ADVANTAGE STEEL

NO 46 SUMMER 2013

2013 Alberta Steel Design Awards of Excellence

+ U.K. perspective on structural fire engineering

Bridge rehabilitation: Thinking outside the box

Structural steel's advantages in hospital construction

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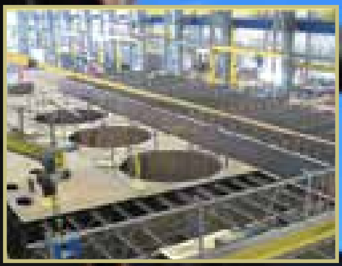

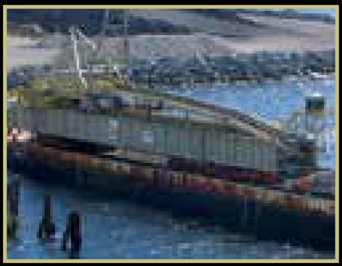

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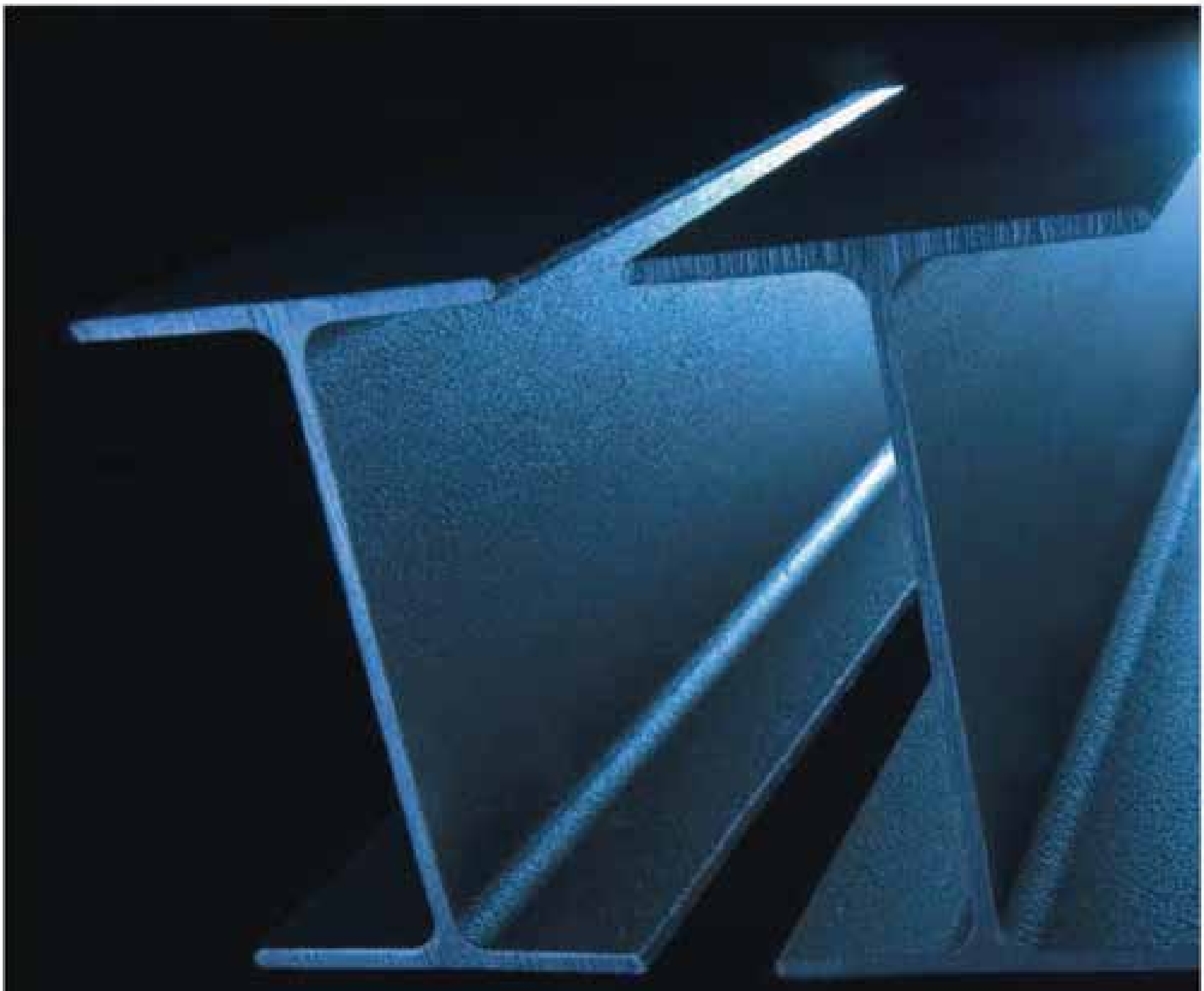

ADVANTAGE STEEL

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By Ed Whalen, P.Eng.

Unethical wood

As I reflect on yet another bill introduced by the Canadian wood industry to bypass provincial building codes by using legislation to expand their market share, I wonder what they are thinking.

I am shocked and dismayed that the desperation of the Canadian wood industry has led to an all-out assault on our construction industry through aggressive lobbying efforts and attempts to convince politicians to pass "Wood First" legislation. This would effectively force architects and engineers to design in wood rather than allowing them to select the best material for their projects based on performance, cost, safety and sustainability considerations. This ultimately threatens to undermine public safety, and stifles innovation and a free and competitive marketplace.

To support their political agenda, the wood industry has been making lofty claims using terms like: most sustainable, biodegradable, less intrusive to the environment, reusable, better than any other material, a carbon capture solution, a solution to climate change, the smallest foot print, and so on.

Really?! I would challenge the wood industry to meet the steel construction industry's record of recycled content of over 90 per cent. In Canada, we use recycled steel for construction – steel that would otherwise end up in landfills discarded by the average consumer or industry.

These specialized mills produce substantially less CO_2 and greenhouse gases than traditional steel mills of the past and lower than the world average. Structural steel can also be reused more than any other construction product without major transformation. The life cycle of steel is almost endless compared to the average life span of wood of 100 years or less.

Both demolished wood buildings (almost all sent to landfills) and burned down wood buildings contribute to CO_2 and greenhouse gas emissions. In landfills, wood rots and decays, something the wood industry does not want to talk about and does not include in their life-cycle analysis or their "smallest footprint" argument. Rotting wood produces CO_2 and methane, and methane is four times worse than CO_2 as a greenhouse gas.

Did you know that it takes 10 tonnes of wood to make one tonne of lumber? These silent nine tonnes of wood include leaves, branches and tree trunks that are left to rot on a clear-cut landscape. Interestingly enough, these nine tonnes are not included in the "we're the best sustainable product" message. So in effect, wood captures CO_2 and releases it back within a lifetime. Time enough for the wood marketers to do a little of their own carbon release.

I also have not seen any mention of all those wonderful chemicals and adhesives used in their new engineered products. Shhhhh, we aren't supposed to know about these. All we are to know is that trees have leaves and leaves are green and lumberjacks eat apple pie for dinner. Let's all have a group hug and sing Kumbaya.

From their actions, it appears that the only sustainable thing the wood industry wants is their industry. They appear to be prepared to misinform, misrepresent, and even legislate their product at the risk of designers' and owners' choice, as well as cost, standards and public safety.

There is a sacred rule in marketing: never lie to your customer. It appears the wood industry's leadership and marketing departments skipped that class.

ADVANTAGE STEEL

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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: What are the most common grades for structural steel shapes and sections used in building construction?

ANSWER: The main contributing factors are: a) their suitability for the intended applications as recognized by codes and standards, and b) availability. A summary for common structural steel grades used for building construction is shown in the table below:

STEEL SHAPES	*MOST COMMON	OTHER
W-shapes	ASTM A992 (F_y = 345MPa)	ASTM A913 Gr. 65 & Gr. 70
channels	CSA G40.21 300W	CSA G40.21 350W
angles	CSA G40.21 300W	CSA G40.21 350W, 380W
HSS	*ASTM A500 Gr. C and CSA G40.21 350W Class C	CSA G40.21 350W Class H
WWF sections	*Remark: Production at Essar Steel Algoma has been discontinued; consider rolled W-shapes and built-up shapes.*	
**Most common in most regions, e.g., G40.21 round HSS may be available in an eastern city but availability of A500 rounds may be better in Vancouver area.*		

It should be noted that an A500 HSS is not an exact substitution for its G40.21 350W counterpart having the same nominal size designation, mainly due to the less stringent ASTM A500 under-mass tolerance and, in some cases, lower tensile strength properties.

QUESTION 2: What are the most common high-strength bolt products used in building construction?

ANSWER: Three-quarter-inch A325 bolts are still very common. Some fabricators/erectors prefer seven-eighth-inch A325 bolts, especially for large projects. A490 bolts are used increasingly in building construction. Typically, they are selected for connections resisting very large forces while A325 bolts may be used elsewhere in the structure. In such applications, care must be taken to prevent A325 bolts from being inadvertently installed in holes designed to receive A490 bolts. It is prudent to segregate them by size, typically, a quarter of an inch difference in diameter.

Practical combinations include:

a) 1″ A490 bolts for heavy connections and $\frac{3}{4}$″ A325 bolts elsewhere; and

b) $1\frac{1}{8}$″ A490 bolts for heavy connections and $\frac{7}{8}$″ A325 bolts elsewhere.

Where pretensioned installation is required, twist-off type tension-control bolts (assemblies) have emerged to be viable options. ASTM F1852 and ASTM F2280 bolts (twist-off type) share the ultimate-limit-state resistances with A325 bolts and A490 bolts respectively. However, CSA S16-09 specifies smaller values for 5 per cent slip coefficients, c_1, for these twist-off type bolt assemblies versus those of high strength bolts pre-tensioned to meet the turn-of-nut method of installation. For further discussion on ASTM F1852 and ASTM F2280, visit Q & A Column in *Advantage Steel* No. 38. A490 and F2280 products shall not be galvanized.

Use of metric bolts is still rare because they are unavailable unless a special order for a very large quantity is placed with advance notice.

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.

QUESTION 3: Is there a standard for anchor bolts?

ANSWER: Yes, ASTM F1554 covers three grades of anchor bolts: Grade 36 (248 MPa), Grade 55 (380 MPa) and Grade 105 (724 MPa).

The vast majority of anchor bolts (or anchor rods as defined in CSA S16-09) are used to position, level and secure base plates for concentrically loaded gravity columns. Fabricators have traditionally supplied these anchor rods manufactured from round bar stocks produced to ASTM A36 (or CSA G40.21 300W). Since the introduction of ASTM F1554, Grade 36 products fill this role.

Grades 55 and 105 are produced to meet higher specified strengths. In addition, when specified in the purchased order as a 'supplementary requirement,' they are supplied to meet specific Charpy notch-toughness with test values.

By Alfred F. Wong, P.Eng.

Increase in probable strength of HSS braces

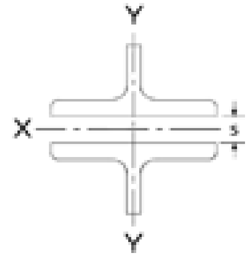


FIGURE: DOUBLE TEE BUILT-UP BRACE (CUT FROM HP SHAPE)

Advantages of HSS as braces

The popularity of hollow structural section bracing stems from two facts:

a) **Square and circular HSS do not have a minor axis**
Typically, the compressive resistance, C_r, for a brace is considerably smaller than its tensile resistance, T_r (for *CSA G40.21 350W* steel, C_r for a brace at the maximum permissible slenderness limit, KL/r = 200, is about $0.13T_r$). Hence, its compressive resistance usually governs the design while its tensile capacity dictates the connection design forces and other elements in Moderately Ductile and many Limited-Ductility Concentrically Braced Frames. Because the cross sections of square and circular HSS braces do not have a minor axis this disparity is minimized.

