NO 31 SUMMER 2008

ADVANTAGE STEEL

STEEL AND OTHER MATERIALS
PART THREE –
STEEL AND CONCRETE

THE CANADIAN MATRIX:
A CATEGORY APPROACH
FOR SPECIFYING AESS

RESIDENTIAL CONSTRUCTION,
PART ONE – HYBRID STEEL
AND HOLLOW-CORE SYSTEMS

BC AND QUEBEC
2007 DESIGN AWARDS

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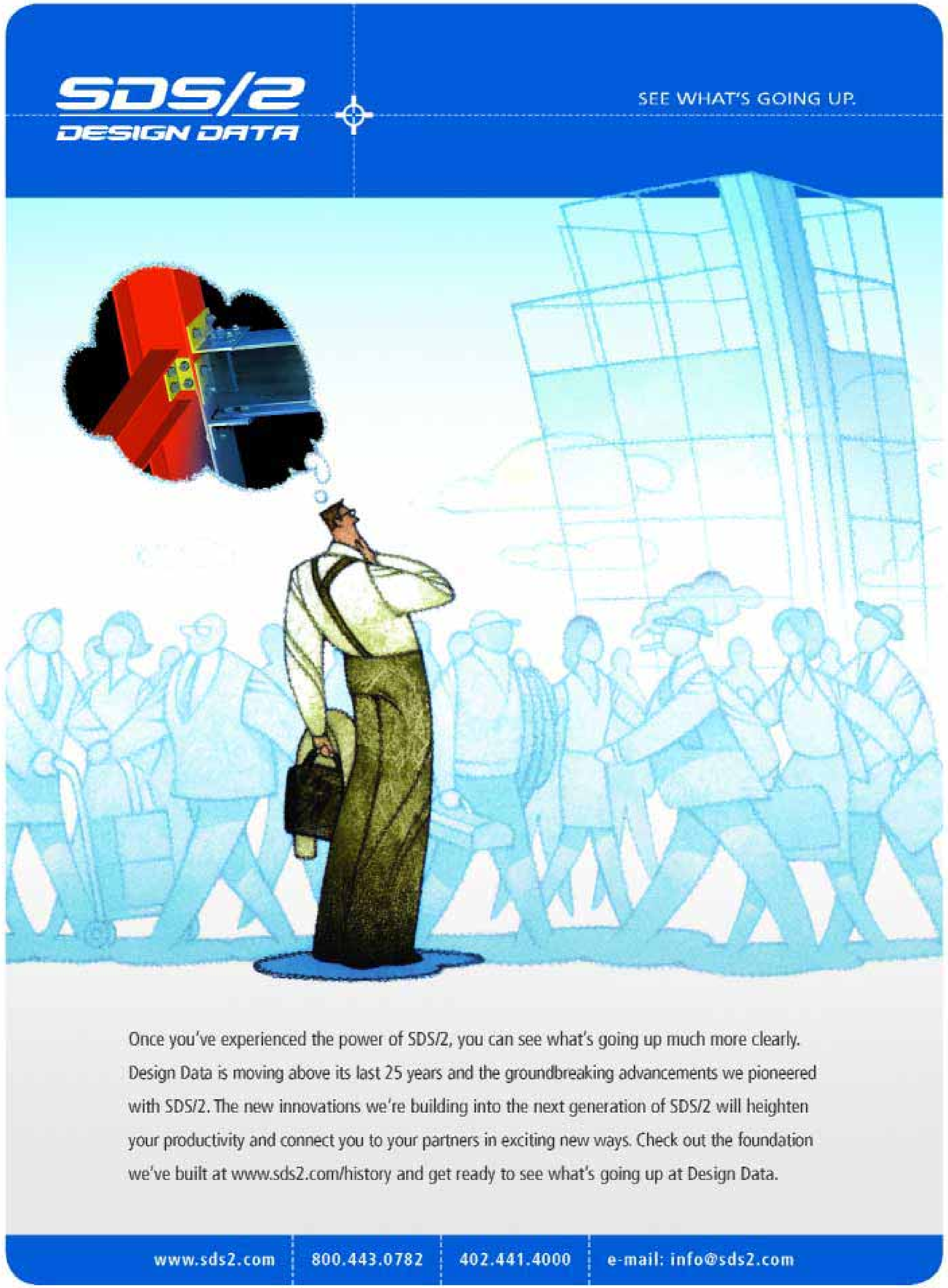

FROM THE EDITOR

Hard to believe but Advantage Steel has now entered its fifteenth year of publication. It has come a long way from that two-colour, 10-page, premier issue. Many thanks to a dedicated team who bring together each issue. I also must thank our advertisers. We can not do it without your support.

