transportation
STRUCTURAL ENGINEER: MMM Group, International Bridge Technologies Inc., Associated Engineering (BC) Ltd.
PROJECT MANAGER/GENERAL CONTRACTOR: Peter Kiewit & Sons Co.
FABRICATOR: Joint venture between Rapid-Span Structures and Structal Bridges
DETAILER: Structal Bridges

Construction on the Pitt River Bridge

The Pitt River Bridge completed

that the six-foot-wide steel piles supporting the concrete pier would hit an obstacle in the course of being driven to a depth of 105 metres. The marine traffic, which consists in large part of heavily laden aggregate barges, also posed a threat to the pier, which accordingly had to be designed to withstand a heavy vessel impact. Maintaining commuter traffic volumes through the complex counterflow interchange and across the two swing bridges during construction was another challenge, compounded by the construction of the new approaches at both ends.

It was the longest push launch ever undertaken in North America, a fact that was singled out by the Consulting Engineers of British Columbia (CEBC) when they gave the Pitt River Bridge an Award of Merit

The road that crosses the Pitt River Bridge is B.C. Highway 7. A couple of kilometres west along the highway is another remarkable cable-stayed project – the Coast Meridian Overpass (CMO). The CMO is a 580-metre span erected to meet a need that was voiced as long ago as the early 1900s: to bridge the broad CPR rail yards that parallel Highway 7 from the banks of the Pitt River for about three kilometres inland. At their broadest, the rail yards contain over 50 sets of track, making them as formidable a barrier as a major river. Not just a physical barrier in terms of the distance that needs to be crossed, but also a huge obstacle to construction, since the vital rail yards simply can't be shut down.

Compressed schedule

To top off the challenges, the design-build project was on an extremely compressed two-year schedule, says Michael Bingham, who served as Project Manager for the fabricator. "It was an extremely fast-track project," Bingham says. "About 5,000 tons of steel had to be fabricated over about an eight-month period. The girders for the bridge were 110 feet long and weighed about 100 tons each, and the schedule required one to be completed every three days – on top of which the contract had a liquidated damages clause."

The schedule was so tight that the project team came together when the design process was only about 25 per cent complete, Bingham says. Fortunately this meant that the fabricator and erector were able to consult with the designer – International Bridge Technologies Inc. (IBT) – as design was proceeding, and recommend the addition or alteration of design details to make fabrication easier.

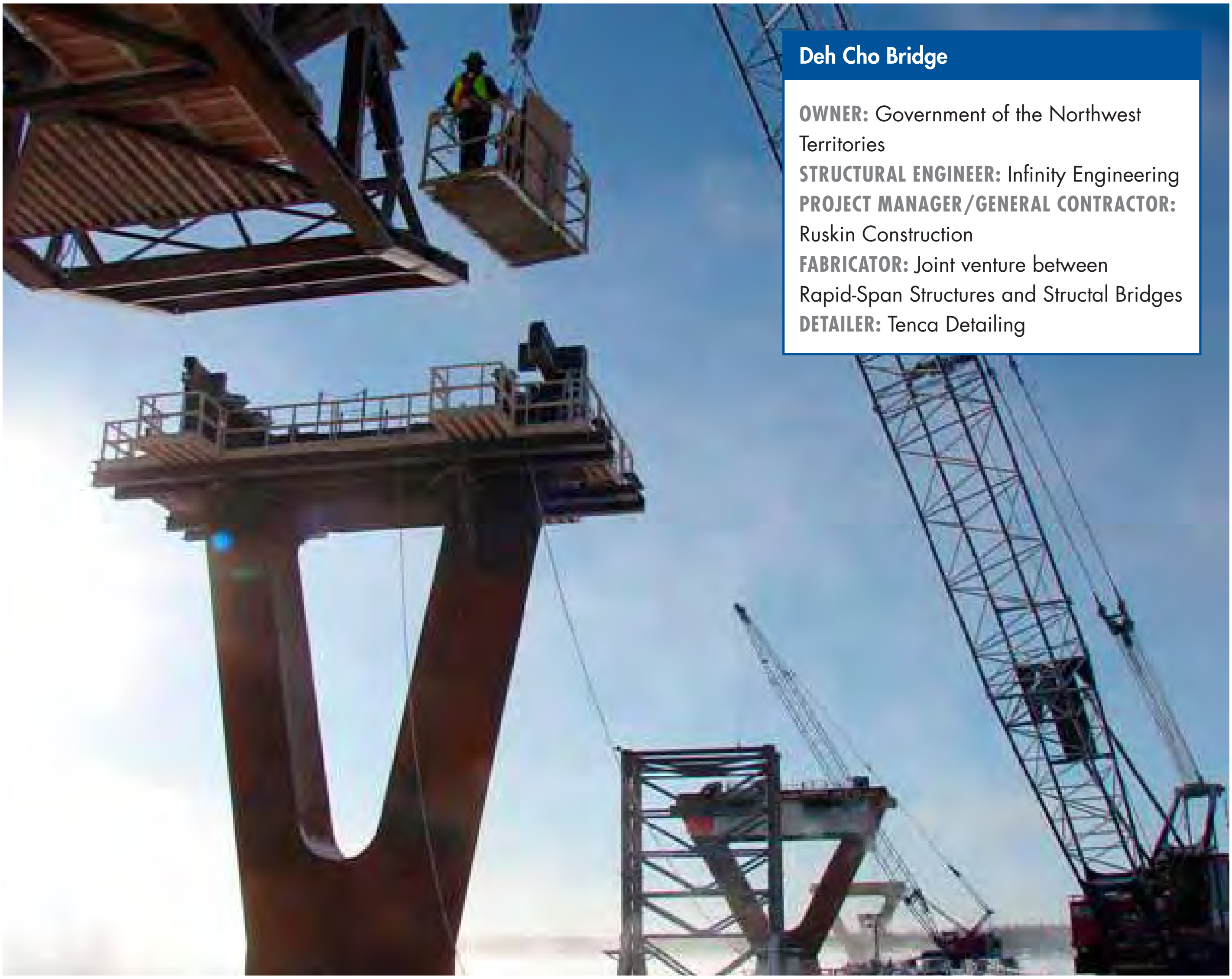
"It was the first time I'd ever experienced (a project) where a fabricator and an erector could go to the designer and tell them that from our standpoint it would be better to put in a bigger weld here, a smaller weld here, or eliminate these splices here, that kind of detail," Bingham says. "Not all of our suggestions flew, but still it was a real partnership."

Bingham says this unusual degree of interaction was indispensable because the bridge was to be erected by the push-launch process. Push-launch involves huge stresses on the structure, and the erector – KWH Structures – had to supply information to IBT about the effect these forces would have. Bingham says that sophisticated modeling software was used to help with these calculations.

Unusually, the pylons were attached to the structure before launch. This meant that structural steel was really the only choice for this part of the bridge, as concrete would simply have been too heavy. And while the use of steel for the pylons brought the total weight within the required envelope, the steel girders had to be of heavy construction to withstand the launch stresses.

The plant where the box girders were fabricated was only half a kilometre from the bridge site, so transport distance wasn't a challenge. But the scale of the steel members was: the box girders weighed some 100 tons apiece, and the plant had two shop cranes of only 20-ton capacity each.

"We had to come up with some ingenious methods to handle and slide the girders around the shop," Bingham says. "We developed something like a railway system, where we could move the girders longitudinally and use a secondary system to move them laterally, all using Hilman rollers and hydraulic jacks." The completed girders had to be trial assembled in the shop prior to making the trim cuts for the splices, and the railway proved its worth here too.



Deh Cho Bridge

OWNER: Government of the Northwest Territories
STRUCTURAL ENGINEER: Infinity Engineering
PROJECT MANAGER/GENERAL CONTRACTOR: Ruskin Construction
FABRICATOR: Joint venture between Rapid-Span Structures and Structal Bridges
DETAILER: Tenca Detailing

The geometry of the pylons for the Deh Cho Bridge is complex

The bridge's concrete piers were cast in place, the bridge was built on the southern abutment and, in June 2009, it was push launched. The five spans, each up to 1,500 tonnes and as long as 125 metres, were launched one by one with hydraulic jacks and rollers. It was the longest push launch ever undertaken in North America, a fact that was singled out by the Consulting Engineers of British Columbia (CEBC) when they gave the bridge an Award of Merit in the transportation category in March of this year.

"I believe this was the first bridge in North America to be launched with its pylons in place," Bingham says. "I think that was really the achievement that persuaded the CEBC to give the award." The other factor that the CEBC noted was the fact that the complex and efficient cable-stayed design allowed a two-metre reduction in the depth of the girders.

Geotechnical conditions were also a problem, with very soft soils forcing the use of lightweight expanded polystyrene (EPS) blocks as fill for the embankments at either end. But because structural steel allowed shallower girders to be used in the bridge structure, the embankments could be correspondingly lower, reducing the fill required.

After the launch, the deck of precast composite concrete panels and asphalt was laid down. The bridge has two general-purpose travel lanes in each direction, bicycle lanes both ways, and sidewalks on one side of the bridge and on both sides of the connecting roadways. The bridge was opened in March 2010.

Remote location

As this goes to press, another noteworthy cable-stayed bridge is taking shape far to the north of Vancouver, in a part of Canada where structures are subject to some of the harshest climatic conditions you'll find anywhere. This is the Deh Cho Bridge, spanning the Mackenzie River near Fort Providence in the Northwest Territories. Scheduled to open this fall, the one-kilometre bridge will replace a summer ferry and winter ice crossing.

"This project is located in one of the most remote places on earth with one of the harshest climates on earth," says Paul King of Rapid Span Structures. In a joint venture similar to their cooperation on the Pitt River Bridge, Rapid-Span Structures has fabricated the two steel A-pylons and Structal Bridges has fabricated the trusses. Rapid-Span is also manufacturing the bridge's precast concrete deck.

"From the standpoint of pylon fabrication, the geometry of the pylons was complex, and there wasn't one straight surface to work off of," King says. "All the welds were complete penetration – distortion due to weld shrinkage was a huge concern. We were very concerned with maintaining the geometry of the pylons." The tolerances for the fabricated weldments were more stringent than common code provisions, notes King.

King also emphasizes that the climatic conditions meant that structural steel was effectively the only possible choice. "Casting concrete in sub-zero temperatures would have been very difficult and costly, while steel comes pre-fabricated and can be quickly erected even in harsh conditions." Similarly, using precast concrete for the deck saves significant time and cost by eliminating forming and casting concrete in the field.