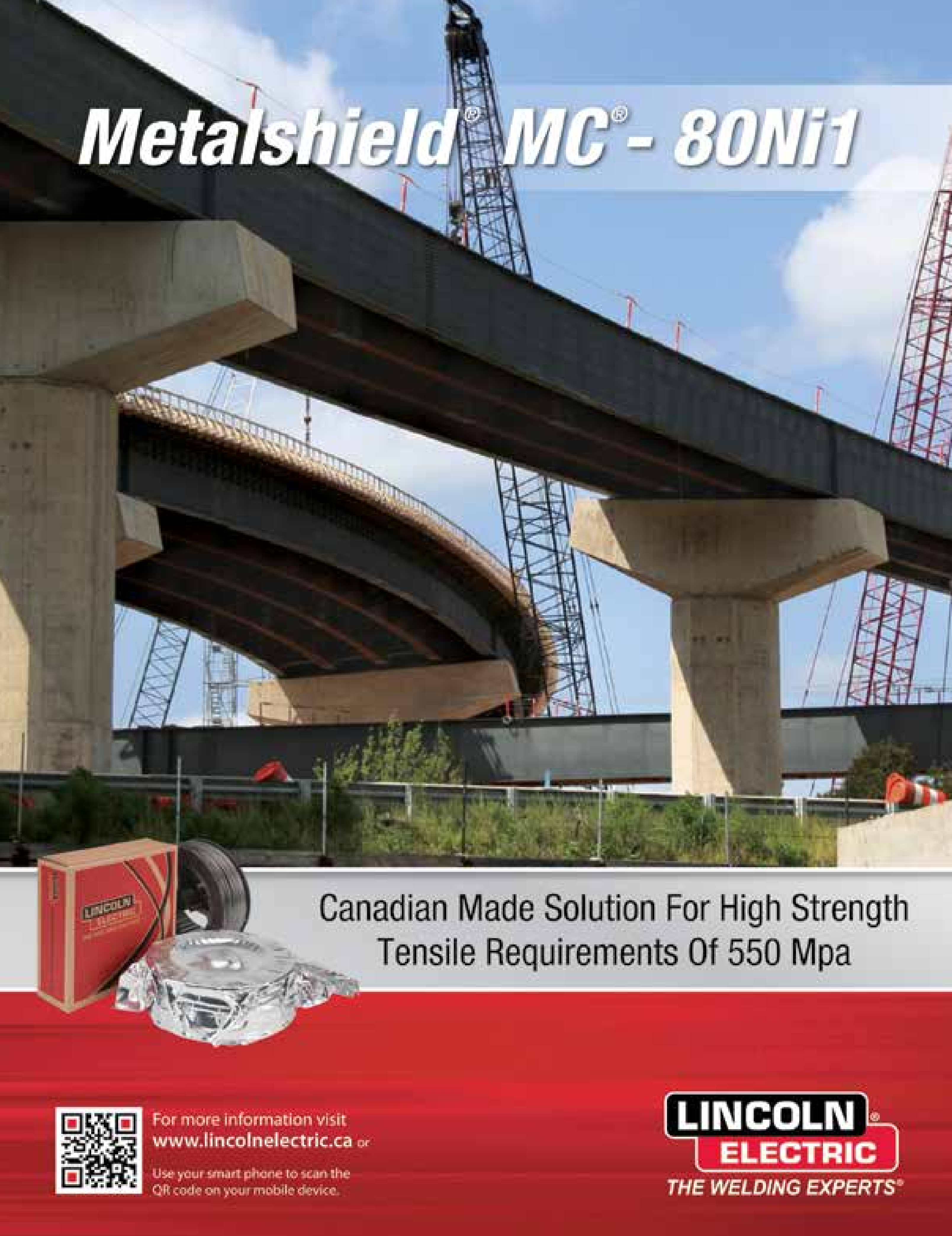
b) **Cross section compactness**
In order to preclude local buckling, brace members are required to meet stringent b-to-t limits. HSS, as closed sections, enjoy a clear advantage.

These advantages usually outweigh any inherent drawbacks, such as more challenging connection design and detailing.

Increase in probable strength

While the specified minimum yield strengths for common grades of hollow structural sections remain unchanged, the minimum value for their *probable yield stress*, R_yF_y, as specified in Clause 27.1.7 of CSA S16, has been increased from 385 MPa to 460 MPa. This higher value was introduced in S16-09 to reflect the strength characteristics of CSA G40.21 350W and ASTM A500 Grade C products.

With the exception of Conventional Construction, the yielding capacities of dissipating elements control the design forces in other parts of the seismic-force resisting system (SFRS). For Concentrically Braced Frames, CBF, the probable tensile and compressive capacities of braces are calculated using their probable yield stress, R_yF_y. Since the probable capacities of braces usually dictate the design forces for columns, beams, roof and floor diaphragms, foundation and connections, this increase generally affects the design and construction of the entire SFRS.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What are the alternatives?

The designer may also consider:

a) SFRS other than Moderately Ductile and Limited-Ductility CBF; and

b) The viability of other shapes as braces.

Other SFRS

Many factors affect the selection of SFRS, including seismicity, building Importance Category, Site Class, mass and height of buildings, etc. Other SFRS are considered in these examples:

- For areas of low seismicity, Conventional Construction, CC, (including braced frames) is usually considered (exception: CC is not permitted for Post-disaster buildings);
- For areas of high seismicity, Eccentrically Braced Frame, EBF, should be considered;
- Beam hinging (instead of brace yielding) is permitted for Low-rise (height ≤ 20 metres) Limited-Ductility Chevron CBF in areas of moderate seismicity; and
- For taller buildings in areas of moderate seismicity, EBF may also be considered.

Other shapes as braces

Shapes other than HSS may be viable alternatives when favourable conditions present themselves, for example:

- Where the brace forces are large, e.g., a large/heavy multi-storey frame, may try W-sections;
- For one- and two-storey tension-only Limited-Ductility frames, may also try double angles, double channels and double tees (as shown in the figure); and
- Where Class 2 sections are permitted for low-rise Limited-Ductility Chevron frames, may also try double tees, etc.

It should be noted that the design and construction of the above-mentioned built-up brace members must also comply with the requirements of clause 27.5.3.3 of S16-09.

In the end, HSS will most likely remain the popular choice in most applications.


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By Tareq Ali, RPM

Environmental Product Declarations

Helping to make informed choices in the "green" construction marketplace

As greenbuilding rapidly evolves to become a mainstream construction practice, companies marketing their building materials as green, sustainable, eco-friendly or by similar labels are coming under increased pressure. They increasingly need to provide standardized, quantifiable and independently verifiable data that make it possible to have an effective comparison of the environmental performance of different products.

This trend builds on the already established holistic life-cycle approach to sustainable design and construction. This is an approach where the environmental footprint of a product during its entire "cradle to grave" life cycle (from resource extraction to use and end-of-life stages) is considered rather than how green a product is in its finished state.

The demand from consultants, designers and specifiers for a more transparent and standardized system of measuring environmental performance has led to the growing popularity of EPDs, or Environmental Product Declarations.

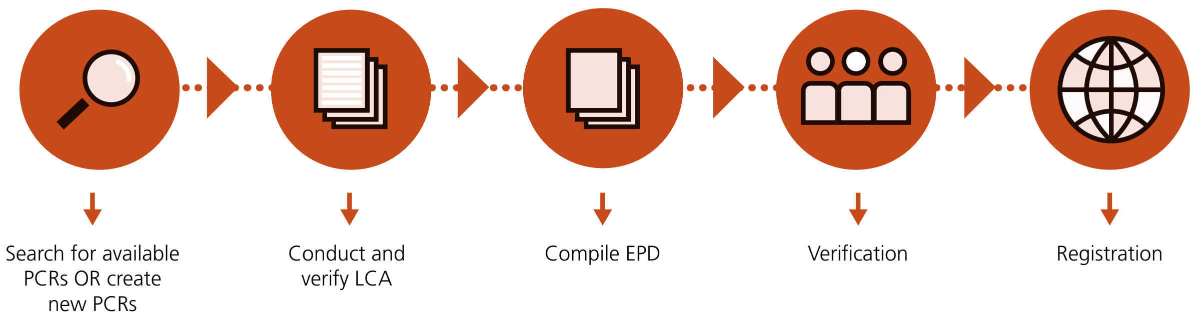
EPDs encompass a labelling system that provides a life-cycle-based snapshot of a product's environmental impact using standardized methodology and protocols that are independently verified. While they are not new, EPDs are becoming increasingly important as the consulting community tries to make informed procurement choices for their project, often from a dizzying array of green building products and services available in the construction marketplace.

An EPD is a globally recognized Type III environmental declaration based on the International Organization for Standardization (ISO) 14025 standard. It is an independently verified product declaration based on a complete assessment of a product's key environmental impacts at all stages of its life cycle. This includes materials extraction, production, transportation, installation, use, and end-of-life stages.

The environmental impacts, including everything from energy, water and materials consumption to waste generation and emissions, are quantified based on Life Cycle Assessment studies conducted in accordance with the ISO 14040 standard and a set of product-specific rules (PCR) and specifications.

The most commonly tracked environmental impact categories are as follows.

- A product's carbon footprint;
- Water and energy consumption;
- Climate change: long-term changes in global weather patterns, including temperature, precipitation and cloud coverage, that are caused by increased concentrations of greenhouse gases in the atmosphere;
- Waste generation;
- Acidification of land and water: the result of human-made emissions and refers to the decrease in pH and increase in acidity of oceans, lakes, rivers and streams – a phenomenon that pollutes groundwater and harms aquatic life;
- Photochemical ozone creation: happens when sunlight reacts with hydrocarbons, nitrogen oxides and volatile organic compounds to produce a type of air pollution known as smog;
- Eutrophication: occurs when excessive nutrients spawn increased algae growth in lakes blocking the underwater penetration of sunlight needed to produce



oxygen and resulting in the loss of aquatic life;

- Ozone depletion: the destruction of the stratospheric ozone layer, which shields the earth from ultraviolet radiation that's harmful to life, caused by human-made air pollution;

- Abiotic resource depletion/elements: the reduction of available non-renewable resources, such as metals and gases that are found on the periodic table of elements, due to human activity; and

- Abiotic resource depletion/fossil fuels: the decreasing availability of non-renewable carbon-based compounds, such as oil and coal, due to human activity.

The EPD also provides additional quantitative or qualitative environmental information that is material to the product such as human toxicity risk and corporate social responsibility.

EPD development process

The EPD is commissioned by a manufacturer and performed by an independent organization (EPD program operator) on the basis of predefined Product Category Rules (PCR). PCRs contain criteria and standardized rules for LCA methodology applicable to individual product groups. The PCRs are developed by the program operator using a defined process that includes consultation with identified stakeholders with expertise in life-cycle assessment as well as those who are knowledgeable about the product.

Final Environmental Product Declarations are subject to verification to confirm that they comply with the applicable international standards and Product Category Rules.

To be approved, the product EPD and the respective PCR should be compliant, at a minimum, with the ISO 14025 and 21930 standards, and be posted in their entirety.

Once verified, the EPD can be officially registered and entered into a public repository. The public database/repository makes it possible for users to access scientifically verified information about environmental impacts of products and to compare their environmental performance.

The EPD is typically valid for three years, after which an internal review and verification is conducted on a regular basis to keep it up to date.

The growing acceptance and usage of EPDs as a standardized environmental "report card" for products will play a key role in promoting quality improvement, innovation and greater transparency in the construction industry, allowing consultants and owners to make the most informed choice for their projects.