In this issue we are proud to be introducing to all a new initiative to assist architects, engineers and fabricators deal with steel that is architecturally expressed and thus exposed to view--architecturally exposed structural steel (AESS). Using a Category Matrix, which is sure to become a standard communication tool, architects, engineers and fabricators will more clearly understand what is expected in creating this product. It should streamline the complicated, multi-staged process in designing, specifying and fabricating AESS components.

The article summarizing the 2007 BC and Quebec steel design awards is always interesting reading. You'll be amazed at the work being done by our members. The images above illustrate one great example. It is the Experimental Media and Performing Arts Center (EMPAC) in New York. Supermetal Structures Inc. is the fabricator.

With this issue we are finishing an excellent series on Steel and Other Materials with Part Three – Steel and Concrete. The article includes an illustrated account of the challenges overcome in constructing the Ontario College of Art and Design's new "table top" addition – an instant classic. At the same time, we begin a new series on Residential Construction with Part One – Hybrid Steel and Hollow Core Systems.

Also in this issue, Ask Dr. Sylvie concentrates on steel tubes and HSS truss connections, while Seismic Corner examines bolted connections for seismic applications. Our overview of all the latest in the world of steel, What's Cool, What's Hot What's New, should not to be missed.

Michael I. Gilmor, P.Eng.
President CISC

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

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Sylvie Boulanger, P.Eng. Ph.D. - *Ask Dr. Sylvie is a column for Advantage Steel aimed at readers seeking technical information on steel structures. Questions are welcome on all aspects of design and construction of steel buildings and bridges. 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. Questions for Dr. Sylvie, or comments on previous questions, may be submitted by e-mail to* ***sboulanger@cisc-icca.ca***.

ASK DR. SYLVIE

BIG TUBES

I've received several questions on large tubular sections, 508 mm (20") diameter or larger, so I thought I would group them in one big three-part question and answer.

1.TAPERED TUBULAR COLUMN

The architect would like to taper the upper portion of tall tubular columns in a large atrium area. The column base starts at 508 mm diameter and 12.7 mm thickness and tapers to 300 mm diameter in the upper 6.5 m portion. Do you have information on the design and fabrication of tapered round HSS columns? - J.E.

You are dealing with a hybrid (non-prismatic) column! The non-tapered portion can be treated as an HSS but the tapered part is a…pole (hollow truncated cone). The round HSS 508 x 12.7 is the largest ASTM A500 HSS you will be able to find that is regularly produced in one of Atlas Tube's plants. For the tapered portion, Professor Jeff Packer says there are specific manufacturers who specialize in cold-rolled tapered tubular poles, mainly for electricity (utility) and lighting industries. The tube is welded up from a plate cut into a trapezoid shape. A well-known producer is Valmont (**www.valmont.com**) but you can get lots more by just googling "Tapered Poles". For general information have a look at the AISI website: **www.steel.org** under utility poles. For design information, try "Design of Steel Transmission Pole Structures", ASCE/SEI 48-05 from **www.asce.org**.

2.A 100-TONNE MINIMUM

We specified 20" diameter HSS at ⅝" thickness but were told we needed a minimum of 100 tonnes for the rolling to take place. Is this true? - R.B.

Yes, it's true. Unless they can piggyback your 40 tonnes with someone else's (called tonnage accumulation), it will not work. But if you had specified ½", you could have been in the next rolling. Even if that size is on a rolling schedule, you won't necessarily find them lying around on a steel service centre's floor. Next time you have HSS that you want to use in reasonable quantities and that are outside the available size range given in the Handbook (greater than 16" diameter), don't hesitate to call the CISC Marketing Director for your region. We can provide general information on availability of such shapes (with a few phone calls). In your case, it was actually possible to find ½" tubes "lying around" in one of Atlas tube's plant and you were able to use them with some re-engineering effort. You were then creative in converting the rest into W-shapes and providing a round architectural finish around them. But next time….