"Precast concrete decks can easily be made composite with structural steel," King says, "making the selection of a steel superstructure even more attractive."

The project is still under construction, after the assignment of a new general contractor and the takeover of project management responsibilities by the territorial government. One pylon is on site, though not yet erected, King says, and the other is 95 per cent complete. Truss fabrication is finished and about half of the trusswork has been erected.

Two decades of National Steel Bridge Competition

What began as friendly local intercollegiate rivalry has become a highly educational and impressive program

By Thomas L. Klemens

This article originally appeared in Modern Steel Construction*, a publication of AISC. It has been revised and appears here with permission and our thanks.*

This year marks the 20th anniversary of the National Student Steel Bridge Competition. Things have come a long way since the first national competition, in 1992, when Michigan State University hosted 13 teams. This year, from May 20 to 21, a field of 48 teams competed in the 2011 finals held at Texas A&M University's Reed Center.

Historical perspective

It all started in 1987 when Bob Shaw, then Director of University Programs at the American Institute of Steel Construction (AISC), arranged a student steel bridge competition for three Michigan universities: Lawrence Technological University, Southfield, MI; Michigan Technological University, Houghton, MI; and Wayne State University, Detroit, MI. The resulting bridges included a deck truss that took more than three hours to build, a chain of heavy wide-flange girders bolted at the webs, and a half-ton replica of a 19th century railroad through truss.

Over the next four years additional schools joined the Michigan competition, and other local competitions developed throughout the country. Each local competition claimed to have the best bridges in the country. To settle the issue, in 1992 Michigan State challenged all bridge teams to the first national competition in East Lansing, MI. Fromy Rosenberg, AISC Director of University Programs from 1990 to 2008, provided organizational, moral and monetary support for the competition. Thirteen teams competed and Michigan State won.

With the educational and financial support of AISC, schools throughout the country were encouraged to develop their own student steel bridge teams and the competition steadily grew. From 1992 through 1995, when 31 teams competed, the national competition was open to all teams.

In 1996, participation in the national competition became by invitation only. By then most bridge teams were organized by the American Society of Civil Engineers (ASCE) student chapters, and the top two teams from each of the then 20 ASCE student chapters were invited. As the number of student chapters grew they were organized into the 18 regional conferences that now host the qualifying round.

Throughout the 25 years of the steel bridge competition, AISC has provided financial support to every team that competes at the conference and national levels, financial support to the host schools and the required equipment, and staff and organizational support.

ASCE's involvement grew over the years, particularly at the local chapter level. In 2000 AISC and ASCE entered into a formal agreement and the competition was officially named the ASCE/AISC National Student Steel Bridge Competition.

Today, approximately 200 teams compete each year in the regional competitions. They come from nearly every state, as well as the District of Columbia, Puerto Rico, Canada, Mexico and China. And, in contrast to the early days of the competition, most of today's student bridges are light and quickly constructed. In 2011, the fastest construction time was 4.74 minutes and the lightest bridge weighed just 141 lb.

Playing by the rules

The competition is based on a substantial set of rules, which include specific design criteria that are modified each year. The members of the Rules Committee develop each year's challenge and attend the regional and national competitions. They are listed below.

- **Frank Hatfield**, the Committee Chair, was Faculty Adviser for the first Michigan State team in 1988. His students hosted the first national competition in 1992 and he has been helping to write the rules and organize the competition ever since.
- **John Parucki** serves as National Head Judge. His fabrication company began supporting local university bridge teams after NSBA's Bill McEleney told Parucki and others attending a 1991 New York State Steel Fabricators Association meeting about the competition. He has been the National Head Judge since 1995.
- **Don Sepulveda** was a member of three student steel bridge teams from 1993 to 1995 and credits participation in this student program with saving his life. He has been on the Rules Committee since 2001.
- **Jennifer Greer Steele** was on the Texas A&M student steel bridge team from 2001 to 2003. She was a Judge from 2004 to 2006 and has been a member of the Rules Committee since 2007.
- **Bart Quimby** was the Faculty Adviser for the University of Alaska, Anchorage student team that competed in the first national competition in 1992. A member of the Rules Committee since 2000, he developed the scoring spreadsheet, provides technical support for scoring throughout the competitions, and maintains the website www.nssbc.info.
- **Mike Engestrom** has been on the Rules Committee since 1995. His employer, Nucor Yamato Steel, has been a sponsor of the competition since 1999.
- **Jim Williams** is on the faculty at the University of Texas, Arlington, and in 1994 helped organize the first Texas student steel bridge competition. He joined the Rules Committee in 2003.
- **Renee Whittenberger** was a member of a student steel bridge team for four years during her college career. After graduation, she served as a Regional and National Judge for four years and has been on the Rules Committee since 2007.
- **Ping Wei** is the ASCE Director of Educational Activities and has been on the Rules Committee since 1998.
- **Nancy Gavlin**, who is AISC's Director of Education.

What it takes to compete

Although many teams begin planning as soon as the new rules are issued each August, this year's all-around winner from Lakehead University, Thunder Bay, ON, began in January with the start of the new semester. Although the school has been fielding steel bridge teams since 1998, this was the first time any of the five senior structural engineering students on this year's team had participated.

The team first considered three different truss types using Bentley's STAAD analysis and design software. "We had a competition amongst ourselves to see who could get the lowest score with some approximated values," said team member Chris Kukkee.

"That's one of the things that pushed the team to do more than what was really required," said Damien Ch'ng. "We all have a competitive nature, and we just kept pushing until we were down to $500 or so between bridge designs."

> **It all started in 1987** when Bob Shaw, then AISC Director of University Programs, arranged a student steel bridge competition for three Michigan universities

To put that level of nickel and diming into perspective, consider this: The competition rules include formulas that combine the scores in various categories to provide an overall cost for the structure. This year Lakehead's bridge came in first with a "cost" of $2,024,822, so a theoretical $500 difference between possible bridge designs was not significant enough upon which to base a decision.

"At the point of the students deciding which design to go with, there's also the element of the roll of the die," said Antony Gillies, one of the team's faculty advisers. On the day of the competition, the position where the load will be placed in the backspan is decided by rolling a die. A table in the rules lists the six possible locations, which teams can consider in developing their designs.

"We knew we could make any of the designs work," said Dave Enns. "There were different elements to consider, like a double stack with fewer members would give us the speed advantage but we'd lose the stiffness. An undertruss would give us stiffness and less speed. Ultimately we went with the deeper truss system to minimize the effect of the roll of the die… it would give the best weight-to-deflection ratio overall."

"We also knew that once we built the bridge, we couldn't change the deflection," Ch'ng said. "But the build time was different; with practice we could get faster." So the team went with the option that gave them more control over the variables.

"We didn't focus on being the fastest bridge only," said Kukkee, "or the stiffest bridge only, or the lightest bridge only. We wanted to be all of those." To do that, the team knew, would require good connections that could be assembled quickly. Kukkee came up with a double stud system that would twist and lock in place. "It was a three-prong keyhole concept," he said. "But with 11/4-in. tube there wasn't enough space to make it work."

Next, Enns drew up a twist lock with protruding L-shaped teeth, but that design also had clearance and fabrication issues.

"As soon as I saw Dave's design I realized it looked like the way you connect a lens to a camera body," Ch'ng said. "So I took what Dave had and modified it a little bit." After some additional analysis to work out the detailed design, he handed over his CAD drawings to team member Cory Goulet for machining.

"That's when the connection design once again got changed," Goulet said. The school had recently acquired a CNC metal working machine and was in the process of getting up to speed on its use. "Once we began to fabricate we realized we didn't have the proper tools to make many of the required cuts, so we decided to change tool diameters and cut sizes in the software. We had to figure it out on the fly because we had a very limited amount of time to make these parts." In the process, Goulet became quite adept at CNC programming with Mastercam.

"There were some who thought the parts couldn't be cut using this equipment," said Timo Tikka, who with Gillies has been a Lakehead Faculty Adviser for many years. "Cory managed to figure out a way to fool the computer software to do anything he wanted."

Continuous improvements

Once the team started fabrication, there was a continual effort to improve various aspects of the bridge. However, maintaining balance — between lightness and stiffness, for example — was also a continual challenge. One such episode occurred shortly before the regional competition when the bridge's lateral deflection increased. The rules limit lateral deflection to ½ in., which this year was tested by sequentially applying a 75-lb side pull at two points on the structure.

"We had built a bridge that was working very well," Ch'ng said. "We ran multiple practices and filed some pieces down to make them connect more smoothly. Then, after running more practices, we did another lateral load test and because of putting everything together and the filing we did, everything had loosened up quite substantially and we failed lateral. And this was the night before leaving for the regional competition."

The team discovered that it wasn't the superstructure itself deflecting, but that the legs were rocking and causing too much sway. "We spent the night and most of the next day trying to stiffen up the legs," Ch'ng said. "Chris came up with a unique sort of clamp system that would tighten everything up. So we fabricated it all up, put it together, and we managed to pass the lateral test. As soon as we had it working, we packed it up and drove down to the regional competition."

"I don't think I've ever made it to the welcoming ceremony at that regional conference," said adviser Gillies. "It's become a tradition for the team to have a last-minute crisis."

After qualifying at the regional conference, the team continued with structural modifications and with improving their construction time. "We had removed three pieces from the bridge in our lateral system to make it faster and lighter, and we were just on the border line at ½ inch," Kukkee said, referring to the limit of lateral deflection. "On our final test just before we left we were really pushing the limit, and not comfortably below half an inch, so we ended up putting a small 3⁄8-in.-diameter tubing on one of the lateral braces on the cantilever. That gave us an extra 0.1-inch margin and we felt comfortable with that. That piece was welded on just before it went in the box."

At the national competition, Lakehead was one of five teams in the first heat, and it was clear they had practised and were very much working as a team. "We decided to use two runners just so we wouldn't tire out too quickly," said Kristen Myles, "even though that extra 'builder' added to the construction cost." The cost figures heavily in the construction economy and overall categories, with the largest component being that each builder-minute adds $50,000 to the cost.

Faculty Adviser Tikka said the team's performance also hinged on coordinated interaction. "Our team's communications were second to none. There was only one other team that was communicating in a similar manner." To see the Lakehead team in action and hear the two runners calling out part identifications and other information in an otherwise quiet arena, go to http://bit.ly/jLQvFc.