Tareq Ali, RPM is the Director of Marketing at the Canadian Institute of Steel Construction

Applicable Standards

- ISO 14020: Environmental labels and declarations – General principles

- ISO 14025: Environmental labels and declarations – Type III environmental declarations – principles and procedures

- ISO 14040: Environmental management – Life cycle assessment – Principles and framework

- ISO 14044: Environmental management – Life cycle assessment – Requirements and guidelines

- ISO 21930: Sustainability in building construction – Environmental declaration of building products

A U.K. perspective on how structural fire engineering can promote steelwork

By Allan Jowsey

The importance of fire protection materials in the event of a fire in a building is critical. However, for many designers little thought is generally given to specific details relating to fire protecting structural steelwork.

In the U.K. and Europe, there are a number of ways in which experts combine structural engineering methods, testing of fire protection materials, and collaborative efforts between designers and manufacturers to arrive at optimized, efficient, robust and safe designs. Such approaches take advantage of steel design and, over the last two decades, they have played an important role in making steel the preferred choice for the construction industry.

Figure 1 shows the cost breakdown for elements forming the structural frame of a typical multi-storey building. It shows that the cost of fire protection to the steelwork can be in the order of 20 per cent of the frame costs. This is not an insignificant value and, as such, designers are now looking for innovative ways to reduce cost on projects. Structural fire engineering can provide a solution in this respect.

Structural fire engineering

There are three common methods of structural fire engineering:

1. Reducing fire resistance periods

Prescriptive codes such as the NBCC and IBC or NFPA 101 in the U.S. define periods of fire resistance for elements of structure. These are typically periods of up to 180 minutes in 30-minute intervals. A fire engineer, however, can look at the anticipated fuel within a building, the compartment geometry, the potential ventilation and the use of suppression systems to arrive at a realistic transient fire and therefore define a performance-based fire resistance period. It is not uncommon in the U.K. for high-rise buildings to reduce from 120 minutes (the maximum fire rating in the U.K.) to 90 minutes fire resistance. This allows for greater choice for fire protection materials and can reduce cost significantly.

2. Limiting steel temperature

Fire resistance periods should ideally be complemented by a limiting steel temperature (the temperature that the steel will reach whilst still maintaining enough strength to carry an amount of load and thus prevent collapse) for every single structural member. This should be determined by a competent structural engineer and can be used by the fire protection manufacturer to assess the appropriate thickness of insulation. In the U.K. and Europe, fire protection materials are tested to a range of temperatures 350°C to 750°C (662°F to 1382°F). The limiting steel temperature is a function of the member capacity and the degree to which it is loaded at the time of a fire. Structural codes such as the Eurocodes provide a methodology to calculate the limiting steel temperature.

This approach frequently results in higher failure temperatures than the defaults assumed by fire protection manufacturers in the absence of it being calculated. Therefore, a reduced thickness of material is required, and often substantial cost savings are achieved. At present, however, the limiting steel temperature for the North American market is implicit within the ULC S101 (or UL 263 and ASTM E119 in the U.S.) fire test and is set at 538°C (1000°F) for columns and 593°C (1100°F) for beams. These temperatures may appear to be conservative, but there are a number of scenarios in which they may not be safe.

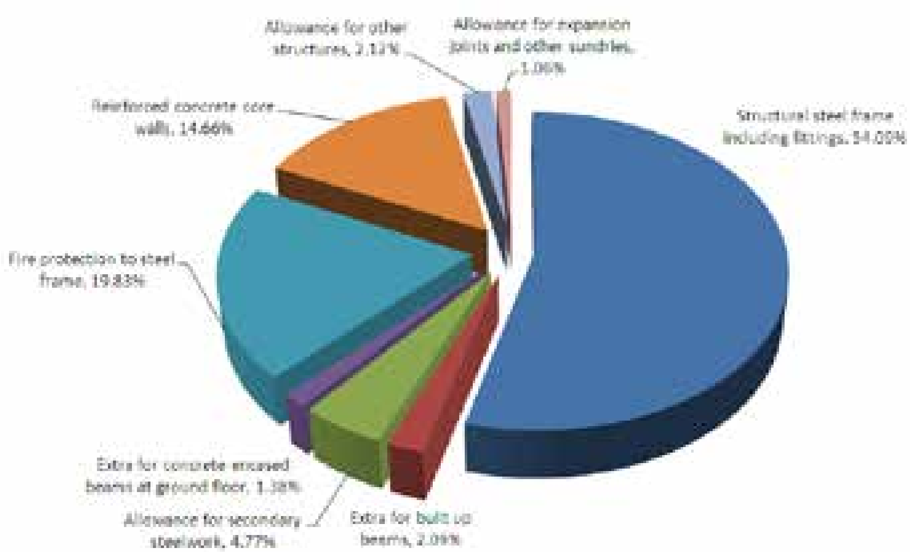


FIGURE 1: Example relative cost breakdown of components of the structural frame cost for a 14-storey office building in central London (*Building Magazine*, 2011) showing the proportion of cost associated with fire protection.

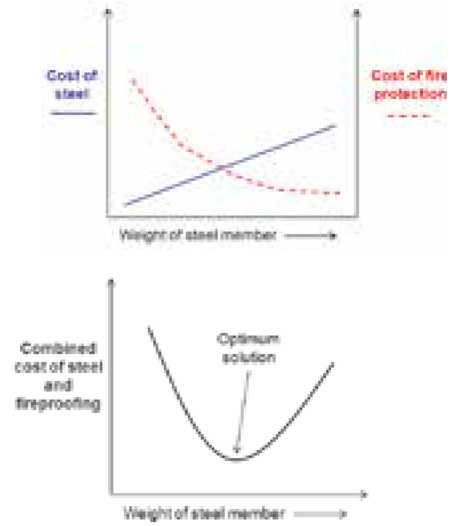


FIGURE 2: (Top) Illustration of the typical steel and fire protection costs associated with an increase in the weight of a steel member, (Bottom), combined cost of steel and fire protection, showing optimum solution with respect to steel weight.

3. Optimization by weight

The greater mass or weight of a steel section, the more slowly it will heat in comparison to a lighter steel section. Large sections will therefore require a comparatively thin thickness of fire protection material to achieve a specific fire resistance period when compared to smaller sections. Structural engineers often design for the lightest, most efficient steel section; however, this can result in high fire protection costs. Designers in the U.K. are now looking at optimization approaches, which account for the combined cost of steel, fire protection material and application rates. In almost all cases, this approach demonstrates that the lightest steel design is not the most economic. This process is illustrated in Figure 2.

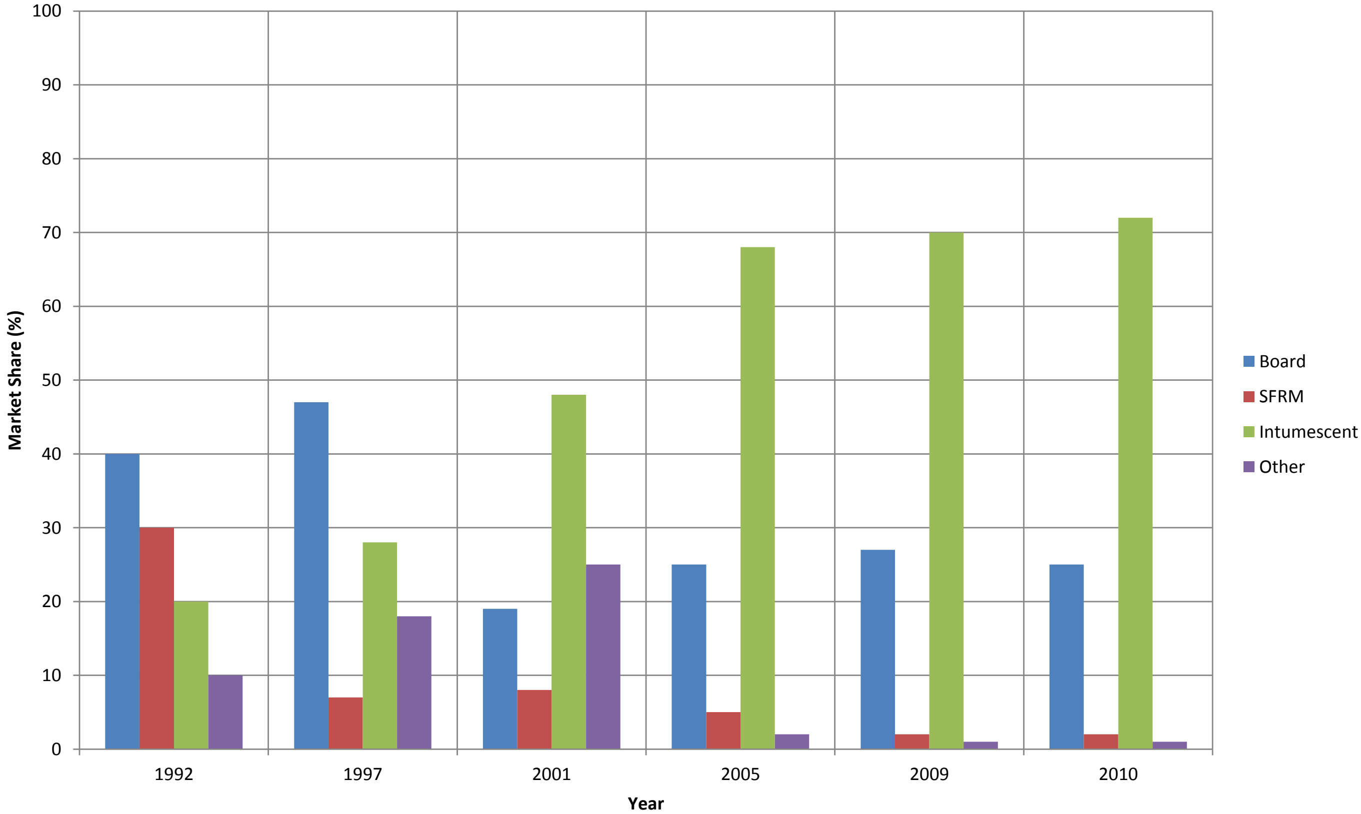


FIGURE 3: Fire protection material usage by date in the U.K. for new building construction.
Courtesy of the British Constructional Steelwork Association (BCSA) and Tata Steel.

Choice of fire protection material

Thin-film intumescent coatings now dominate the U.K. structural fire protection market in new buildings as shown in Figure 3. This can be attributed to the commitment on the part of the manufacturers to research and design. This has been helped and encouraged by the growth of in-shop application and structural fire engineering by consulting engineers.

In-shop application is more expensive than most other forms of fire protection in terms of initial cost. However, for projects where speed is of the essence, health and safety creates difficulties, access is difficult, weather may cause problems, disruption of other trades on site may be experienced, etc., this premium can pay big dividends later. It is mainly used where medium to large buildings are constructed quickly. Estimates in the U.K. suggest that in-shop application accounts for about 15 per cent market share of all fire protection materials, with around 25 per cent of all thin-film intumescent coating applied this way.

Fifteen years ago, intumescents in the U.K. were a niche product, with an approximate overall 20 to 25 per cent market share. Today, that figure is in excess of 70 per cent and manufacturers are now starting to look at structural fire engineering approaches that assist clients to reduce cost, increase efficiency and promote the use of structural steelwork.

Influencing the steel market

The feature of the fire protection market that has enabled the U.K. steel construction industry to solve the problem of fire is illustrated in Figure 4 and is often referred to as a virtuous circle. In the U.K., the key event was the appearance of lightweight fire protection systems in the 1980s. These reduced prices considerably, which improved the economies of steel construction, which in turn increased the amount of steel in use. This then encouraged more fire protection companies to enter into the market, which then encouraged research and innovation (in the form of structural fire engineering and product development) and decreased prices. Ultimately, this approach improved the economics of steel construction and the circle began again.