3.HELICAL WELDS

In two projects, I needed 30" and 24" diameter tubular shapes respectively for architecturally exposed steel columns (just painted). In both cases, the fabricator proposed using pipes with helical welds after the tender was awarded but were refused by the architect. How common are these and should we be explicit in our tender documents? - J.C.

Oh. I can understand why the architect wouldn't be happy with helical welds but as you pointed out, it wasn't explicitly stated in your tender document. As you also pointed out, ASTM A252, a piles standard, says the product can be formed either with helical or longitudinal welds. A note like "helical welds are not acceptable" should be added in the Architecturally Exposed Structural Steel (AESS) subsection of the Structural Steel section 05120 of the job specification. (Please read about CISC's AESS documents in this issue. You might have wanted to create your own custom category, or AESS C, for the columns.)

In summary, up to 20" diameter HSS at ½" thickness, ASTM A500 is available. Above that, you join the ranks of pipes, piles and poles, each with their own standards. It is then up to the engineer to decide whether these are acceptable for the project.

- In situations where large-diameter or thick tubes are required, many fabricators elect to use API-grade pipes (where API stands for American Petroleum Institute) after close discussion with the engineer. Specifically, this type of large tubing is covered by ANSI/API Spec 5L which is actually a modified American adoption of ISO 3183: 2007, available for purchase at **www.techstreet.com**. API sections are commonly available from steel distributors in the southern U.S. However, please note that interior pressure requirements have nothing to do with a structural application.
- Alfred Wong adds that some of the production requirements of ASTM A252 piles deviate from those governing the production of CSA G40.21 HSS, including tolerance for straightness, wall thickness and other imperfections. The helical seam in an A252 pile may be a butt seam or a lap seam. These characteristics, among other things, must be accounted for in the structural design.
- In the case of poles, don't forget that, unlike most poles, columns support substantial axial loads.

Finally, fabricators tell me there can be surface issues with some of these larger tubes; apparently more so with seamless tubes or pipes which are typically less smooth than cold-formed tubes.

HSS TRUSS CONNECTIONS

I am detailing the connections of an HSS truss submitted by the engineer who wants to have the branch members of the truss welded directly to the chords. However, when I check the ranges of validity as proposed by Packer and Henderson, I end up needing either to provide a gap or an overlap with eccentricities at the joint to respect that wish. Should those eccentricities have been taken into account by the engineer at the design stage? - E.D.

In a word, "yes". We provide information on HSS connections so that design engineers pay attention to member compatibility issues before the job is let. We suggest the design engineer be directed to the Handbook (9th edition) Part 3, pages 3-89 to 3-98. Since the behaviour and resistance of welded HSS connections are not always intuitive, their detailed design should be undertaken with scrutiny.

Engineers involved in HSS connections should take into account some of the basic considerations that you will find in the Handbook, which I've paraphrased and summarized below:

1. HSS members should not be selected on the basis of minimum mass. - Sounds familiar?
2. Remember that the "connection resistance" is a function of the relative dimensions and wall thicknesses of the members. It is frequently less than the capacity of the connected member.
3. Do not specify "connect for member capacity" to avoid unnecessary reinforcement.
4. Try using square and rectangular HSS which are much easier to fabricate than round HSS.
5. Avoid connections whose members are the same width. The maximum branch member's width should be equal to or less than the main member's minus about 5 or 6 times the wall thickness of the main member.
6. Choose branch members that have thin walls relative to the main member.
7. Do not specify full penetration welds automatically as they are seldom justified.
8. Do not specify ultrasonic inspection as this has limited application to HSS connections.

Engineers involved in these types of connections should also read pages 3-90 to 3-91 for additional considerations. Here are a few:

1. Reduce the number of different size members for optimum economy.
2. Use simple gap connections as much as possible as they are usually the most economical.
3. If fatigue is an issue, consider using overlap connections of at least 50%.

There are also several recommendations as to when the connection eccentricity effect in primary and secondary bending moments can be ignored or should be considered. There are useful suggestions for improving connection efficiency and weld effectiveness as a function of dimensional parameters of the connected members and in terms of the inclination of web members. Finally, if the engineer is to really get into HSS truss design, a "must" is Packer and Henderson's Design Guide: **Hollow Structural Section Connections and Trusses**, published by CISC: **www.cisc-icca.ca/publications/technical/design/hsscx/**

In particular, engineers should read through section 3.6 of that reference which deals with ranges of validity for different types of connections: square, rectangular and circular members; gap and overlap geometries; T, Y and X configurations. These ranges of validity in reality reflect the limit on range of sizes that were used in experimental or numerical research from which the design rules were derived. I understand that for some connections, the compromise was to reinforce the joint by introducing a plate hence avoiding eccentricities in the chord.