"The troubleshooting experiences on this project were really valuable," Enns said. "It's a prime example of showing up on a job site and site conditions aren't exactly what you anticipated and making corrections on the fly. The fabrication was also an eye opener, like how much movement there was on a thin piece of steel when you welded it."

Additional benefit

One additional benefit accruing from the student steel bridge competition, Gillies observed, is the connection it is building to the local community. "The students do the whole package, including the fundraising," Gillies said. "Almost all the money is raised from outside of the university. This program really opens up a relationship with the local community, from structural engineers down to parts suppliers — the company that gives us bolts, for example. You realize the power of communication from the day you are actually speaking to people and these people get as enthused as the students."

Of course, hosting the competition is also a substantial undertaking. Beyond the details of the competition itself, arrangements for this year's event included providing two lunches and a banquet for nearly 800 people; setting up blocks of rooms in nine area hotels; contracting with two facilities — one for the bridge construction and another for the display and banquet; and communicating with all involved. Jenna Kromann, a junior civil engineering student at Texas A&M, was this year's Host Committee Director.

The biggest hurdle they faced, Kromann said, was taping off the floor for the competition. The taping group could only get access after a Friday evening event. "We had people there until three in the morning," Kromann said.

The spring semester was a busy one for Kromann. "I would get so many emails in my inbox — sometimes eight in an hour!" But the pace obviously suited her, because she ended the semester with a 4.0 grade average. "I guess when you're busiest is when you do your best," she said.

Thomas L. Klemens, P.E., is a Senior Editor at Modern Steel Construction

The Rules Committee conferring at the team captains' meeting May 20, 2011. Clockwise from lower left: Mike Engstrom, Ping Wei, Nancy Gavlin, John Parucki, Frank Hatfield, Jennifer Greer Steele, Bart Quimby, Jim Williams. Don Sepulveda and Renee Whittenberger are facing away from the camera.

Measuring the Lakehead University bridge's horizontal deflection

The judges check the completed Lakehead University steel bridge

2011 National Student Steel Bridge Competition winners

The "camera connection" developed by the Lakehead University steel bridge team was both very efficient in transferring load and quick to assemble

John Parucki (center, left) and Frank Hatfield fielding questions from team captions at the 2011 Nationals Student Steel Bridge Competition

The Lakehead University team's bridge components in the staging area

The 2011 Lakehead University student steel bridge team, in hardhats from left: Chris Kukkee, Kristen Myles, Damien Ch'ng, Dave Enns, Cory Goulet. Faculty advisers Timo Tikka (left) and Antony Gillies stand at either end. Machinist adviser Kailash Bhatia is not in the photo but was an important part of the team.

The top three national winners overall are:

Overall winners

1. Lakehead University
2. Michigan Technological University
3. SUNY College of Technology at Canton

The top three winners of the following six categories that the students competed in are:

Construction speed

1. Lakehead University
2. Michigan Technological University
3. SUNY College of Technology at Canton

Lightness

1. Lakehead University
2. University of Hawaii at Manoa
3. Georgia Institute of Technology

Display

1. Georgia Institute of Technology
2. University of Hawaii at Manoa
3. California State University, Long Beach

Stiffness

1. University of Hawaii at Manoa
2. Arkansas State University
3. SUNY College of Technology at Canton

Economy

1. University of Alaska Fairbanks
2. Lakehead University
3. Michigan Technological University

Efficiency

1. Lakehead University
2. University of Hawaii at Manoa
3. Michigan Technological University

2011 Steel Structures Education Foundation Program Update

A review of the 2011 SSEF reward and research grant recipients

By Maura Lecce

2011 G.J. Jackson Memorial Fellowship Award

The G. J. Jackson Fellowship is awarded annually by the Steel Structures Education Foundation in memory of the late Geoffrey Jackson. Jackson was, for many years, a leader in the Canadian structural steel fabrication industry and a founding member of the Steel Structures Education Foundation.

The Award is presented to Canadian engineering students conducting graduate studies in structural engineering, with major emphasis on steel structures. This prestigious award is currently valued at $20,000 over a one-year period. It is presented at the SSEF annual general meeting and commemorated with the Geoffrey J. Jackson Memorial Medal.

The 2011 Jackson Fellowship recipient is Morteza Dehghani, a Ph.D. student who is studying at École Polytechnique Montréal under the supervision of Robert Tremblay. Morteza was presented with the award at the annual SSEF and CISC convention this past June in Mont Tremblant, Quebec.

Morteza's research project is on the development and seismic qualifications of an innovative ductile steel bracing system. The all-steel "Buckling Steel Bracing," or BSB system has a slender steel core as its main dissipation element and a steel restrainer to prevent buckling. Comprehensive numerical simulations and full scale experimental tests will be conducted in this research.

Morteza Dehghani (centre) receiving the GJ Jackson Award

Information about the Jackson Fellowship can be found on the SSEF website at www.ssef-ffca.ca.

2011 SSEF University Research Grants

The SSEF has been actively promoting research of topics that are considered to be of interest and importance to the steel industry since 1995. University research grant applications are reviewed and ranked by the SSEF and, at the discretion of the SSEF, are awarded to full-time members of engineering faculties of Canadian universities for a one-year period. The total value of grants awarded in 2011 was $95,710. The principal researcher of the top-ranked SSEF university research grant applications is also awarded the H. A. Krentz Award.

The 2011 grant recipients and topics include: Dr. Carlos E. Ventura, "Tension-only brace system for earthquake resistance of low rise buildings: shake table testing"; Dr. Yi Liu, "Lateral torsional buckling of plate girders with flexible restraints"; Dr. Colin Rogers (in collaboration with Drs. Robert Tremblay, Jean Proulx and Charles-Phillipe Lamarche), "Dynamic testing of low-rise steel framed buildings with flexible roof deck diaphragms"; Dr. Robert G. Driver, "A holistic approach to evaluating and enhancing the progressive collapse resistance of steel structures"; Dr. Tony T.Y. Yang, "Development of innovative steel structural systems for seismic applications in Canada." Information about these research topics as well as those from previous grant years can be found on the SSEF website.

Suggestions for research topics can be made by completing the "SSEF Research Topic Suggestion Form" found on the SSEF website at www.ssef-ffca.ca/research.

2011 H.A. Krentz Award

The H.A. Krentz Award recognizes a researcher whose research topic has special merit and interest with promise that it will make a significant contribution to understanding the behaviour of steel structures, advances in the economy, safety or reliability of steel structures. A gift of $5,000 is part of this notable award. The 2011 H.A. Krentz Award is awarded to Dr. Carlos E. Ventura, Professor and Director of the Earthquake Engineering Research Facility, Department of Civil Engineering, University of British Columbia.

Dr. Ventura has over 30 years of experience as a structural engineer. His research focuses on structural dynamics and earthquake engineering. He has done a significant amount of experimental and analytical research on the seismic response of civil engineering structures. He has also conducted extensive analyses of the response of instrumented structures, including some of the tallest steel frame buildings in Los Angeles, and has developed various software packages for signal analysis and structural dynamics. He has been conducting shake table testing studies for more than 12 years. Some of these tests include tests of steel plate shear walls and slotted braced frames. Dr. Ventura has written over 300 technical papers and reports related to the seismic behaviour of structures.

The Steel Structures Education Foundation awarded Dr. Ventura a grant of $25,000 for his research on "Tension-Only Brace System for Earthquake Resistance of Low Rise Buildings: Shake Table Testing."

2011 National Student Steel Bridge Competition

CISC and SSEF are proud sponsors of the ASCE/AISC National Student Steel Bridge Competition (NSSBC). The competition requires civil engineering students to design, fabricate and construct a steel bridge and encourages them to apply their theoretical knowledge in a hands-on project that addresses the full breadth of steel design requirements, including aesthetics, speed of erection, lightness, stiffness, economy and efficiency.

The 2011 NSSBC was held May 20 to 21 at Texas A&M University, College Station, Texas. A total of 48 teams qualified for the national level competition, including two teams from Canadian institutions: Lakehead University and University of British Columbia.

This year, the Lakehead University student team placed an impressive first overall in the competition with top rankings in the categories of construction speed, lightness and efficiency. This is a great achievement for the student team at Lakehead University as this is the first time that a Canadian institution has placed first overall in the NSSBC.

Lakehead University Student Steel Bridge Team at the 2011 NSSBC

The 2012 NSSBC will be held at Clemson University, Clemson, South Carolina, May 25 to 26. For more information about the Student Steel Bridge Competition, please visit our SSEF website at www.ssef-ffca.ca/competitions/asce-aisc.