Figure 5 shows the change in usage of the main framing options in multi-storey, non-domestic construction, over the last thirty years. It shows that steel has increased its market share hugely since the early 1980s. One of the key reasons for this is attributed the reduction in cost of fire protection for fabricated steelwork.

Summary

There are a number of methods of undertaking structural fire engineering, each with the potential to bring substantial cost savings to a project. Importantly though, they can be used to quantify structural performance in the event of a fire rather than assuming performance, implicit from a fire test alone.

Fire protection manufacturers in the U.K. and Europe now employ qualified structural and fire engineers and are beginning to align with consulting engineers, steelwork fabricators and steel construction institutes to demonstrate added value by incorporating fire protection characteristics into steelwork designs. This approach is welcomed by the steel industry as it helps to promote steel as a construction material and ultimately leads to robust and safe designs in the event of a fire.

Allan Jowsey PhD, MEng, CEng, MIFireE, MSFPE, is the Fire Engineering Manager in the Structural Fire Design Department at International Paint Ltd. in Felling, U.K.

FIGURE 4: Virtuous circle showing interaction between fire protection manufacturers and increased use of structural steelwork. *Courtesy of the British Constructional Steelwork Association (BCSA) and Tata Steel.*

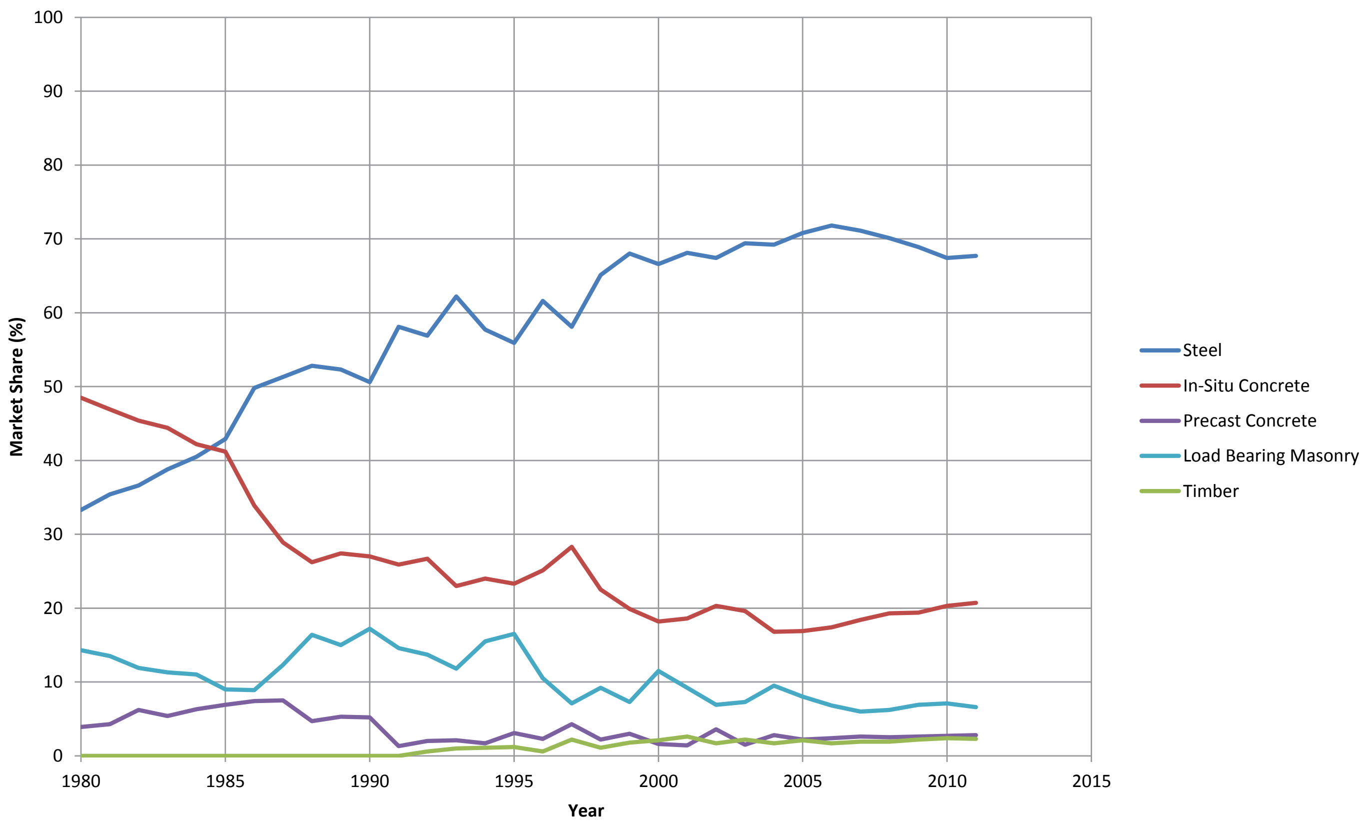


FIGURE 5: Structural material usage for multi-storey buildings by date in the U.K. *Courtesy of Construction Markets Annual Survey, the British Constructional Steelwork Association (BCSA) and Tata Steel.*

An advantage overlooked

Structural steel's advantages play out just as strongly in hospital construction as in other building types

By Andrew Brooks

The advantages of structural steel are well known – lightweight, ease and speed of construction, adaptability, creativity in design, and strength. But there are some project categories where the use of structural steel is not as widespread as its multiple advantages warrant. Case in point is hospital construction.

True, structural steel is regularly used for hospital building elements such as awnings, canopies and atriums, where an open, bright, yet strong structure is required. However, structural steel still is not used as commonly for the main structural elements as it could and should be. Cast-in-place concrete still tends to be favoured for a range of reasons that have as much to do with intuition and gut feel as they do with hard science.

The concrete-versus-steel debate was the focus of a presentation delivered to CISC Alberta's Steel Workshop in Calgary in 2011 by Jeff DiBattista, principal in DIALOG's Edmonton office. The presentation, titled "Concrete or Steel? Considerations for the Edmonton Clinic," compared the use of structural steel and cast-in-place concrete in two medical buildings in Edmonton, the Edmonton Clinic South and Edmonton Clinic Health Academy (ECHA), with a total project value of almost $1 billion. The Edmonton Clinic South, due for completion this summer, is built with cast-in-place concrete, and the ECHA, which was finished last summer, utilizes structural steel. DIALOG was the structural engineer for both projects, partnered with Halcrow Yolles.

DiBattista found that structural steel had clear advantages in the project's design and construction phases. Some of these are well known and apply across a wide range of projects, while others stand out particularly when building hospitals.

Steel staircase being installed at Credit Valley Hospital

Faster option

At a basic level, structural steel work simply tends to go faster than cast-in-place due to the intrinsic advantages of having pieces fabricated off-site and delivered ready for assembly. Steel also allowed the superstructure bulk steel preorder bid for the ECHA to be issued in April 2008, in advance of the architects completing the design development phase. “Steel allows us to move more quickly through the design process, since we can avoid having to draw all the bits of rebar,” says DiBattista.

Another important cost-cutting factor is the fact that project managers can entertain competitive bids from steel fabricators across the country, whereas cast-in-place work relies on the availability of local firms and skilled local labour. Both of the projects referenced in DiBattista’s comparative presentation faced a similar labour-shortage situation in Alberta, which raised labour rates at the same time as it became harder to find the kind of labour skills required.

“With concrete, you have to do a lot on-site,” says Jim Montgomery, DiBattista’s fellow principal at DIALOG.


Steel frame construction at the Carlo Fidani Peel Regional Cancer Centre

"It makes it harder to do quality work. There aren't as many people who can place rebar and concrete as there used to be. When you use steel, you can engage fabricators across the country in the bidding process, and in addition to quality work you also get increased competition."

The lighter weight of a structural steel building compared with cast-in-place concrete means that less substantial footings can be used, which saves time and expense. And the ability to employ larger bays than the 9m x 9m typical with cast-in-place concrete means that over the scope of an entire building, one or more column lines can be eliminated, in addition to the added design flexibility larger bays afford. Cast-in-place concrete simply becomes progressively less economical to use when spans reach 12 metres and higher.

The Edmonton Clinic South – the cast-in-place concrete example in DiBattista's presentation – features 9.6m x 9.6m bays, a fairly typical size for a cast-in-place structure. The steel ECHA has two bay sizes – 9m x 7.5m and 7.5m x 15m for the classroom bays, larger than what can conveniently be achieved with cast-in-place concrete.

Steel's lighter weight also has a direct bearing on seismic loading, notes Paul Sandford, chief engineer, structural, with exp. "In seismically active zones, concrete will require more shear walls to take out the seismic loading," he says. "So steel is probably a better choice, due to the lighter structure and the resultant lower seismic loading."

The role of politics

Another advantage tipping the scales in favour of structural steel derives from the fact that hospitals are a major element of public infrastructure. Structural steel's advantages in terms of build time is crucial here, since political involvement in any project always introduces a certain element of uncertainty that can affect budgets and timelines. When governments invest in infrastructure, they want to get results quickly, on their watch, rather than have projects completed under some future administration. Also, public-sector budgets are always subject to rapid change – and it's never for the better. So the ability to lock in pricing, and to have the necessary fabrication completed separately and, if required, in advance, allows for added adaptability on the part of the project managers.

Hospital timelines are tight for other reasons. When the project includes the renovation and upgrade of an existing facility that is open and operating throughout the process, as was the case with the Trillium Health Partners - Credit Valley Hospital project in Mississauga that started in 2007, the faster the job gets done, the better for all concerned. The Credit Valley project included the construction of the new four-storey Carlo Fidani Peel Regional Cancer Centre in steel.

When governments invest in infrastructure, they want to get results quickly, on their watch, rather than have projects completed under some future administration

"Speed of build is an important issue when working in or near an operating hospital," says Michael Jelicic, principal of Halsall Associates. Jelicic was the structural engineer for the Credit Valley project. "It's especially important with public infrastructure projects like hospitals, where political considerations are also involved. You tend to have very hard deadlines, but


The four-storey Carlo Fidani Peel Regional Cancer Centre

what's more, governments and funding frameworks can change. It's important to get the work done as quickly as possible before conditions change."

Hospital structural drawings often go out before architects and planners have determined how hospital rooms are to be set up, adds Jim Montgomery. "There's a high risk that changes will be needed at some point, and it's much easier to accommodate these if you're working with a steel structure." Two-way cast-in-place slabs are difficult to engineer for revisions.

"In my opinion, with structural steel it's much easier for the structural engineer to implement major design changes," DiBattista says. "The choice between structural concrete or steel-frame construction can come down to something as simple as floor penetrations. Hospitals typically require a tremendous number of them, both during construction and as buildings modernize over time. Steel frames with concrete on metal deck floors are easier and less expensive to core."

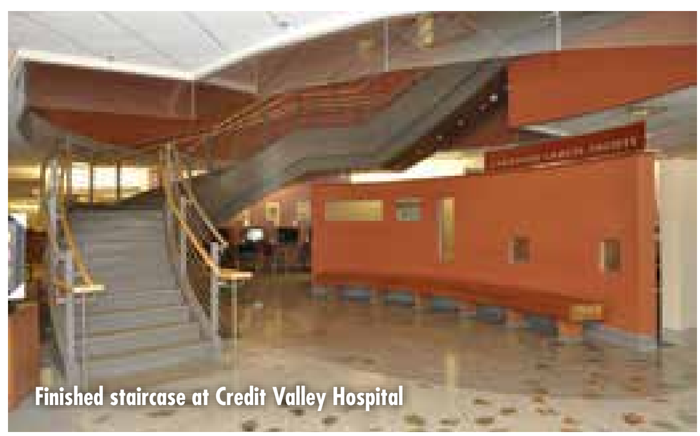
Hospitals, in particular, need to be adapted and changed over time, and structural steel is much easier to cut and replace that cast-in-place concrete. "There's very little room for cutting and filling in a concrete structure," Sandford says. "With concrete, when you cut an opening you change the way the slab's working. You can't go and fill it in and get it back to its original state because you've cut all the reinforcing steel." In many cases, steelwork has to be inserted to support the altered slab.