Here is my final note to engineers: If the truss you are designing is going to be Architecturally Exposed Structural Steel, it is essential that you pay particular attention to member compatibility at the design stage and prior to bid time to avoid reinforcement that architects will find unacceptable and to reduce cost. Read the Handbook pages on the subject, the reference suggested, and do not hesitate to contact fabricators on such issues. Fabricators are more and more often called upon early in the project to assist. To find a fabricator in your region, consult our membership directory or call one of the regional marketing directors. Such contact information may be found on our website: **www.cisc-icca.ca**.

SEISMIC CORNER - BOLTED CONNECTIONS FOR SEISMIC APPLICATIONS *Alfred F. Wong, P.Eng.*

Bolted connections, used in seismic-force-resisting systems (SFRS) for which the seismic design loads are based on a ductility-related force modification factor, Rd, greater than 1.5, must satisfy Clause 27.1.6 of S16-01 as well as other pertinent requirements that apply to bolted connections.

In accordance with Clause 27.1.6, these bolted connections shall

(a) have pretensioned high-strength bolts;

(b) have surfaces of Class A or better, when designed as bearing-type connections;

(c) not be considered to share load with welds;

(d) not have long slotted holes;

(e) not have short slotted holes unless the load is normal to the slot; and

(f) have end distances in the line of seismic force not less than two bolt diameters when the bearing force due to seismic load exceeds 75% of the bearing resistance.

Generally, bolted connections subjected to shear are either bearing-type or slip-critical. In a nutshell, a slip-critical joint requires more bolts and the bolts must be pretensioned. Clause 27.1.6 introduced a unique type of bolted shear connections whose bolts are pre-tensioned, but the connections need not be designed as slip-critical connections. They may be proportioned as bearing-type provided the surfaces are Class A or better, etc. Since uncoated structural steel having clean mill scale faying surfaces meets Class A surface requirements, no special surface preparation or coating is necessary. The provisions in Clause 27.1.6 ensure that friction plays a role in load transfer, recognizing that premature slip into bearing is undesirable but slip-critical connections are unnecessary.

Since NBCC 05 stipulates deformation control at the 'near-collapse' limit state only (1-in-2500 annual probability of exceedance) Clause 27.1.6 of S16-01 provides an added benefit because it also serves to limit damages to steel buildings in relatively frequent seismic events.

The requirements of Clause 27.1.6 may be waived when fastener and connection details conform to those of a tested assembly. For example, beam-to-column moment connections in Ductile Moment-Resisting Frames and Ductile Eccentrically Braced Frames that must qualify by means of physical tests are required to conform to the connection details and method of bolt installation used in the tested assembly instead.

In any case, Clause 27.1.6 does not apply to field-welded connections where bolts are provided solely for erection purposes.