2011 Architectural Student Design Competition

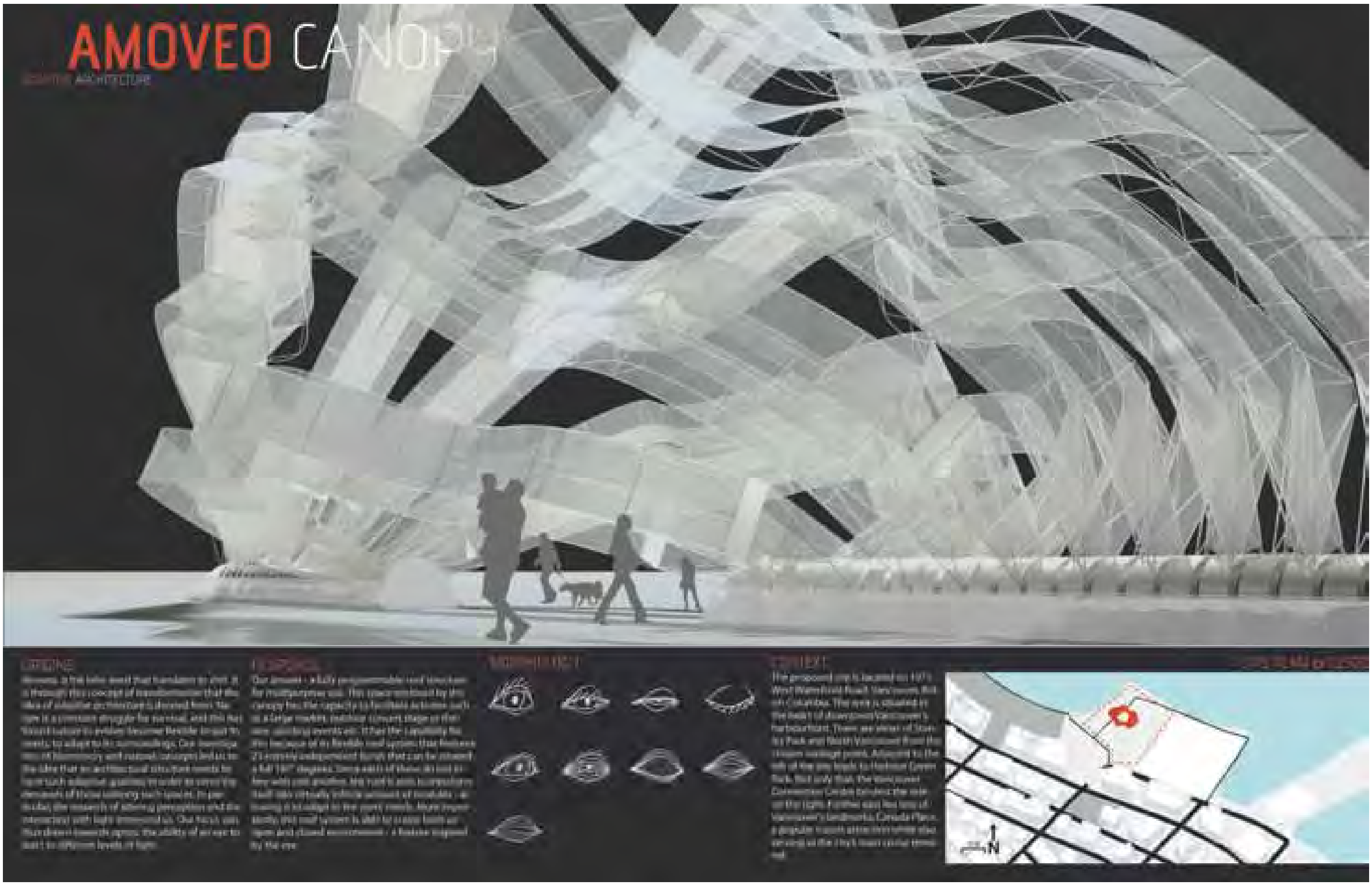
2011 marked the 10th Anniversary of the SSEF Architectural Student Design Competition. Since its inception, the competition has encouraged architectural students to consult with experts, engineers and fabricators to arrive at a true understanding of the structural design and detailing requirements of a steel structure – taking the study of steel beyond the technical and into the realm of supposed application and arriving at a meaningful realization of architectural ideas. Eligibility for this competition is limited to students registered in professional architectural programs in Canada.

The 2011 competition challenged students to include biomimicry in their designs. As described in the Biomimicry competition poster (see also www.ssef.ca/competitions/ssef/2011), "The Challenge" is as follows.

"Derived from the root terms bios (life) and mimesis (to imitate), Wikipedia defines biomimicry as 'the examination of nature, its models, systems, processes, and elements to emulate or take inspiration from in order to solve human problems.' Nature has been refining and perfecting structures since time immemorial. The demands of standing up to climatic and environmental forces have resulted in the development of structural systems that are highly advanced, structurally efficient and resourceful. The resulting solutions range from exquisite patterns of mathematical precision, proportion and balance, to deceptively chaotic fractal geometries. From the structural interdependencies of the rhizomic root system, long slender culms, and interwoven dense canopy of branches of the tensegrity-like bamboo grove, to the Golden Section qualities found in the curve of a nautilus shell, the logarithmic spiraling pattern of seeds at the heart of a sunflower and the proportional harmonies of the human body, the constructions of nature provide a myriad of structural possibilities to inform architectural design. Students are invited not only to explore biomimicry as it may be expressed in form, surfaces, members and connections, they are also invited to engage in the exploration of biomimicry through structural and architectural design. While they may range from utilitarian to exquisite in their execution, all responses must come to terms with one simple problem: the clear incorporation of biomimicry as the basis for structural form."

Students were to conceptualize, and realize in detail, a structure of simple program that explores biomimicry with emphasis on the architectural exploration through form and material and on the essential relationship between architecture and structure. Students were required to include buildable details, primarily using structural steel, and were to collaborate with fabricators on those details.

Submissions for this competition are examined by a panel of judges that includes an architectural educator, a practising architect, a



Award of Excellence: "Adaptive Architecture - Amoveo Canopy" panel by Justin Lai and Charles Ye

consulting structural engineer and a structural steel fabricator. The top three submissions receive awards.

Award Winners

The awards were presented at the SSEF - CISC Annual Convention this past June in Mont Tremblant, Quebec.

Award of Excellence

Justin Lai and Charles Ye, University of Waterloo
Faculty Sponsors: Terri Meyer Boake and Mark Cichy
Justin and Charles will share $3,000 and the faculty sponsors will share $1,500.

Awards of Merit

Katherine Holbrook-Smith and Guang Xi (Tony) Shi, University of Waterloo
Faculty Sponsors: Terri Meyer Boake and Mark Cichy
Katherine and Tony will share $2,000 and the faculty sponsors will share $1,000.

Sheelah Tolton and Jeremy Jeong, University of Waterloo
Faculty Sponsors: Terri Meyer Boake and Mark Cichy
Sheelah and Jeremy will share $2,000 and the faculty advisors will share $1,000.

Award Winners: Charles Ye and Justin Lai

Architectural Student Design Competition – 10th Anniversary Exhibition

In celebration of the 10th Anniversary of the successful Architectural Student Design Competition, the SSEF prepared an exhibition to demonstrate architectural student talent. The exhibition includes English and French display panels which describe the competition and its history along with panels from the Top 10 submissions of the 2011 Architectural Student Design Competition. To see a list of the Top 10 submissions, please visit the SSEF website at www.ssef-ffca.ca/competitions/ssef/2011/topten.

New Offerings from CISC

New CISC Software

CISC is introducing new Excel spreadsheets to assist engineers in designing steel structures:

- Steel Seismic Systems (SSS10) helps identify permissible steel seismic-force-resisting systems in accordance with the National Building Code of Canada 2010 based on the building location, height, importance category and site class.

CISC Members: Free

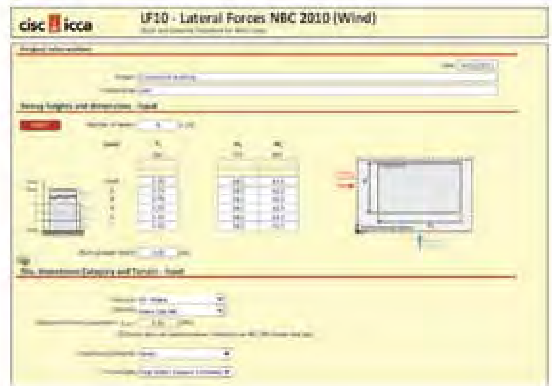
Non-members: $19.50

- Lateral Forces (LF10) includes two separate modules for computing wind and seismic forces on buildings in accordance with NBC 2010. Wind forces may be determined using the Static or Dynamic procedure. Lateral forces may be computed based on NBC site-specific data or user-specified values.

CISC Members: $175

Non-members: $299

For more information, visit the CISC website:
www.cisc-icca.ca



LF10 Wind - Input


LF10 Wind - Output

New Course – Inspection of Steel Structures

CISC is introducing a new one-day course (0.7 CEUs) for owners, designers, constructors, building officials and inspection agencies on the requirements, recommendations and resources for the inspection of steel-framed buildings in Canada.

Lead by Robert E. Shaw, Jr., PE, President, Steel Structures Technology Center, Inc., discussion will include both detailed technical requirements and methodologies for implementation, from both a quality control (production) and quality assurance (third party) inspection perspective.

2012 Course Schedule

Moncton, NB	February 21
Montreal, QC*	February 22
Toronto, ON	February 23
Saskatoon, SK	February 28
Edmonton, AB	February 29
Vancouver, BC**	March 1

*Sponsored by Genivar

** In partnership with the Independent Contractors and Businesses Association of British Columbia

CISC Members: $440
Non-members: $490

For more information, visit www.cisc-icca.ca/courses

CISC Scholarship and Coop Programs

An overview of CISC's efforts to promote structural steel studies through scholarships and coop programs

By Rob White

CISC offers a number of scholarship and coop programs for students across Canada. Funded and administered through regional efforts, these initiatives are offered to students conducting studies in the field of structural engineering, and are designed to help promote structural steel studies at Canadian education institutions.

Atlantic region

The Atlantic region's scholarship program offers a scholarship with a value of $7,500. The Atlantic Regional Committee of the Canadian Institute of Steel Construction (CISC) has established this graduate scholarship to support an engineer who is pursuing a post graduate degree in civil engineering with emphasis on structural steel structures or a related steel topic at one of the four Atlantic engineering universities (University of New Brunswick, Université de Moncton, Dalhousie University and Memorial University).

The applicant can be a recent engineering graduate or an engineer that is working in industry, government or the academic field. The goal is to provide monetary support to a person who is continuing their study in the structural steel field, while encouraging that person to continue their career in the steel industry.

Chris Mantha was chosen as the recipient of the 2011 CISC Atlantic Canada Scholarship for Steel Structures Studies. Research is being done under Dr. Yi Liu at Dalhousie University in Halifax, NS. This award is intended to help towards Mantha's graduate work examining the lateral torsional stability of tied steel plate girders.

This scholarship has been made possible through the contributions of the Atlantic Region CISC members and the International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers Locals 752 and 842.

Ontario Region

The Ontario Regional Committee awarded scholarships in 2011 to students who excelled in their steel design courses. Seven of these scholarships were presented to engineering students, and two to architectural students. Chosen recipients were selected based on input from their professors at each respective institution. This year scholarships went to:

- Carleton University – Jacob Hertz
- McMaster University – Matthew Scott
- Ryerson University, Architectural

CISC Atlantic Region Manager Alan Lock, Chris Mantha and Dr. Yi Liu.

- Ryerson University, Engineering – Bradley Maguire
- University of Toronto, Architectural
- University of Toronto, Engineering – Izabela Bugan
- University of Western Ontario – Graeme Johnston
- Waterloo University – Kan Zhang
- Windsor University

These awards provide each recipient with $2,000 in scholarship funding. The applicants must be undergraduate students who excel in the steel design course during their third year and who also selected a steel elective in their final year. The award presentations were part of the Ontario Region's 21st Annual Spring Reception, held May 19, 2011 in Mississauga.