Reduction in vibration

One key factor that seems to prompt a preference for concrete in hospitals is the need to reduce any vibration that can interfere with the operation of highly sensitive equipment. Again, the preference has more to do with intuition than hard facts, because structural steel buildings can also be constructed to be free of detrimental vibration. "You can always design slab and steel in such a way that vibration isn't an issue," Sandford says. "You use heavier steel and thicker slabs than what you'd usually see in a steel building." In the construction of the ECHA, the 114mm topping on the 75mm deck utilized to meet the two-hour floor fire rating without spray-applied fireproofing also proved to be just as effective at damping vibration, DiBattista says.

"You don't need to make an entire hospital vibration-free – just certain areas," Jelicic adds. "With planning


Steel as structural material for entrance canopies at Toronto Western Hospital


Finished staircase at Credit Valley Hospital


Welders at work on Toronto Western Hospital project

it's possible to move vibration-sensitive equipment to slab on grade. That's the most economical way to go."

Walt Koppelaar of Walters Inc., the fabricator that worked on the Trillium Health Partners - Credit Valley Hospital, has had experience with sound and vibration damping for public performance venues, notably Carnegie Hall and the Lincoln Center in New York. "They had rooms that had to be totally isolated from sound and vibration," he recalls. "We were able to achieve that using structural steel and bearing pads."

Both concrete and steel can be recycled, but steel can, in many cases, actually be reused as such, while concrete is typically ground up and used for other applications. Halsall Associates designed the Michael Lee-Chin "Crystal" addition to the Royal Ontario Museum, and Jelicic points out that in the course of the work, a portion of the old building was demolished and the steel beams that were removed were able to be reused as is in a different project.

Anecdotal evidence suggests that the advantages of structural steel in hospital construction are much better understood in other jurisdictions than they are in some parts of Canada. Maybe it's time for a rethink?

Finished staircase at Credit Valley Hospital

Bridge rehabilitation: Thinking outside the box

To avoid possible disasters, we need to look into "smart" technology solutions to maintain our bridges

Bridges are the backbone of our transportation infrastructure and they require significant investment for inspections, maintenance, restoration and replacement. Not that long ago, the deterioration of our bridge infrastructure was brought to the forefront following the 2006 collapse of the Boulevard de la Concorde overpass, in Laval, Quebec.

The frail condition of many of our bridges is the result of structural weaknesses. Why these weaknesses aren't being addressed in a timely fashion has become a major concern, and a dilemma. Apart from the huge financial losses that result from bridge disasters, there is also the tragic loss of life, which is unacceptable.

A large percentage of bridges in Canada were built between 1960 and 1980, when technical knowledge about bridge performance and durability was at its infancy. Despite the fact that these bridges were designed with a 70-year lifespan, deterioration, damages and sometimes failure have become commonplace. According to a 2008 Statistics Canada report, the average age of bridges and overpasses (which at the time comprised eight per cent of total public assets) rose by 3.2 years over the preceding 22-year period, while the ratio of average age over useful life was over 57 per cent.[i]

There is no unequivocal way to anticipate tragedies such as the collapse of the Boulevard de la Concorde overpass. However, events such as these should drive us to improve bridge safety and consider out-of-the-box, technologically viable solutions. With significant advances in "smart" technology, we can adopt a proactive, rather than reactive, approach, fulfilling an important responsibility to ensure the safety of our bridges.

"As bridge engineers we have a result-based obligation, both legally and ethically, and a duty, to take an active interest in, rather than a passive approach to, searching for solutions," explains Dr. Hellen Christodoulou, CISC's Québec Regional Manager. "Good intentions, inexperience and critical commentary do not suffice."

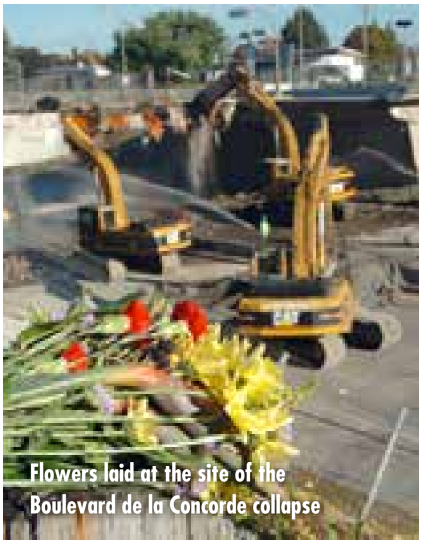
Given that the country's bridge population is continuing to age, it is essential that we implement an efficient structural health monitoring system to ensure more accurate, prompt and continuous evaluation of problems.

The smart solution

Retrofitting or embedding "smart" material-sensing technologies into existing or new bridges would be a more proactive approach. While costly at the outset – given the necessary and significant restructuring of bridge management systems – smart technologies would allow us to continuously monitor bridge structures. This would result in increased accuracy and better detection and assessment, which in turn would lengthen bridge lifespan and deliver long-term financial benefits.

This smart technology has already been theoretically introduced in academic environments, with several pilot projects going on in Canada. Other countries have more readily implemented this technology, resulting in reliable, precise information and proven benefits. The emphasis, says Christodoulou, should be on the technology's positive attributes: "The focus should be on the advantages of introducing this technology and effectively managing this disruptive innovation. It is an intervention that could improve the effectiveness of data evaluation and methods of analyses."

The main purpose of bridge inspections is to identify emerging problems at their infancy, and to rectify them before they require major repairs that could affect a bridge's structural integrity. Routine periodic inspections and maintenance need precise data, which are not always available through visual or even



Flowers laid at the site of the Boulevard de la Concorde collapse detailed standard inspections. Smart technology could help us achieve this goal. "Individual members requiring repairs could be spotted early on, resulting in immediate repairs that would possibly reduce the need for an outright replacement before its time," notes Christodoulou.

Another objective of a bridge inspection is to properly identify hazardous conditions, whether immediate or potential, and recommend appropriate remedial measures. Compiling clear, precise data and detailed, accurate reports is an integral part of the inspection process. Evaluations, calculations and decisions concerning bridge safety need to be premised on this information, as do assessments on the physical condition of the bridge.

Traditional inspections warrant a certain degree of expertise, however assumptions, determinations and evaluations made during the inspection are dependent on individual competencies. They are therefore subjective, as shown in a recent study conducted in the U.S.[ii]

The study surveyed various bridge inspection agencies to determine the accuracy and reliability of both

The steel advantage

The decision to repair or replace a bridge is premised on a need to optimize its serviceability, prolong the durability of its materials and minimize maintenance requirements, which in turn maximize the long-term cost benefits. When making this decision, bridge engineers evaluate the tradeoffs between parameters.

Steel bridges meet many of these requirements. Major advances in automated fabrication and construction techniques offer significant advantages and economic solutions when it comes to safety, rapid construction, esthetic appearance, shallow construction depth and flexibility.

"Steel is considered the more sustainable solution," says Dr. Hellen Christodoulou, CISC Québec Regional Manager. "It is a recyclable construction material, easy to assemble, and erect, durable and adaptable."

More importantly, steel bridges facilitate the inspection process. Defects in structural steel are visible and often repairable. The corrosion or warping of steel members, connections to gusset plates and bolts or rivets are all readily detectable. This information is available to bridge engineers with the appropriate expertise to determine solutions.


NUCOR-YAMATO
STEEL
GRAND OPENING

routine and in-depth inspections, and to identify key factors impacting performance and outcome of bridge inspections. It showed that routine inspections were completed with significant variability, especially where condition ratings were concerned, and that visual acuity and complexity of damage were also critical factors. The study also showed that many critical defects, such as weld cracks, went undetected.

The study's recommendations focused on ensuring more accuracy and reliability in the inspection process. Properly evaluating and determining bridge ratings is critical when it comes to providing the criteria upon which to base a decision to repair, rehabilitate or replace a bridge. Visual inspections, as the study showed, do not always deliver. "Needless to say, neither visual inspections nor non-destructive testing are methods that allow us to predict unexpected behaviour," observes Christodoulou.

Adding smart technology would result in automated measurements, assessment of internal conditions, distribution of data for analysis and related improvements in bridge performance and safety management.[iii] Smart technology would improve on the systems and processes currently in place, which are weak in control mechanisms intended to ensure quality detection and protection. This weakness has already negatively impacted the effective conservation of bridges.[iv]

In summary, smart monitoring systems offer a better solution for the near future, increasing efficiency while providing uniform information. With the reliable information delivered by a health monitoring system, we can take a more proactive approach to bridge monitoring, reacting quickly to early detectable problems.

"Without a doubt, the immediate availability of pertinent data allows for the appropriate action to be taken without delay should structural problems arise," says Christodoulou. "Immediate corrective or restorative action will, no doubt, result in a longer lifespan for new structures and less expensive restoration costs for existing ones. Let's think outside the box."

Dr. Hellen Christodoulou is Québec Regional Manager for the Canadian Institute of Steel Construction (CISC).

Endnotes

[i] http://www.statcan.gc.ca/pub/11-621-m/11-621-m2008067-eng.htm
[ii] http://www.tfhrc.gov/focus/jan01/bridge_study.htm
[iii] http://spie.org/x15813.xml?highlight=x2420&ArticleID=x15813
[iv] http://www.pdth.com/images/quebec.pdf

If you're an Ironworker Contractor in Canada, you have access to a wealth of programs funded by the **Ironworker Management Progressive Action Cooperative Trust (IMPACT)**. IMPACT is a joint labour-management association whose primary goal is to create job opportunities for Ironworkers and their Contractors.

For more information about how IMPACT can help you, contact Bert Royer, our Canadian regional representative, at broyer@impact-net.org, or by phone at (306) 536-0442.