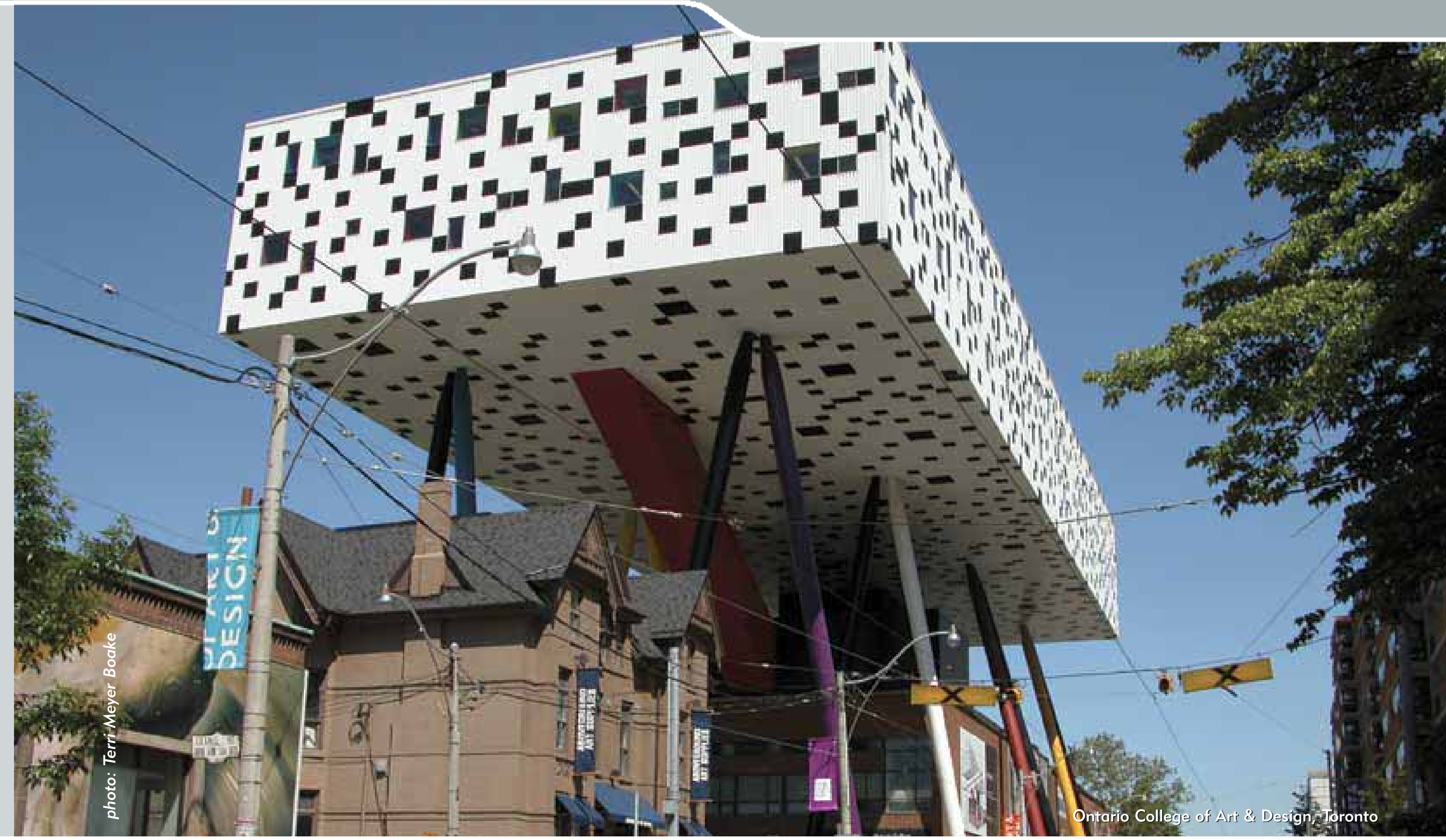


photo: Terri Meyer Boake

Ontario College of Art & Design, Toronto

STEEL AND OTHER MATERIALS THREE-PART SERIES
PART THREE: STEEL AND CONCRETE

John Leckie

Partners and competitors, steel and concrete are virtually inseparable. Few major structures are constructed without substantial amounts of both materials, often resulting in an open competition to be the structural material of choice.

The strengths of one match the weaknesses of the other. Steel buildings have concrete foundations and concrete floor slabs. All concrete buildings have reinforcing steel. Steel is unsurpassed in tension, is shop-fabricated to close tolerances while concrete is constructed in the field with much greater variances. Concrete is strong in compression but relatively weak in tension, requiring substantial amounts of reinforcing steel to counter that weakness and often resulting in twice the weight of a comparable steel structure. Sometimes the reinforcing steel in a concrete building is the equivalent weight of the structural steel present in a comparable steel building.

HISTORY

Concrete and steel have been combined in buildings for more than a century, but for much of that time they were not really working together that well. In many older buildings, seemingly solid concrete columns had steel embedded in them – essentially steel drowned in concrete. These steel columns and steel girders were used in place of reinforcing steel. Sometimes, builders weren't too fussy about the type of steel they used. At least one building in Old Montreal contains steel billets – small, usually rectangular bars of iron or steel in an intermediate stage of manufacture – completely encased in concrete.

As engineers began to get a better handle on concrete as a material, more concerted efforts were made to have the materials work together, gaining the high strength-to-weight properties of steel with the compressive strength of concrete.