The awards are presented by CISC Ontario in partnership with the member sponsors of the program – Dymin Steel, M&G Steel, Mirage Steel, Telco Steel Works and Walters Inc.

Central Region

The Central Regional Committee has established an annual scholarship award in the amount of $10,000. It is presented to a graduate student or students involved in structural steel research that have graduated from a central region university and are pursuing post graduate research at another university.

The Central Regional Committee of the Canadian Institute of Steel Construction (CISC) established this award for two purposes: first, to honour Canadian steel engineering graduates who are pursuing an advanced degree in steel structures research; and second, to encourage them in their education by assisting them financially.

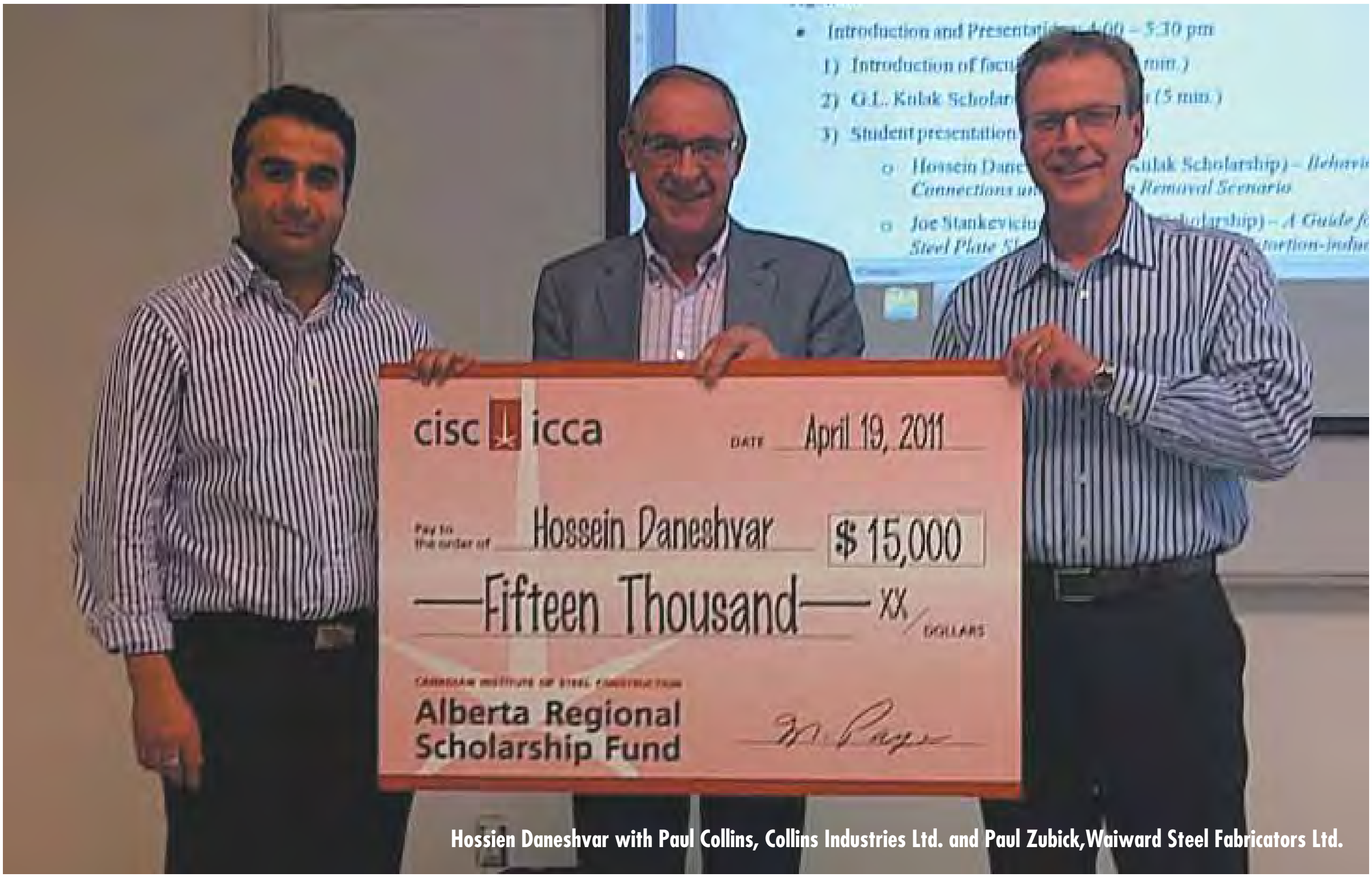
Alberta Region

The Alberta Regional Committee offers civil engineering students from the University of Alberta an opportunity to participate in a Cooperative Employment Placement Program. The program selects a group of outstanding third year students based on their submissions, and places them into a working environment with a CISC Alberta region steel fabricator.

The region also offers the G. L. Kulak Scholarship, an annual award of $15,000 available to postgraduate students doing research in structural steel to encourage them to work and remain in the steel industry.

Written submission concerning the research to be undertaken and the expected results is accompanied by references from University of Alberta professors, as well as applicants' academic scores. These submittals are then sent to the committee for review and determination.

The award is presented annually at the joint meeting with the Alberta Region and the University of Alberta, which is normally held in April. The 2011 recipient is Hossien Daneshvar.



Hossien Daneshvar with Paul Collins, Collins Industries Ltd. and Paul Zubick,Waiward Steel Fabricators Ltd.

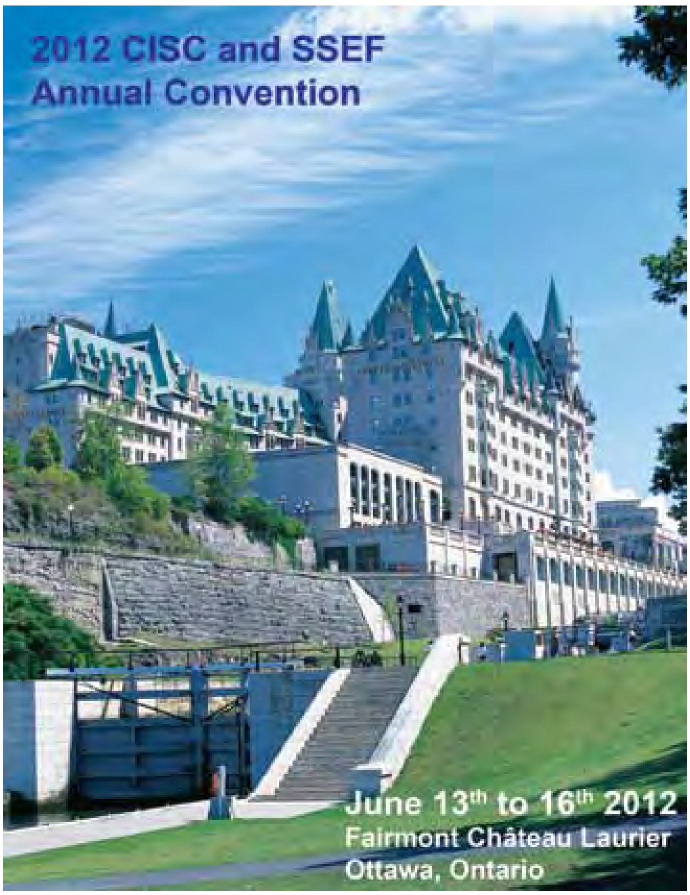
News and Events

CISC & SSEF Annual Convention

The CISC and SSEF 2012 Annual Convention will take place June 13 to 16 in our nation's capital – Ottawa! The city offers visitors a wealth of quintessentially Canadian experiences. It is filled with capital sights and attractions, and just about as many ways to explore and see them.

We are looking forward to an exciting time for all of our members during the four-day convention. As in the past, this coming year's convention will include educational seminars, incredible and informative speaker seminars, along with an open marketing discussion forum.

Delegates can also look forward to a great game of golf or a city tour that will include a food-tasting expedition or a lovely kayak river adventure. You spoke – we listened! Friday 'Fun Night' will return at this year's event and we will also host the 2nd National Design Awards on Saturday night. We look forward to seeing you in Ottawa!



SteelDay 2011

Friday, September 23 marked the second installment of SteelDay in Canada. Events were held across the country as the steel fabrication industry opened its door to architects, engineers, owners and the general public. This year, 28 locations hosted 2,000 guests at their facilities. While the number of host locations was trimmed back, attendance per location met or exceeded that of last year.

While events are produced with many objectives in mind – most notably, industry awareness and participation – certainly one of the most visible objectives for host locations is to pursue the highest attendance figures. This year, there were two standout locations: Russell Metals in Nova Scotia (260 attendees) and Waiward Steel in Alberta (261 attendees).

Hands down, Atlantic Canada demonstrates its commitment to the industry and the region by hosting the largest crowds nationally. In Nova Scotia and New Brunswick, nearly 650 guests attended five host locations (Cherubini, Marid, Ocean Steel, RKO and Russell Metals).

High attendance figures are not necessarily the primary measure of success though, as each location prioritizes its own objectives for the day. As one fabricator explained, "SteelDay is a no brainer for us. Once a year, the shop gets cleaned, the staff gets a barbeque, and family and friends come by to see what we do. Visits from architects, engineers, etc., is the icing on top."

Here is a taste of some of the other events that happened this past September.

Atlantic

In coordination with the Canadian Institute of Steel Construction's SteelDay 2011, Ocean Steel's Saint John facility opened its doors to the business community. Members of the design and construction industry as well as local government officials were shown firsthand how building with structural steel is an economical building framing material and how Ocean Steel has incorporated advanced technology to reduce or eliminate errors, improve safety, lower project costs and ensure a successful project is delivered on time and on budget.

Attendees also got to try their hand at welding with the Lincoln Electric Virtual Welding Trainer. The VRTEX 360 is a Virtual Reality Arc Welding (VRAW) training trainer. This computer-based training system is an educational tool designed to allow students to practise their welding technique in a simulated environment. It promotes the efficient and effective transfer of skills from the virtual training environment to the weld booth. General Manager Harrison Wilson, Operations Manager Bill Gates, Plant Manager Troy Hawkes, and Business Development Manager Bernie Blakely provided office and plant tours.