Funding

- USA/Canadian Ironworkers mobility program to ensure Ironworkers and contractors can take advantage of job opportunities across North America
- The entire budget of the National Ironworkers and Employers Apprenticeship Training and Journeyman Upgrading Fund (NIEATJUF)
- Training materials are developed jointly with Canadian representatives participating throughout the process of updating manuals and creating new training materials
- The Annual Ironworkers Instructor Training Program
- The International Apprenticeship Competition
- Reciprocal Canadian Welding Bureau (CWB)/ American Welding Society (AWS) Development Agreement
- The Ironworker Wind Turbine Training Program available to all local unions and our contractors
- The development of Green Construction for Ironworkers training materials
- The purchase of Mobile Training Trailers across North America
- Access to training reference materials for contributing contractors
- The Distance Learning Prototype for Training Programs
- Marketing and training programs for the Shop Department that help our signatory shops stay competitive and grow the number of signatory shops
- Programs of the Department of Reinforcing Steel (partial funding)
- The Ironworker Safety & Health Department
- Dozens of new welding fume extraction systems and welding booths in Local Union Training Facilities
- The IMPACT Safety & Health Roundtable, which brings all the major organizations in the Ironworking trade together to address the major safety and health issues in our industry

RAB Funding

- 20 percent of all contributions go back to your local IMPACT Regional Advisory Board to help fund existing labour-management programs and develop new programs to grow market share and get more work

Leadership Training

- The development of the Ironworker Foreman Training Program and the Ironworker Foreman Pocket Guide
- The development of the new Ironworker Superintendent Training Package and Online Course
- The development of a leadership seminar for labour and management
- Development of the Annual Business Manager Leadership Course
- The IMPACT Mentoring Program
- Shop Supervisor Courses

Education

- Courses for contractors conducted at the Annual Ironworker Instructor Conference, the Iron Workers/ IMPACT Labour-Management Conference and other locations across North America

Lobbying/Getting More Work

- Major infrastructure lobbying efforts around the country to get more work for Ironworkers and our employers

Marketing/Member Engagement

- Development of "Entering the Circle of Trust: Marketing Skills for Ironworkers" to retain our existing contractors and grow our contractor base
- Local and regional marketing efforts and advertising in industry publications
- A website program to help local union and contractors establish or upgrade their websites at no charge
- A comprehensive social media campaign to tell the story of the Union Ironworking industry
- Distribution of the Ironworker magazine to all contributing contractors/owners
- Project tracking systems to assist local unions and our employers to identify new construction and maintenance projects and to capture more work
- Membership Engagement – IMPACT Industry Events
- Displays to promote the industry at conferences and conventions
- Displays for local unions for industry promotion and recruitment

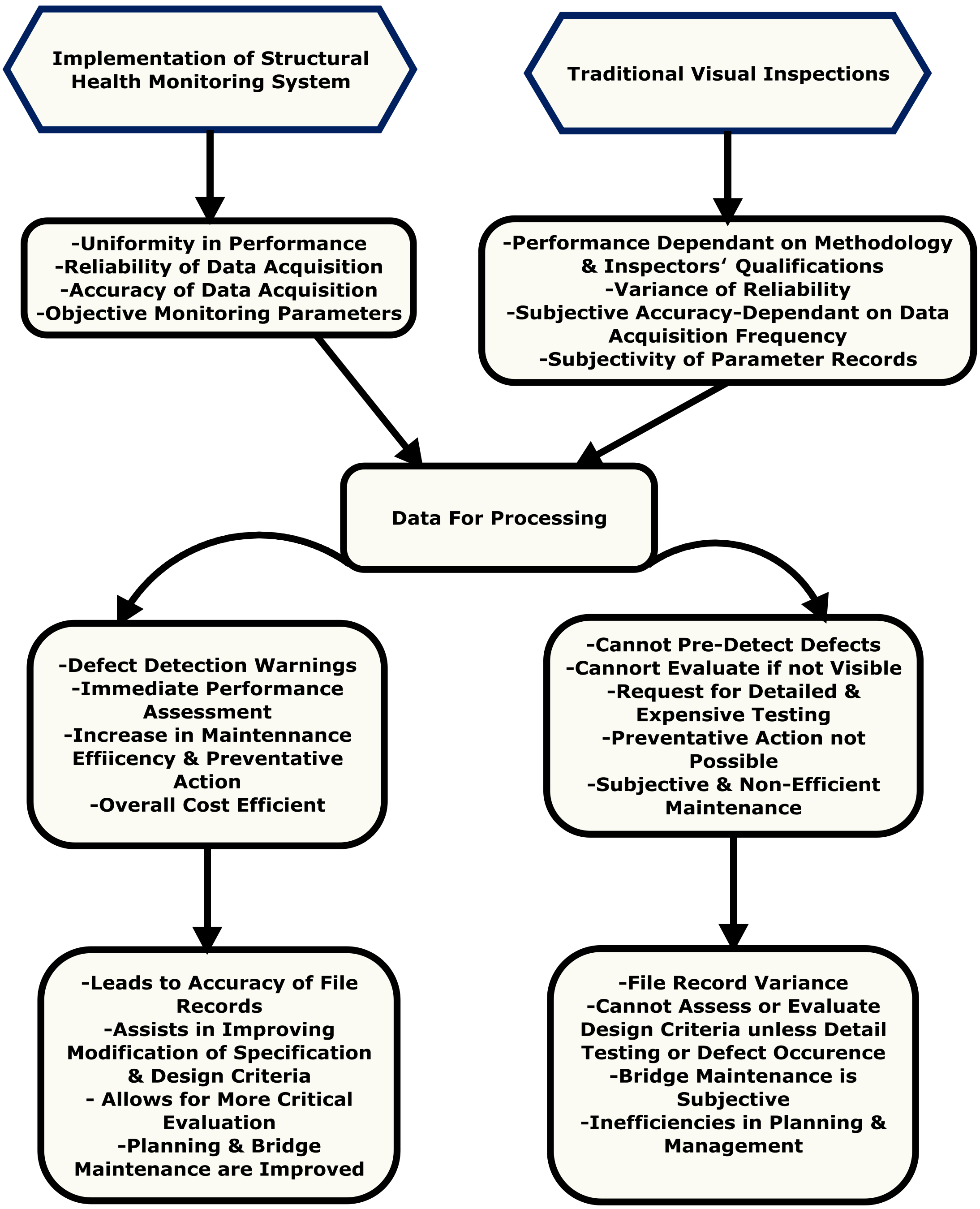
Global view

Below are several world applications of smart bridge monitoring systems for existing and new bridges.

(1) anemometers; (2) temperature sensors; (3) strain gauges; (4) accelerometers; (5) displacement transducers; (6) global positioning systems; (7) weigh-in-motion systems; (8) corrosion sensors; (9) elasto-magnetic sensors; (10) optic fibre sensors; (11) tiltmeters; (12) level sensors; (13) total stations; (14) seismometers; (15) barometers; (16) hygrometers; (17) pluviometers; (18) video cameras.

BRIDGE/LOCATION	MAIN SPAN(M)	SENSORS INSTALLED
Jiangyin Bridge (Suspension)/Jiangsu	1385	(1), (2), (3), (4), (5), (6), (9), (10), (13)
1st Nanjing Yangtze River Bridge (Steel truss)/Jiangsu	160	(1), (2), (3), (4), (5), (7), (14)
2nd Nanjing Yangtze River Bridge (Cable-stayed)/Jiangsu	628	(1), (2), (3), (4), (7), (9), (13), (16)
Runyang South Bridge (Suspension)/Jiangsu	1490	(1), (2), (3), (4), (6)
Runyang North Bridge (Cable-stayed)/Jiangsu	406	(1), (2), (3), (4)
Sutong Bridge (Cable-stayed)/Jiangsu	1088	(1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (16), (18)
TsingMaBridge (Suspension)/Hong Kong	1377	(1), (2), (3), (4), (5), (6), (7), (12), (18)
KapShui Mun Bridge (Cable-stayed)/Hong Kong	430	(1), (2), (3), (4), (5), (6), (7), (12), (18)
Shenzhen Western Corridor (Cable-stayed)/Hong Kong	210	(1), (2), (3), (4), (5), (7), (8), (15), (16), (17), (18)
Stonecutters Bridge (Cable-stayed)/Hong Kong	1018	(1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (15), (16), (17), (18)
Tongling Yangtze River Bridge (Cable-stayed)/Anhui	432	(1), (2), (4), (11),(13)
Wuhu Bridge (Cable-stayed)/Anhui	312	(2), (3), (4), (5), (10), (12)
Humen Bridge (Suspension)/Guangdong	888	(3), (6), (11), (12)
Zhanjiang Bay Bridge (Cable-stayed)/Hong Kong	480	(1), (2), (3), (5), (6), (9), (11), (14), (16)
Xupu Bridge (Cable-stayed)/Shanghai	590	(2), (3), (4), (7), (12)
Lupu Bridge [37] (Arch) Shanghai	550	(2), (3), (4), (12)
Dafosi Bridge [38] (Cable-stayed) Chongqing	450	(2), (3), (4), (5), (10), (12)
Binzhou Yellow River Bridge [14] (Cable-stayed) Shandong	300	(1), (2), (3), (4), (6), (10)
4th Qianjiang Bridge (Arch)/Zhejiang	580	(1), (2), (3), (4), (9),(13)

System comparison



Pembina Hall: An uplifting transformation

University of Manitoba erects a modern $40-million addition to its student residence

By Sylvie Boulanger, P.Eng., & Kelly J. Hearson, P.Eng.

When the University of Manitoba needed additional student residence rooms, it looked for a solution that would closely integrate with current facilities. After considering several scenarios, it was clear the best approach was to go up and above the existing Pembina Hall.

For Crosier Kilgour & Partners, developing and executing the design concept for the Pembina Hall Residence was no small feat: build two slender 14-storey towers at each end of the building with sufficient strength to support a 10-storey residence block; incorporate 36 rooms on each level; and have the residence block span 50 metres over the existing Pembina Hall.

The structure rises 57.2 metres above grade, extends almost 80 metres in an east/west direction, and is only 13.3 metres wide in a north/south direction – making it very slender. The answer to the long span constraint could only be in steel: four parallel full-storey depth, 50m-long trusses stacked 10 times. There were two interior trusses hidden in corridor walls and two fully exposed exterior trusses.

Room with a diagonal view

For Raymond S.C. Wan, project architect, the best way to integrate the imposing structure was to fully expose the exterior trusses. While highly unusual, exposing the robust exterior truss members within the modestly sized residence rooms created a dramatic design, which accentuated the need to care about the form, fit and finish of the diagonals and the connections. The exposed diagonals created what the university has described

The challenge

- Execute the project within the University's multi-building "Project Domino" budget;
- Complete the design, tendering, construction and certification of a complex $40-million facility in less than 30 months, in order for students to take residence in September 2011;
- Have the design take into account that the site access is very difficult, and there is essentially no lay down area for the contractor to be able to work from; and
- Construct the building to maintain safety to the occupied Pembina Hall beneath, and the hundreds of students and staff that pass by the site every day.

as "a blend of contemporary and innovative design. This state-of-the-art facility will be comparable to other urban living centres found across the globe."

Each student resident gets "a room with a diagonal view." The diagonals are also visible from the outside. Although an engineer would typically design the diagonals inclined away from the centre line, it was decided that they would have a more "uplifting" effect if they were inclined towards the centre line. The diagonals are wide flange shapes, which measure 308 mm by 305 mm. The truss verticals are typically welded wide flange shapes, measuring up to 660 mm by 660 mm.

Exposed diagonal and ceiling

Once the decision was made to expose the diagonals, the focus turned to fire protection. Although

> Long span trusses and exposed diagonals at the University of Manitoba's Fort Garry Campus contribute to a unique student experience

unusual, use of an intumescent coating rather than spray-applied fireproofing or gypsum board finishes on the diagonals was the better choice, both in terms of esthetics and durability requirements.

Floors were constructed with a two-hour fire separation and a suitable separation to noise transfer, yet were designed to be as light as possible, to minimize the cumulative load that the trusses needed to support. Spray-applied fire-protection on the underside of the deck was considered to be insufficiently durable, given the occupancy by students. Hence, the deck was left exposed in the room, which also has the benefit of not adding superfluous false ceiling materials. Rather than employ a separate floor finish, the concrete itself was coloured and patterned, in order to provide a suitable appearance, and enhance durability significantly.

Construction

In August 2010, with the facility consisting of two towers 50 metres apart, Supermetal Construction connected the towers together by erecting one of the largest steel trusses ever installed in Manitoba. Two 300-ton cranes simultaneously navigated over one building and beside another to put the truss into place. The truss measured 50 metres long, 5.2 metres high and 2.4 metres wide and was assembled on the ground. Crews took eight days to assemble the 55-tonne truss, which is comprised of six individual pieces.