Today, there are effectively three ways steel and concrete interact. The first occurs when load transfers from steel to concrete or vice versa, for example from concrete foundation to steel column, or from steel girder to concrete core. The second occurs when steel and concrete work together in composite action, so they are in direct contact with or encasing the other material, for example composite floors or composite columns. Thirdly, there is interaction when each shares part of the lateral or gravity load without being in contact with each other, for example when gravity loads are shared between steel columns and a concrete core, or when a steel lateral-load-resisting system is added to help the concrete core resist lateral loads such as in seismic retrofits.

THE OTHER MATERIAL: CONCRETE

In the 1840s, Portland cement, a mixture of the oxides of calcium, silicon and aluminium named because of its resemblance to the limestone quarried on the Isle of Portland, was developed.

Most concrete contains cement, some other types of cementitious material such as fly ash or slag cement, coarse aggregates such as gravel or limestone, and fine aggregates such as sand. These are all combined with water, with which the cementitious materials form a cement paste, gluing the aggregates together and filling the voids in the material. Reducing the amount of water in the mix will create a more durable concrete; adding water will make the concrete more workable. Because concrete is weak in tension, it requires reinforcing, most often with steel, to carry tensile loads.

CHALLENGES AT THE INTERFACE

Jim Brennan, vice-president of operations for the Atlantic region for Bird Construction Company, is a contractor in a position to see the problems on both sides of a steel-concrete interface in particular when load transfers from the concrete foundation to the steel base plate and column, and when steel girders are connected to a concrete core.

"The steel guys have a whole set of shop drawings. Their stuff goes into the shop and it is made precisely to those drawings," he says. It is not like you're a mason working with units on the site, where you take eight-inch blocks and keep stacking them together until you have run out of space and then you stop. To change a piece of the steel, to make it longer or shorter, is a big deal." At the same time, the foundation contractor may not have such an easy time placing the anchor rods.

Load transfer from one material to another - Base plates that only need to transfer compression typically have 4 anchor rods (1). When lateral forces are important, shear keys can be used (2). Situations not shown include large plates that need to resist important overturning moments, or systems that need to transfer important forces in tension. Embedded plates provide load transfer from steel beams to the concrete core (3) but need to be properly positioned during the concrete pour! Another alternative for connecting to the core is a seat, either in concrete (4) or steel.

"You look at one of the caissons full of rebar and you've got those anchor rods that have to go in there. It is easy to get them offset at a bit of an angle that causes a lot of problems for our steel guys."

Most floors in multi-storey buildings are composite. By making the concrete slab participate in the compressive resistance of the top flange, it is possible to reduce the depth of the steel beams required in the building and reduce the cost. This is accomplished by using a special gun to weld shear studs — usually 19 mm (three-quarter inch diameter) Nelson studs with a 12 mm (one-half inch) thick head that is about 38 mm (an inch-and-a-half in diameter) — to the steel deck. These shear studs link the steel and concrete and allow them to work together in composite action.

One consideration is: will you save enough money by reducing the beam size to pay for the studs and the cost of applying them in the field? "These studs cost about 60 cents each and they can usually install about 40 an hour, so if a workman is being paid roughly $60, it is about $1.50 to apply in the field," says Richard Vincent, vice-president of research and development at Canam. "So that makes the total cost of a single stud about $2." Usually, the point is reached with spans that are greater than eight or nine metres, he said, and the longer the span, the greater the savings.

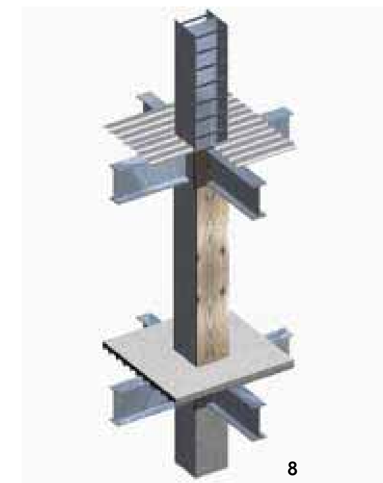
Composite action / floors - Shear studs are used to provide composite action. Studs are welded to the top flange or chord (5) and covered completely with concrete. A composite floor which is ideal in combination with a concrete core is the stub-girder system (6), which acts as a Vierendeel truss, spanning anywhere from 8-12 metres. Today, all steel bridges are composite (7).

Composite action can be achieved with several types of structural systems. Shear studs can be installed on wide-flange girders and beams, on triangulated trusses or on stub-girders (the latter is a variation of a Vierendeel truss).