Ontario

Four CISC facilities hosted SteelDay: Gerdau, Cambridge; Samuel, Sons + Co, Hamilton; Kubes Steel, Stoney Creek and ACL Steel, Kitchener, Ontario. The four companies took a novel approach to SteelDay by showcasing steel products through their lifecycle. The day started at Gerdau (mill), then proceeded on to Samuel (service Centre), Kubes (roller, bender) and finally ACL (fabricator).

CISC helped arrange busing between the locations, which each showcased a different set of skills and capabilities. The coordination of food and drinks was based on the time that attendees arrived at each location. The event showcased excellent coordination amongst CISC members, and was overseen by Regional Manager Suja John.

Central Canada
Provincial Galvanizing had a total of 16 people attend its event and had interest from the local trade college to schedule a tour of its facility at another time. The response from attendees was absolutely positive. Some are long-time customers and now understand the process, which allows them to fabricate items properly the first time and avoid extra costs and time delays.

Provincial Galvanizing considers itself very fortunate to have such wonderful customers and expects this extra knowledge and personal contact to strengthen its relationships. The company was also happy to see some engineers attend and considers the day to be an overall success for all involved.

Alberta
Supreme Steel had three Edmonton facilities with open houses for SteelDay: Acheson, Bridge and Quality. The response was excellent, with a number of different events taking place at the three locations.

At the company's Acheson location, there was a virtual welding booth, a climbing exhibit, a drafting modeling station and shuttle lift demonstration as part of the tour. One of Supreme Steel's suppliers generously donated prizes for the visitor who guessed how many feet of wire were in a roll.

A bolt manufacturer conducted a demonstration at both the Acheson and Bridge locations, and a table was set up for the union and Careers Next Generation for their promotional displays. At Acheson, the company hosted a barbeque luncheon and held a draw for an iPad. Lunch was also served at the Quality and Bridge locations, and snacks were provided throughout the day. In total, there were more than 175 attendees at the three facilities.

British Columbia
Canron Western Constructors LP had 53 guests, many of which were students from the University of British Columbia and the British Columbia Institute of Technology. SteelDay provided the students with the opportunity to see fabrication facilities first hand. For many, it marked the first time they were able to see a live production environment and speak with industry participants first hand.

Solid Rock also hosted a very successful event with 40 guests ranging from students, representatives from the Department of Transportation, engineering firms and architects.

Thanks to Alan Lock!
Alan Lock has been associated in one way or another with CISC since the 1980s: throughout his career at Robb Engineering (Dominion Bridge) and Ocean Steel right until his retirement in 2002.

In 2004, the Atlantic Committee asked Alan to consider working part time as the Atlantic Region Representative for CISC. This part-time (for a year or two!) representation turned into a very exciting and rewarding seven years during which Alan was able to maintain his keen interest in all aspects of the steel industry. It also allowed him to work with people within the industry that he had known for years and to meet new people in the industry as well.

Alan felt fortunate to be able to help out as a temporary Central Region Representative for over a year and to get to know many steel industry people in this region as well. Through various programs and initiatives he was able to further advance the recognition of CISC and the Atlantic Region members in the construction business in the region.

CANstruction
Living in poverty with the constant struggle of putting food on the table is an all-consuming reality for many people. Hunger hurts and the challenges of hunger and poverty go beyond dollars and cents. These are the realities people face day to day in every community.

What happens when creative genius, engineering prowess, team spirit and countless cans collide? CANstruction! CANstruction Nova Scotia, a Feed Nova Scotia community event, helps fight hunger in a way that is both educational and fun. It also provides an opportunity to showcase remarkable talent from the region as teams of architects, engineers, designers, and students mentored by professionals compete to design and build structures made entirely from full cans of food. At the conclusion of the competition all cans of food are donated to Feed Nova Scotia. This year, CANstruction donated 27,878 cans of food (14,867 kilograms) which represented a donation of $33,195.28.

For the last seven years the Atlantic Region CISC has been a proud sponsor of Dalhousie University Civil Engineering student teams who have constructed many winning structures. Thanks to the creative genius of the teams, fantastic "CanSculptures" gradually emerge from what at first looks like organized chaos, which is both challenging and heaps of fun.

CISC members and students that participate in the event are very aware of the real winners – the seniors that live alone in poverty, the kids that go to school hungry, those that lost their job and have no money for food. CANstruction is our way of helping and we are proud to do our small part. Together we are better, we are stronger and we can accomplish more.

Ice Cream Cone - 2011 sculpture

From left to right: Alan Lock (Atlantic Region Manager), Matt Dugie, Courtney McCarthy, Leonard Stuart, Michelle Parent, Dr. Yi Liu (Dalhousie Civil Engineering Professor and team mentor), Brenton Turner, Josh Gray and Avrian Dolcy

New Publications

CISC Guide for Specifying Architecturally Exposed Structural Steel

The AESS Guide was developed to facilitate communication between architects, engineers and fabricators. It features numerous illustrations of buildings and connections, given that visual references help all parties understand the intent of new AESS documents as applied to the design of structures.

The Guide serves as a companion to other AESS documents such as the Sample AESS Section in the Structural Steel Specification, the Category Matrix and the CISC Code of Standard Practice. It is aimed primarily at architects but is also intended for all design professionals interested in AESS applications.

The AESS Guide may be freely downloaded from the CISC website at www.cisc-icca.ca.

Software Solutions from CISC

Steel Seismic Systems 10 (SSS10)

SSS10 has been developed as part of a continuing effort by CISC to streamline the design of steel structures. This Excel spreadsheet assists users in identifying permissible structural steel seismic-force-resisting systems (SFRS) in accordance with NBC 2010 and CSA S16-09. User input includes the building location, importance category, site class and building height.

Lateral Forces NBC 2010 (LF10)

(a) LF10-Wind

This Excel spreadsheet computes wind storey forces in accordance with the Static and Dynamic procedures of the National Building Code of Canada 2010. User input includes building height and geometry, location, importance category and terrain type. The speed-up factor for buildings on a hill or escarpment may also be included if desired. As an option, a user-specified wind pressure may be entered instead of the NBC 2010 value based on location.

(b) LF10-Seismic

This Excel spreadsheet computes seismic storey forces in accordance with the Equivalent Static Force Procedure of the National Building Code of Canada 2010. Seismic force increases based on the type of seismic force-resisting system (SFRS) and building height are determined according to CSA S16-09. User input includes building height, storey masses, location, importance category and site classification for ground. As an option, user-specified spectral accelerations may be entered instead of the NBC 2010 values based on location.

For more information and to order the software, visit the CISC website at http://www.cisc-icca.ca.

Continuing Education Courses

CISC has recently added two new English language courses, "Inspection of Steel Structures" and "Seismic Connections for Steel-Framed Buildings," and one significantly updated and enhanced course, "Seismic Design of Steel-Framed Buildings" to the spring 2012 schedule.

A new French-language course, "Assemblages pour structures en acier," is now ready and has also been added to the schedule. For full course schedule, information, online registration and the latest updates please visit our website www.cisc-icca.ca/courses, or request a copy of our course calendar.

Inspection of Steel Structures
– New Course –

This course will prepare designers, building officials and other specialists for the inspection of steel-framed buildings in the fabrication shop and the field. It is presented online in four two-hour live sessions over one or two days. Applicable sections of the National Building Code of Canada, CSA S16 plus referenced material, product and quality standards, CISC Code of Practice and CISC Certification guidelines will be addressed. Typical structural design, erection and shop drawings for steel-framed buildings will be explained. Material identification, tolerances, seismic connections, bolting and welding processes and procedures will be reviewed.

The course developer and leader is Robert E. Shaw, Jr., PE, President, Steel Structures Technology Center, Inc.

Moncton, NB	February 21
Montreal, QC (E)	February 22
Toronto, ON	February 23
Saskatoon, SK	February 28
Edmonton, AB	February 29
Vancouver, BC	March 1

Seismic Design of Steel-Framed Buildings
– Updated & Enhanced Course –

Held in tandem with the Seismic Connections for Steel-Framed Buildings course (see following page), this course is intended to provide understanding on design theory and the rationale behind code provisions as well as the application of specific Code formulae and requirements. It will cover the design of seismic resisting systems for steel-framed buildings to the requirements of the 2010 National Building Code of Canada and the pertinent provisions of CSA Standard S16-09.

New topics include ductile plate walls, buckling-restrained braces and higher limits for conventional construction. Updated topics include tension only braced frames, concentrically braced frames, ductile eccentrically braced frames, Type LD moment resisting frames, ductile moment resisting frames, notional loads, P-delta effects, and diaphragms.

Principal course leader: Alfred F. Wong, M.Eng., P.Eng., Director of Engineering, CISC

Seismic Connections for Steel-Framed Buildings
– New Course –

Held in tandem with the Seismic Design of Steel-Framed Buildings course (see above), this course prepares consulting structural engineers and steel fabrication engineers for the design of connections in ductile Seismic Force Resisting Systems in steel-framed buildings to the requirements of the 2010 National Building Code of Canada and Clause 27 of CSA Standard S16-09. The critical connections in the design examples developed for the Seismic Design of Steel-Framed Buildings course are used.

Capacity design requirements, now well entrenched in Clause 27 of S16-09, have virtually revolutionized the design, detailing and construction of connections for seismic applications. These requirements make it almost impossible to design Seismic Force Resisting Systems in isolation since the overall behaviour of these frames is highly dependent on the configuration and proportioning of these connections. The course will take participants through the detailed design of connections for moment connections covered in the CISC publication "Moment Connections for Seismic Applications," links and brace connections in Eccentric Braced Frames, tension-compression brace connections, tension only brace connections, and more.

Principal course leader: Larry S. Muir, M.S., P.E., President, The Steel Connection, LLC

	Seismic Design	Seismic Connections
Calgary, AB	May 28	May 29
Vancouver, BC	May 30	May 31
Montreal, QC (E)	June 19	June 20
Toronto, ON	June 21	June 22
Fredericton, NB	September 10	September 11
Halifax, NS	September 12	September 13

Steel Bridges – Design, Fabrication, Construction
– Updated & Enhanced Course –

This course covers the design, fabrication and construction of steel bridges based on the 2010 Canadian Highway Bridge Design Code. The practical and economical aspects of fabrication, erection, choice of material and their impact on design will also be emphasized. The presentation and the Course Notes include four design examples illustrating extensive design calculations for I-girders and box girders of straight and curved configurations. Topics receiving greater emphasis in 2011 include fatigue and brittle fracture, integral abutments, aesthetics and sustainability.