Lifts of this magnitude, coupled with the fact that throughout the entire construction process work always had to be completed above an occupied space, raised the need for comprehensive safety measures, which the team was mindful of throughout the design process. The contractor, Bird Construction, summed up the situation best: "We built a platform over the existing structure to protect the roof and its occupants, and we covered the walkways into the building to keep people safe. The construction area went beyond the existing structure's footprint and above. We started with the east and west towers and built up to the eighth floor, and then we began erecting the trusses for each floor."

Lifting the first two interior trusses was critical. They were assembled as a box section. Special connection elements on the tower were designed to provide maximum on-site flexibility for fit-up. The Vierendeel panels in the interior trusses are the openings for the doors to the residence rooms.

Deflections

The overall vertical deflection of the 50-metre span was a concern. Building codes will typically stipulate an L/360 limit but that translates as 140 mm – which is not acceptable. Taking into account concrete curing issues, the composite action between steel and concrete, and the progressive addition of gravity loads, the correct amount of camber was specified for each floor and a casting schedule determined. Supermétal designed splices in the trusses, which allowed for ease of transport and a reduction in costs.

Given the length of the truss members, thermal expansion and contraction played a pivotal role in the constructability of the building frame. Precise calculations were completed at the time of design in order to understand how temperature effects would affect the ability to construct the frame and also the stresses introduced into the structure.

Sustainability

LEED concepts were followed in the design of the facility, resulting in a highly efficient building with reduced energy consumption. Expressing the structure and maintaining a minimalist design approach to the room fit-up, rather than employing numerous finishes, significantly reduced the amount of end-product materials incorporated into the

PROJECT TEAM

Owner: The University of Manitoba

Architect: Raymond S.C. Wan Architect

Structural Engineer: Crosier Kilgour & Partners Ltd.

General Contractor: Bird Construction Company Ltd.

CISC Steel Fabricator and Erector: Supermétal

CISC Steel Detailer: Techdess inc.

building. Finally, a high portion of the steel used in the project is wide flange sections, which are typically over 90 per cent recycled content, recyclable and reusable. Minimizing finishes and maximizing space by leaving diagonals, deck and slab exposed, accentuated the need for close collaboration between team members.

Impact on the community

University of Manitoba President David Barnard has said, "Pembina Hall (Residence) will greatly enhance the already excellent student experience we offer and is a cornerstone of the positive physical transformation of our campuses that will make the University of Manitoba an even better place to live, to work and to study."

The fact that the residence stands high above the surrounding campus and can be seen from a significant distance no doubt has had an effect on the aura that the building radiates. Contributions made by the University of Manitoba Physical Plant Department, as well as the Student Residence Group, were vital to the success of the project, and the delivery of the rooms within the required University timetable.

Sylvie Boulanger, Ph.D., P.Eng., is Vice-President, Technical Marketing for Supermétal, a large structural steel specialty contractor with four plants across North America.

Kelly J. Hearson, P.Eng., is President of Crosier Kilgour & Partners Ltd., a specialized structural engineering firm based in Winnipeg.

2013 Alberta Steel Design Awards of Excellence

The six winners of the 2013 Alberta Steel Design Awards of Excellence were announced on March 21 during a gala awards ceremony at the Alberta Ballroom in Northlands Edmonton EXPO Centre. The Alberta Steel Design Awards of Excellence represent North America's largest steel industry awards program. The goal of this biennial awards event is to share and recognize steel design and innovation excellence, promote awareness of the advantages of steel in construction, and create networking opportunities for industry stakeholders.

The awards recognize exceptional talent and ingenuity in steel design and the innovative use of steel in addressing a variety of construction challenges. Projects compete in five categories: Architectural, Engineering, Industrial, Sustainability, and Steel Edge. New in 2013 is a sixth category, entitled the Building Communities Award, recognizing steel structures, created as part of a community development project with a focus on serving community needs.

ARCHITECTURAL

TELUS Spark, The New Science Centre

Owner: TELUS Spark

CISC Fabricator/CISC Detailer/CISC Erector: Triangle Steel Ltd.

CISC Architect: DIALOG

Engineer: Stantec Consulting Ltd.

General Contractor: CANA Construction

This natural science museum complex, the biggest in Canada, is a unique focal point that invites citizens to reconnect with nature and invent a new way of living. The use of steel proved to be essential in the design stages; in addition to being light, it offered more possibilities than any other material in producing this daring design. Steel turned out to be the ideal choice to meet the very specific requirements of the project and the site, blending in perfectly. The result is a LEED Platinum building – representing a first in institutional building in Canada – made up of daring shapes. LEED Platinum is the highest certification available in sustainable construction.

BUILDING COMMUNITIES

Edmonton Federal Building, Parkade, and Centennial Plaza

Owner: Alberta Infrastructure

CISC Fabricator: Whitemud Ironworks Group Inc.

Architect: Kasian Architecture Interior Design and Planning Ltd.

Engineer: Stantec Consulting Ltd.

General Contractor: Clark Builders

Renovation of the 70-year-old Art Deco-style Edmonton Federal Building, on the northeast corner of the Alberta Legislature grounds, is one of the largest renovation projects ever undertaken in Edmonton. The project involved comprehensive redevelopment and repurposing of the existing Edmonton Federal Building and the addition of a new west entrance pavilion, a new public plaza, and a three-level underground parkade. One challenge was the need for large committee rooms that were column-free in a building originally designed as an office building. The committee rooms would require double the weight-carrying capacity that the floors were originally designed for and columns removed. The new west entrance pavilion opening onto the plaza provides a link between the old and the new, and created another interesting challenge.

ENGINEERING, STEEL EDGE

Peace Bridge

Owner: City of Calgary

Architect: Santiago Calatrava LLC

Engineer: Santiago Calatrava LLC/ Stantec Consulting Ltd.

General Contractor: Graham Infrastructure Ltd.

CISC Erector: Norfab Mfg. (1993) Inc.

The Peace Bridge spanning the Bow River in Calgary has become a favourite with photographers since it opened in May, 2012. Designed by world-renowned architect Santiago Calatrava, the stunning structure is a pedestrian and cyclist bridge that connects the vibrant neighbourhoods of Sunnyside and Hillhurst to the city's downtown core. The bridge structure is a sleek helix-shaped steel truss system developed over a semi-elliptical cross-section in a single span of 126 metres. The deck is eight metres wide to accommodate pedestrian lanes on either side and a central bike lane separated by curbs. Due to the challenging design criteria of a long span, wide bridge deck, and low structural depth, structural steel was chosen for its high strength-to-weight ratio. The bridge structure is symmetrical along the centre of the deck section, with the two identical halves connected at the top and bottom chords.

INDUSTRIAL

Suncor TRO Water Barges

Owner: Suncor Energy Services Inc.

CISC Fabricator/CISC Detailer: Supreme Steel LP

Architect: Hall Marine Design Ltd.

Engineer: Weir Minerals Canada

General Contractor: Weir Minerals Canada

Erector: Midwest Constructors

Suncor Energy required a floating barge system with a 27,000-cubic-metre-per-hour pumping capacity for its tailings reduction process. The system was to be the largest floating process water pumping facility of its kind in the world and it had to be operational within 18 months. A modular solution was proposed that minimized on-site welding requirements at the remote Fort McMurray location by providing shippable pre-assembled modules fabricated entirely off-site.

SUSTAINABILITY

Pembina Hall Student Residences (University of Manitoba)

Owner: University of Manitoba

CISC Fabricator: Supermétal Structures

Architect: Raymond S.C. Wan Architect

Engineer: Crosier Kilgour & Partners Ltd.

General Contractor: Bird Construction

Detailer: Techdess Inc.

Erector: Supermétal Construction Inc.

When the University of Manitoba required a new student residence that would be closely integrated with existing facilities, the only solution was to go over and up – above the Pembina Hall service centre. The location of the structure above a busy occupied building essentially meant no lay-down area for the contractor to work from, as well as unique construction safety issues. The design concept called for two slender 14-storey towers at each end of Pembina Hall with sufficient strength to support a 10-storey residence block with 36 rooms on each level and a span of 50 metres over the existing structure. The exterior trusses are fully exposed, creating a dramatic design that provides each room with a "diagonal view." The minimalist architectural look also required careful attention to the form, fit and finish of the diagonals and connections.

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News and Events

2013 CISC Annual General Meeting and Conference

The 2013 Annual General Meeting and Conference is being held at the Fairmont Chateau Whistler, in Whistler, B.C., from September 18 to 21, 2013.

We are looking forward to an exciting time for all of our members during the four-day conference. Take in some of the great speaker sessions, presentations, a game of golf, or join one of many tours and experience all that Whistler has to offer. There are many things to do and see in the heart of Whistler – walk the Village Stroll and browse the unique shops. Whistler Village is large enough to have all the amenities expected of a world-class resort, yet small enough for you to feel its unique mountain culture and distinctive hospitality. We will also be hosting our second CISC Lifetime Achievement Awards!

The agenda for the conference is currently being developed and will be sent out and posted upon completion.

We hope to see you in Whistler!

CISC proudly presents SteelDay 2013

SteelDay will be an interactive and networking event for members of the design, construction and structural steel industry. Across the nation, steel fabricators, mills, service centres, galvanizers, HSS producers, bender-rollers and others will open their facilities, job sites and offices to guests. Architects, engineers, contractors, developers, students, educators and the general public are invited to see how we contribute to building Canada.

SteelDay provides a unique opportunity for those in the structural steel industry to raise the profile of our industry while building lasting relationships with the local design community. We encourage all members to take advantage of this extremely cost-effective marketing and promotional strategy geared towards the architecture, engineering and construction communities, as well as the general public.

In addition to facility tours, some SteelDay hosts will also offer other events and activities, including job site tours, multiple facility tours, presentations and seminars, walking tours and hands-on activities.

More details will be released shortly on SteelDay.ca. In the meantime, think about becoming a host for SteelDay 2013.

Continuing Education Courses

Along with our ongoing calendar of courses, CISC is pleased to present two new English-language courses in the fall of 2013, one of which leads to CISC accreditation. The new 40-hour Connections II course and examination leads to the CISC Accredited Steel Connections Designer - Conventional Construction qualification. In addition, the new Single Storey Building Design course will be offered across Canada.

For full course schedule, information, online registration and the latest updates, please visit our website at www.cisc-icca.ca/education/courses, or request a copy of our course calendar.

Steel Bridges – Design, Fabrication, Construction

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 include fatigue and brittle fracture, integral abutments, esthetics and sustainability. Major changes and new provisions that were introduced in the tenth edition of CAN/CSA-S6 and their effect on the design of steel girders will be highlighted. Timber decks will be addressed in these locations.

Course Leaders:
Gilbert Grondin, Ph.D., P.Eng., Senior Bridge Engineer, AECOM and Adjunct Professor, University of Alberta

James Montgomery, Ph.D., P.Eng., LEED AP, Principal, DIALOG

Paul J. King, P.Eng., VP Engineering, Rapid-Span Structures Ltd.

Thunder Bay, ON	September 9 & 10
Moncton, NB	September 12 & 13

Industrial Building Design

This course is intended to provide understanding on design theory and the rationale behind code provisions that are unique to steel-framed industrial buildings. It focuses on practical and economical solutions for framing a typical industrial building to the requirements of the 2010 National Building Code of Canada and the pertinent provisions of CSA Standard S16-09.

The learning goals for this course include the following: identify the unique environmental and mechanical loading conditions in industrial buildings, learn the applicability and limitations of current codes and standards in Canada, select the most cost-effective framing schemes, design crane-supporting girders, stepped columns, purlins and girts, explore lateral force resisting systems, roof trusses and efficient connections, understand serviceability considerations and limitations, design for high and low temperatures, learn the implications of seismic provisions, plus other topics such as fatigue, standing seam roofs, rehabilitation, tolerances and coatings.