Course leaders for the English language edition are:
Gilbert Grondin, Ph.D., P.Eng., Professor of Civil Engineering, University of Alberta; James Montgomery, Ph.D., P.Eng., LEED AP, Principal, DIALOG; and Paul J. King, P.Eng., VP Engineering, Rapid-Span Structures Ltd.

Toronto, ON	April 10-11
Vancouver, BC	April 12-13

Assemblages pour structures en acier
– Nouveau cours –

Ce cours est conçu pour offrir des conseils pratiques aux concepteurs et clarifier le rôle complémentaire du fabricant et de l'ingénieur en structures pour la conception des assemblages. L'accent est placé sur les assemblages et leurs conséquences sur les coûts et l'économie.

Le principal objectif est d'aider les concepteurs à mieux comprendre comment les assemblages influencent la conception des éléments de charpente et vice-versa, et d'insister sur l'importance de réfléchir au choix des assemblages et des éléments de charpente pour une économie optimale.

Les sujets abordés incluent les principales modifications à la norme S16-09, les boulons à haute résistance, les soudures, les boulons en traction et avec effet de levier, les assemblages anti-glissement, les assemblages mixtes soudures-boulons, les assemblages excentriques, les assemblages en cisaillement simple, les sièges, les assemblages au béton, les assemblages de poteaux, les assemblages rigides (profilés W et HSS), les assemblages de contreventements, les goussets et les assemblages de fermes.

Conférenciers:
Serge Dussault, M.Eng., ing., Vice-président, ingénierie, Groupe Canam
Danilo D'Aronco, M.Ing., ing., Associé et directeur de l'ingénierie, DPHV

Montréal, QC	avril 3
Québec, QC	avril 4

New Members

At the November meeting the CISC Board of Directors elected the following organizations as new members. Welcome all!

Associate Fabricators
George Third & Son (A Div. Of Trapp Ave. Industries Ltd.)
Northwest Fabricators Limited

Associate Suppliers
Daley Metals Ltd.
Allgrade Bolt & Chain Inc.
S.B. Simpson Group Inc.

Associate Erectors
St. Peter Steel Inc.
Island Industries Ltd.

Detailer
Service Technique Asimut inc.

Fabricator
AC Metal Fabricating Ltd.

Regional Events

Alberta
The Steel Workshop
Keynote Speaker, Robert Forest, Partner and Co-founder of Adrian Smith Architects, Chicago
April 3, 2012, Radisson Hotel Airport, Calgary, AB
www.cisc-icca.ca/albertaworkshop

Events

NASCC – The Steel Conference
April 18-21, 2012, Grapeview, Texas
www.aisc.org/nascc

AISC / ASCE Student Steel Bridge Competition
May 25-26, 2012, Clemson University, Clemson, South Carolina
www.aisc.org/content.aspx?id=780

International Symposium on Tubular Structures
September 12-14, 2012, London, England
www.istructe.org

SMMH 2012 – Structures for Mining and Related Materials Handling Conference
October 15-18, 2012, Vanderbijlpark, South Africa
www.smmh2012.co.za

Common Codes and Standards for Design and Construction of Steel Structures

Current Status and Future Publication Targets

CODE/STANDARD SUPPLEMENT/COMMENTARY	CURRENT EDITION	NEXT EDITION/ REVISION	PUBLICATION TARGET
National Building Code of Canada (NBC)	NBC 2010	NBC 2015	2015
NBC Structural Commentaries (Part 4 of Div. B)	NBC 2010 Str. Comm.	NBC 2015 Str. Comm.	
CSA S16 Design of Steel Structures	CSA S16-09	S16-14	2014
CISC Commentary on CSA S16 (Part 2 of CISC Handbook of Steel Construction[1])	CISC Handbook 10th Edition[1]	CISC Handbook 11th Edition	2015
CSA S6 Canadian Highway Bridge Design Code	CSA S6-06	S6-14	2014
- Supplements to CSA S6	CSA S6S2-11	S6S3-12	2012
CSA S6.1 Commentary on Canadian Highway Bridge Design Code	CSA S6.1-06	S6.1-14	2014
- Supplements to CSA S6.1	CSA S6.1S2-11	S6.1S3-12	2012
CSA G40.20/G40.21 General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel	CSA G40.20-04 CSA G40.21-04 (R2009)[2]	G40.20-13 G40.21-13	2013
CSA W59 Welded Steel Construction (Metal Arc Welding)	CSA W59-03 (R2008)[3]	W59-12	2012
CSA W47.1 Certification of Companies for Fusion Welding of Steel	CSA W47.1-09	W47.1-14	2014
CSA S136 North American Specification for the Design of Cold-Formed Steel Structural Members	CSA S136-07	S136-12	2012
- Supplements to CSA S136	CSA S136S2-10		
CSA S136.1 Commentary on CSA S136	CSA S136.1-07	S136.1-12	2012

[1] CISC Handbook of Steel Construction - 10th Edition includes CSA S16-09, its Commentary, CISC Code of Standard Practice - 7th Edition, and design and detailing aids in accordance with CSA S16-09
[2] Reaffirmed in 2009
[3] Reaffirmed in 2008

CISC FABRICATOR MEMBERS

CISC Member Directory - Listing as of January 16, 2012

Legend:
*sales office only
B Buildings
Br Bridges
S Structural
P Platework
J Open-web Steel Joist

ATLANTIC

Canam-Canada
Moncton, NB 506 857 3164
www.canam.ws

Cherubini Metal Works Limited P, S
Dartmouth, NS 902 468 5630
www.cherubinigroup.com

Eascan Building Systems Ltd.
Truro, NS 902 897 9553
www.eascan.ca

MacDougall Steel Erectors Inc. S
Cornwall, PE 902 855 2100
www.macdougallsteel.com

Marid Industries Limited S
Windsor Junction, NS 902 860 1138
www.marid.ns.ca

MQM Quality Manufacturing Ltd. P, S
Tracadie-Sheila, NB 506 395 7777
www.mqm.ca

Ocean Steel & Construction Ltd. P, S
Saint John, NB 506 632 2600
www.oceansteel.com

Prebilt Structures Ltd. P, S
Charlottetown, PE 902 892 8577
www.prebiltsteel.com

RKO Steel Limited P, S
Halifax, NS 902 468 1322
www.rkosteel.com

Tek Steel Ltd. S
Fredericton, NB 506 452 1949

QUÉBEC

Acier Fortin Inc. S
Montmagny, QC 418 248 7904
www.acierfortin.com

Acier Métaux Spec. inc. S
Chateauguay, QC 450 698 2161
www.metauxspec.ca

Acier Robel inc. S
St-Eustache, QC 450 623 8449
www.acierrobel.com

Acier Trimax Inc. S
Ste-Marie de Beauce, QC 418 387 7798
www.trimaxsteel.com

Alma Soudure inc. S
Alma, QC 418 669 0330
www.almasoudure.com

Canam-Canada J, S
Ville de St-Georges, QC 418 228 8031
www.canam.ws

Charpentes d'acier Sofab Inc. S
Boucherville, QC 450 641 2618
www.sofab.ca

Charpentes Métalliques TAG (6541984 Canada inc.) S
Ange-Gardien, QC 450 379 9661

Constructions PROCO Inc. S
St. Nazaire, QC 418 668 3371
www.proco.ca

Lainco Inc. B, Br, S
Terrebonne, QC 450 965 6010

Les Aciers Fax inc. B, S
Charlesbourg, QC 418 841 7771

Les Constructions Beauce-Atlas Inc. S
Ste-Marie de Beauce, QC 418 387 4872
www.beauceatlas.ca

Les Industries V.M. Inc. S
Longueuil, QC 450 651 4901

Les Structures C.D.L. Inc. S
St-Romuald, QC 418 839 1421
www.structurescdl.com

Les Structures GB Ltée P, S
Rimouski, QC 418 724 9433
www.structuresgb.com

Métal Moro inc S
Montmagny, QC 418 248 1018

Métal Perreault Inc. B, P, S
Donnaconna, QC 418 285 4499
www.metalperreault.com

Mometal Structures Inc. B, S
Varennes, QC 450 929 3999
www.mometal.com

Nico Métal inc. S
Trois-Rivières, QC 819 375 6426
www.nico-metal.com

Poutrelles Delta Inc. / Delta Joists Inc. J
Ste-Marie, Beauce, QC 418 387 6611
www.deltajoists.com

Produits Métalliques PMI S
Rimouski, QC 418 723 2610
www.pmibuilding.com

Quirion Métal Inc. S
Beauceville, QC 418 774 9881
www.quirionmetal.com

Ray Metal Joliette Ltée S
Joliette, QC 450 753 4228

Structal - Bridges, A Division of Canam Group Inc. P, S
Québec, QC 418 683 2561
www.structalponts.ws

Structal-Heavy Steel Construction- A division of Canam Group Inc. [Boucherville] J, S
Boucherville, QC 450 641 4000
www.canam.ws

Sturo Metal Inc. S
Lévis, QC 418 833 2107
www.sturometal.com

Supermétal Structures Inc. P, S
St. Romuald, QC 418 834 1955
www.supermetal.com

Tardif Metal Inc. B, P, S
Lac St-Charles, QC 418 849 6919
www.sm-inc.com

Tecno Metal Inc. B, S
Quebec, QC 418 682 0315
www.tecnometal.ca

ONTARIO

A.J. Braun Mfg. Limited Br
Kitchener, ON 519 745 5812
www.ajbraun.com

AAP Steel Inc.
Vaughan, ON 905 669 2274
www.aapsteelinc.net

AC Metal Fabricating Ltd.
Oldcastle , ON 519 737 6007

ACL Steel Ltd. S
Kitchener, ON 519 568 8822
www.aclsteel.ca

Arkbro Structures
Mississauga, ON 905 766 4038

Austin Steel Group Inc. S
Brampton, ON 905 799 3324
www.gensteel.ca

Azimuth Three Enterprises Inc. S
Brampton, ON 905 793 7793

Benson Steel Limited J, S
Bolton, ON 905 857 0684
www.bensonsteel.com

Burnco Mfg. Inc. S
Concord, ON 905 761 6155
www.burncomfg.com

C & A Steel (1983) Ltd. S
Sudbury, ON 705 675 3205
www.casteel1983.com

C_ore Metal Inc.
Oakville, ON 905 829 8588
www.coremetal.com

Canam Canada - A division of Canam Group inc.(Mississauga) J, S
Mississauga, ON 905 671 3460|
www.canam.ws