Course Leaders:
Robert A. (Bob) MacCrimmon, P.Eng., Senior Civil/Structural Specialist, Hatch

Greg Miazga, P. Eng., Vice-President Engineering, Waiward Steel Fabricators Ltd.

Toronto, ON	September 24
Calgary, AB	September 25
Vancouver, BC	September 26

Connections II
– Online Course –
This course is the third in a four-level series intended to develop the skills necessary for the design of steel connections as related to the construction of steel-framed structures.

The main objective is to assist steel industry personnel and steel-related service providers in their understanding of basic connection design principles, and to design more complex welded and bolted connections suitable for fabrication. Participants will also understand the origin of the rules and standards used in the steel industry.

This training has the following goals:

- Apply knowledge of physics to solving real technical problems; and

- Develop curiosity and critical judgment.

Course Leader:
Royce Johnson, M.Eng., P.Eng., Structural Engineer, Waiward Steel Fabricators Ltd.

Webinar Format (20@2hrs)
Tuesdays and Thursdays, 7:00 p.m. to 9:00 p.m. ET, starting October 1, 2013

Single Storey Building Design
This course focuses on practical and economical solutions for framing a single-storey warehouse building with attached office area to the requirements of the 2010 National Building Code of Canada and the pertinent provisions of CSA Standard S16-09.

Practical steel framing concepts and integration with architectural and mechanical features will be discussed. The presenters will highlight major changes in NBCC 2010 and CSA S16-09.

Topics include ponding of rainwater, snow drifting, companion load combinations, wind and seismic loads, notional loads, P-delta effects, selection of deck and joist systems, design of Gerber girders, design of interior and exterior columns, girts, base plates and anchor rods, selection and design of braced frames and roof diaphragm, fire protection issues, steel fabrication considerations, material selection and economics.

Course Leader:
R. Mark Lasby, B.Sc., P.Eng., Principal Structural Engineer, Fluor Canada Ltd., Vancouver

Toronto, ON	Oct. 21	Winnipeg, MB	Nov. 19
Montreal, QC (E)	Oct. 22	Saskatoon, SK	Nov. 20
Halifax, NS	Oct. 23	Calgary, AB	Nov. 21
Fredericton, NB	Oct. 24	Vancouver, BC	Nov. 22

Seismic Design of Steel-Framed Buildings
Held in tandem with the Seismic Connections for Steel-Framed Buildings course, this course is intended to provide understanding on design theory and application of specific Code formulae for seismic force resisting systems in 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.

Seismic Connections for Steel-Framed Buildings
Held in tandem with the Seismic Design of Steel-Framed Buildings course, 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.

Course Leaders:
Alfred F. Wong, M.Eng., P.Eng., Director of Engineering, CISC

Larry S. Muir, M.S.C.E., P.E., President, The Steel Connection, LLC

Toronto, ON	December 2 & 3
Vancouver, BC	December 5 & 6

Changes to CSA S16-09 & Steel Handbook Highlights
- Online Course -
This course covers the changes in CSA S16-09 and the design of steel members and elements using the 10th Edition of the Handbook of Steel Construction. It is presented online in four two-hour sessions. Registration can include all four sessions with 0.8 CEUs awarded upon completion, or the CSA S16-09 session alone with 0.2 CEUs awarded upon completion. In addition, discounted bundles with the Handbook and CISC Membership are available at registration.

Course Leaders:
David MacKinnon, M.A.Sc., P.Eng., Director of Training, CISC

Charles Albert, M.Sc.E., P.Eng., Manager of Technical Publications, CISC

Webinar Format (4@2hrs)
June 5 & 6, 12:00 p.m. - 2:00 p.m. and
3:00 p.m. - 5:00 p.m. ET

December 10 & 11, 12:00 p.m. - 2:00 p.m. and
3:00 p.m. - 5:00 p.m. ET

Conception de bâtiments industriels en acier
Ce cours permet de mieux comprendre la méthode de conception et le fondement des dispositions de code spécifiques aux bâtiments industriels à charpente d'acier. L'accent sera mis sur les solutions pratiques et économiques pour la charpente d'un bâtiment industriel type, conformément au Code national du bâtiment du Canada 2010 et aux dispositions pertinentes de la norme CSA-S16-01.

Conferenciers:
RichardVincent, ing., VP recherche, Groupe Canam Inc.

Julien Richard, M.Sc.A., ingénieur, Groupe Civil-Structure, Hatch

Montréal, QC	19 juin
Québec, QC	20 juin

Nouveautés CSA S16-09 et survol du Handbook
Ce cours traite des modifications apportées à la norme CSA S16-09 et au dimensionnement des charpentes métalliques à l'aide de la 10e Édition du « Handbook of Steel Construction ».

Ce cours est proposé en ligne, en quatre séances de deux heures, via le système GoToWebinarMC. Les personnes intéressées peuvent s'inscrire aux quatre séances (0,8 UFC/CEU seront accordés à la fin du cours), ou à la séance unique sur la norme CSA S16-09 (0,2 UFC/CEU seront accordés à la fin du cours). De plus, des offres de remise groupées avec le « Handbook » et l'adhésion à l'ICCA seront proposées aux participants lors de l'inscription.

Le cours de formation continue de l'ICCA, Nouveautés CSA S16-09 et survol du « Handbook », est présenté en ligne (webinaire) en quatre séances de deux heures comme suit.

Conferenciers:
Hellen Christodoulou, Ph.D., ing., B.C.L., LL.B., M.B.A.,

Directrice Régionale-Québec, ICCA

Charles Albert, M.Sc.E., P.Eng., Directeur des publications techniques, ICCA

10 septembre
12 h - 14 h et 15 h - 17 h (HAE)

11 septembre
12 h - 14 h et 15 h - 17 h (HAE)

Conception, fabrication et construction de ponts en acier
Ce cours traite de la conception, de la fabrication et de la construction de ponts en acier selon la norme CAN/CSA-S6-06, Code canadien sur le calcul des ponts routiers, supplément no #1. Ce cours a pour but d'aider à mieux comprendre la théorie de conception et le raisonnement des dispositions du code ainsi que l'application de certaines formules et exigences du Code. Les aspects pratiques et économiques de la fabrication, du montage, du choix des matériaux et leurs conséquences sur la conception seront également mis en évidence.

Conferenciers:
Gilbert Grondin, Ph.D., P. Eng., Senior Bridge Engineer, AECOM & Adjunct Professor, University of Alberta

Jean de Gaspé Lizotte, M.Sc., ing., Directeur, Projets spéciaux, Dessau Soprin inc.

Richard B. Vincent, B.Eng., ing., Vice-président, recherche, Groupe Canam Inc.

Montréal, QC	25 et 26 novembre
Québec, QC	27 et 28 novembre

New Members and Associates

CISC welcomes the new members and associates approved by the board:

Detailer
Spec 5 Services Inc.

Associate Consulting Company:
Calculatec

Associate Technical
Julius P. Magnaye

Associate Professionals
James Rudy
Normand Trudel
David Vadocz
Bahram Mirpourian
Roland A. Hase
Hugo G. LeBihan

Membership list as of April 16, 2013

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S Structural
P Platework
J Open-web Steel Joist

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Group Canam Inc. S, J
Calgary, AB 403-252-7591
www.canam.ws

Hranco Industries Ltd. Br, P, S
Medicine Hat, AB 403-527-4190
www.hranco.com

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

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

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 S
Edmonton, AB 780-435-3807

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

Supreme Steel Ltd. [Edmonton] S, P
Edmonton, AB 780-483-3278
www.supremegroup.com

Supreme Steel LP., Bridge Division P, S
Edmonton, AB 780-467-2266
www.supremegroup.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

Waiward Steel Fabricators Ltd. P, S
Edmonton, AB 780-469-1258
www.waiward.com

Whitemud Ironworks Limited S
Edmonton, AB 780-701-3295
www.whitemudgroup.ca

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Delta, BC 604-924-0424
www.belairfabrication.com

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www.canam.ws

Canron Western Constructors LP P, S
Delta, BC 604-524-4421
www.supremegroup.com

Impact Ironworks Ltd. B, S
Surrey, BC 604-888-0851

ISM Industrial Steel & Manufacturing Inc. B, Br, P, S
Delta, BC 604-940-4769
www.ismbc.ca

JP Metal Masters 2000 ULC B, Br, J, P, S
Maple Ridge, BC 604-465-8933
www.jpmetalmasters.com

Macform Construction Group Inc. B, P, S
Langley, BC 604-888-1812
www.macform.org

Rapid-Span Structures Ltd. P, S
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www.rapidspan.com

Solid Rock Steel Fabricating Co. Ltd. S
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www.solidrocksteel.com

Warnaar Steel Tech Ltd. S
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www.warnaarsteel.com

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www.wesbridge.com

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www.russelmetals.com

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www.customplate.net
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www.dymin-steel.com

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www.russelmetals.com

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www.salitsteel.com

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www.samuel.com

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www.samuel.com

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www.samuel.com

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www.samuel.com

Samuel, Son & Co., Limited
Winnipeg, MB 204-985-6600
www.samuel.com

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www.wilkinsonsteel.com
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www.atlastube.com

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www.essarsteelalgoma.com

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www.jpdrafting.com

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www.kgsgroup.com

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www.steltec.ca

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www.sde-draft.com

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www.asimut.ca

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www.spec5services.com

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www.tdsindustrial.com

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www.techdess.com

Tenca Steel Detailing Inc. Br
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www.ai-industries.com

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www.brucesteel.ca

CC Industries
Saskatoon, SK 306-374-8228
ww.ccindustries.ca

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www.geothird.com

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www.norweld.com

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www.esfox.com

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K C Welding Ltd. B
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www.montacier.com

Montage D'acier International - division de Louisbourg SBC S.E.C. Br, P
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Superior Steel Erectors Ltd. B
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Acier Picard inc.
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www.acierpicard.com

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www.amercoatcanada.com
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www.scrapmetal.net

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Brunswick Steel
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www.castconnex.com

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www.corrcoat.ca
Sandblasters and coaters

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www.courtgalvanizingltd.com

Daam Galvanizing Inc.
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Hot dip galvanizing

Daley Metals Ltd.
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www.daleymetals.com

Devoe Coatings
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www.devoecoatings.com
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Terrebonne, QC 450-965-0200
www.drytec.ca
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EBCO Metal Finishing L.P.
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www.ebcometalfinishing.com
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www.ifastgroupe.com

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www.midwaywheelabrating.com
Wheelabrating, sandblasting, industrial coatings

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VICWEST Corporation [Oakville]
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Steel metal floor/roof deck, wall and roof cladding

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Steel metal floor/roof deck, wall and roof cladding

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Waxman Industrial Services Corp.
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Western Industrial Services Ltd. (WISL)
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BPTEC - DNW Engineering Ltd., Edmonton, AB	780-436-5376
Brenik Engineering Inc., Concord, ON	905-660-7732
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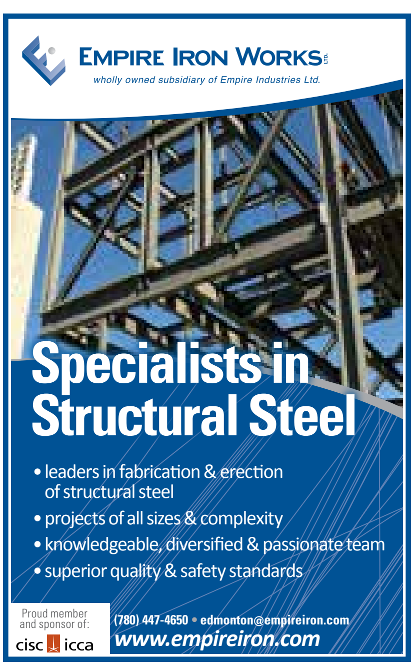

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