Central Welding & Iron Works Group P, S
North Bay, ON 705 474 0350
www.centralwelding.ca

Cooksville Steel Limited [Kitchener] S
Kitchener, ON 519 893 7646
www.cooksvillesteel.com

Cooksville Steel Limited [Mississauga] S
Mississauga, ON 905 277 9538
www.cooksvillesteel.com

D & M Steel Ltd. S
Newmarket, ON 905 836 6612

Eagle Bridge Inc. S
Kitchener, ON 519 743 4353
www.eaglebridge.ca

Ed Lau Ironworks Limited S
Kitchener, ON 519 745 5691
www.edlau.com

Fortran Steel Inc. S
Greely, ON 613 821 4014
www.fortransteel.com

G & P Welding and Iron Works P, S
North Bay, ON 705 472 5454
www.gpwelding.com

Gorf Contracting Limited P, S
Porcupine, ON 705 235 3278
www.gorfcontracting.net

IBL Structural Steel Limited B
Mississauga, ON 905 671 3301
www.iblsteel.com

Lambton Metal Services S
Sarnia, ON 519 344 3939
www.lambtonmetalservice.ca

Laplante Welding of Cornwall Inc. S
Cornwall, ON 613 938 0575
www.laplantewelding.com

Linesteel (1973) Limited B, S
Barrie, ON 705 721 6677

Lorvin Steel Ltd. S
Brampton, ON 905 458 8850
www.lorvinsteel.com

M&G Steel Ltd. S
Oakville, ON 905 469 6442
www.mgsteel.ca

M.I.G. Structural Steel (Div. of 3526674 Canada Inc.) S
St-Isidore, ON 613 524 5537
www.migsteel.com

Maple Industries Inc. S
Chatham, ON 519 352 0375
www.mapleindustries.ca

Mariani Metal Fabricators Limited S
Etobicoke, ON 416 798 2969
www.marianimetal.com

MBS Steel Ltd. J
Brampton, ON 905 799 9922
www.mbssteel.com

Mirage Steel Limited J, S
Brampton, ON 905 458 7022
www.miragesteel.com

Nor-Weld Ltd. B
Orillia, ON 705 326 3619
www.norweld.com

Norak Steel Construction Limited S
Concord, ON 905 669 1767
www.noraksteel.com

Paradise Steel Fab. Ltd. S
Richmond Hill, ON 905 770 2121

Paramount Steel Limited S
Brampton, ON 905 791 1996
www.paramountsteel.com

Pittsburgh Steel Group S
Mississauga, ON 905 362 5097
www.pittsburghsteel.com

Quad Steel Inc. S
Bolton, ON 905 857 9404
www.quadsteel.ca

Quest Steel Inc. B, Br, P, S
Mississauga, ON 905 564 7446

Refac Industrial Contractors Inc. P, S
Harrow, ON 519 738 3507
www.refacindustrial.com

Shannon Steel Inc. S
Orangeville, ON 519 941 7000
www.shannonsteel.com

Steel 2000 Inc. S
Chelmsford, ON 705 855 0803

Steelcon Fabrication Inc. B
Bolton, ON 416 798 3343

Telco Steel Works Ltd. S
Guelph, ON 519 837 1973
www.telcosteelworks.ca

Tower Steel Company Ltd. S
Erin, ON 519 833 7520
www.towersteel.com

Tresman Steel Industries Ltd. S
Mississauga, ON 905 795 8757
www.tresmansteel.com

Victoria Steel Corporation S
Oldcastle, ON 519 737 6151

Walters Inc. P, S
Hamilton, ON 905 388 7111
www.waltersinc.com

Central
Abesco Ltd. S
Winnipeg, MB 204 667 3981

C & C Pneumatics P, S
Saskatoon, SK 306 374 8228
ww.ccindustries.ca

Capitol Steel Corp. S
Winnipeg, MB 204 889 9980
www.capitolsteel.ca

Coastal Steel Construction Limited P, S
Thunder Bay, ON 807 623 4844
www.coastalsteel.ca

Elance Steel Fabricating Co. Ltd. S
Saskatoon, SK 306 931 4412
www.elancesteel.com

Empire Iron Works Ltd. [Winnipeg] S
Winnipeg, MB 204 589 7371
www.empireiron.com

IWL Steel Fabricators Ltd. P, S
Saskatoon, SK 306 242 4077
www.iwlsteel.com

JNE Welding Ltd. P, S
Saskatoon, SK 306 242 0884
www.jnewelding.com

Shopost Iron Works (1989) Ltd. S
Winnipeg, MB 204 233 3783
www.shopost.com

Supreme Group Inc. [Saskatoon] P, S
Saskatoon, SK 306 975 1177
www.supremesteel.com

Weldfab Ltd. S
Saskatoon, SK 306 955 4425
www.weldfab.com

CENTRAL

Abesco Ltd. S
Winnipeg, MB 204 667 3981

C & C Pneumatics P, S
Saskatoon, SK 306 374 8228
www.ccindustries.ca

CISC FABRICATOR, SERVICE CENTRE, MILL AND DETAILER MEMBERS

Capitol Steel Corp. S
Winnipeg, MB 204 889 9980
www.capitolsteel.ca

Coastal Steel Construction Limited P, S
Thunder Bay, ON 807 623 4844
www.coastalsteel.ca

Elance Steel Fabricating Co. Ltd. S
Saskatoon, SK 306 931 4412
www.elancesteel.com

Empire Iron Works Ltd. [Winnipeg] S
Winnipeg, MB 204 589 7371
www.empireiron.com

IWL Steel Fabricators Ltd. P, S
Saskatoon, SK 306 242 4077
www.iwlsteel.com

JNE Welding Ltd. P, S
Saskatoon, SK 306 242 0884
www.jnewelding.com

Shopost Iron Works (1989) Ltd. S
Winnipeg, MB 204 233 3783
www.shopost.com

Supreme Group Inc. [Saskatoon] P, S
Saskatoon, SK 306 975 1177
www.supremesteel.com

Weldfab Ltd. S
Saskatoon, SK 306 955 4425
www.weldfab.com

ALBERTA

AAA Steel Limited
Calgary, AB 403 236 4625
www.aaasteel.com

Anglia Steel Industries (1984) B, P, S
Calgary, AB 403 720 2363
www.angliasteel.ca

Bow Ridge Steel Fabricating S
Calgary, AB 403 230 3705

C.W. Carry (1967) Ltd. P, S
Edmonton, AB 780 465 0381
www.cwcarry.com

Canam Canada -A division of Canam Group inc. [Calgary] J, S
Calgary, AB 403 252 7591
www.canam.ws

Capital Steel Inc. S
Edmonton, AB 780 463 9177

Collins Industries Ltd. S
Edmonton, AB 780 440 1414
www.collins-industries-ltd.com

Empire Iron Works Ltd. [Edmonton] J, P, S
Edmonton, AB 780 447 4650
www.empireiron.com

Eskimo Steel Ltd. P, S
Sherwood Park, AB 780 417 9200
www.eskimosteel.com

GAR-DON Steel Industries Ltd. S
Nisku, AB 780 955 8034
www.gardon.ca

Garneau Manufacturing Inc. S
Morinville, AB 780 939 2129

JV Driver Fabricators Inc. B, S
Nisku, AB 780 955 1746
www.jvdriver.com

Leder Steel Limited S
Edmonton, AB 780 962 9040
www.ledersteel.com

Moli Industries Ltd. S
Calgary, AB 403 250 2733
www.moli.ca

Norfab Mfg (1993) Inc. B
Edmonton, AB 780 447 5454

Northern Weldarc Ltd. P, S
Sherwood Park, AB 780 467 1522
www.northern-weldarc.com

Omega Joists Inc. J
Nisku, AB 780 955 3390
www.omegajoists.com

Precision Steel & Manufacturing Ltd. S
Edmonton, AB 780 449 4244
www.precisionsteel.ab.ca

Rampart Steel Ltd. S
Edmonton, AB 780 465 9730
www.rampartsteel.com

RIMK Industries Inc. B, S
Calgary, AB 403 236 8777

Spartan Steel Ltd. S
Edmonton, AB 780 435 3807

Supermétal Structures Inc., Western Division P, S
Leduc, AB 780 980 4830
www.supermetal.com

Supermétal Structures Inc., Western Division P, S
St. Romuald, QC 418 834 1955
www.supermetal.com

Supreme Group Inc. [Edmonton] P, S
Edmonton, AB 780 483 3278
www.supremesteel.com

Supreme Group Inc., Bridge Division P, S
Edmonton, AB 780 467 2266
www.supremesteel.com

Triangle Steel (1999) Ltd. P, S
Calgary, AB 403 279 2622
www.trianglesteel.com

TSE Steel Ltd. S
Calgary, AB 403 279 6060
www.tsesteel.com

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www.wfwelding.com

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www.whitemudgroup.ca

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www.canam.ws

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www.supremesteel.com

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www.macform.org

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www.rapidspan.com

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www.warnaarsteel.com

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www.xliron.com

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www.leroux-steel.com

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www.samuel.com

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www.summyx.com

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www.tdsindustrial.com

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www.harsco.com

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www.kubesteel.com

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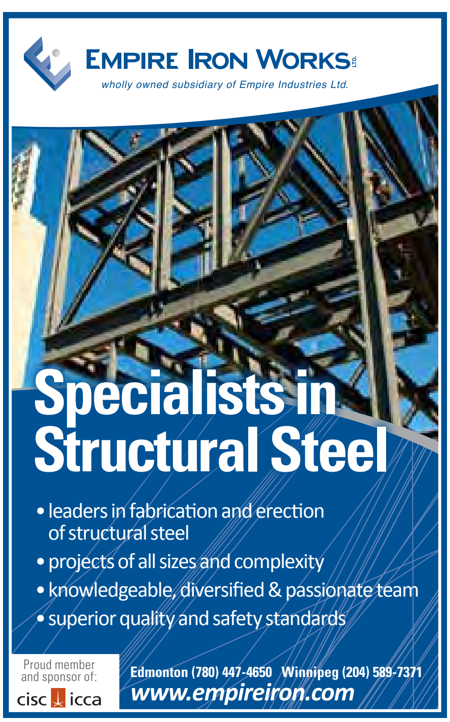

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