Composite steel floor systems are used frequently in high-rise buildings as they provide large, clear, economical spans in the building between the core of the building and the outside wall. The stub-girder is a useful although less well-known system, where a small W-shape forms the bottom chord of the truss and the concrete slab becomes the top flange of the truss. The web consists of small W-shape "stubs" so the system can be analysed as a Vierendeel truss resulting in a shallow system with several opportunities to integrate ducts.

Columns are another area where there is a potential for composite action available in several configurations: concrete-filled tubes, fully encased and partially encased. The partially encased thin-walled built-up section is the newest addition available to designers (see CSA S16-01 Clause 18.3). This variation is particularly attractive for multi-storey buildings and has been the subject of substantial research in Canada at École Polytechnique and the University of Alberta.

The column – developed by Vincent, patented by Canam – consists of three relatively thin plates in an H-shape and, using simple plywood formwork on the outside with the Us on each side of the web, concrete is poured in from above. To get around the problem at the floor, a plate is welded onto the tips of the flanges so it closes off the tube going through the floor. It then gets filled with concrete.



Composite action / columns: The partially encased thin-walled built-up section is the newest addition available to designers (see CSA S16-01 Clause 18.3). This variation is particularly attractive for multi-storey buildings and has been the subject of substantial research in Canada at École Polytechnique and the University of Alberta. The end result is a composite column that is very efficient, with steel and concrete acting compositely and sharing the load about equally.

The end result is a composite column that is very efficient, with steel and concrete acting compositely and sharing the load about equally. Its cross-section is about midway between an all-steel and all-concrete version.

When steel framing interacts with a concrete core, other considerations arise. Typically, to frame a steel girder to a concrete core, embedded plates with significant anchors in the concrete are used. Concrete seats can also be seen. It is important to make the plate large enough or the seat wide enough to accommodate erection tolerances.

CASE STUDY: 1000 DE LA GAUCHETIÈRE, MONTREAL

The 51-storey building 1000 de la Gauchetière – the tallest in Montreal – was built using a concrete core, and a steel frame for the rest of the structure. Composite trusses were used to transfer the floor loads to the concrete core and steel columns, hence the core and columns shared the gravity loads. After a certain height, a peripheral steel moment frame was built to share the lateral loads with the concrete core (the latter becoming significantly smaller as fewer elevator shafts were needed in the upper floors).

The core of the 1000 de la Gauchetière went up on a three-day cycle. The structural steel followed behind at about the same rate. It took about a year for the structure of the building to be completed. By comparison, the all-concrete IBM Marathon building, about the same size and constructed at the same time, took two years to complete. "So, there was a significant difference in the time to construct it and, of course, in these types of projects, time means money and there was a significant savings," Vincent says.

CASE STUDY: ONTARIO COLLEGE OF ART, SHARP CENTRE FOR DESIGN

The unique, floating structure that is the $42.5-million Sharp Centre for Design at the Ontario College of Art and Design is a product of necessity. The college wanted to expand and was considering a traditional tower in a parking lot but nearby residents objected, not wanting to lose their sightlines to the park behind the existing college buildings that line McCaul Street in downtown Toronto. British architect Will Alsop came up with the idea of putting the structure in the air, providing the space but preserving the sightlines.

His "table top" structure consists of a two-storey, metal-skinned structure 9 metres high by 31 metres wide by 84 metres long, perched 26 metres above the ground, supported by a concrete core and 12 multi-coloured, angled steel legs, looking like six pairs of pick-up-sticks that have fallen out of the black and white, Dalmatian-like box above. The hollow steel legs, originally intended for a natural-gas pipeline, are coated with intumescent coating for fire protection which, in the case of extreme heat, will swell to provide a protective cushion around the structure. Each of the six pairs of legs sits on five steel-reinforced concrete caissons, eight feet in diameter. The building is formed from two-storey steel trusses that were stick-built in the air onsite.

The construction required a complicated connection between the steel trusses and the concrete core, involving massive steel plates embedded in the concrete. Couplers were welded to the back of the plate so reinforcing steel could be threaded into the plate.

The connection of the reinforcing steel to steel plates was a unique process, says Paul Sandford, senior associate and chief engineer of Carruthers & Wallace Consulting Structural Engineers, the structural engineers for the project. It was done to reduce the amount of rebar needed on the project. This interconnection required close co-ordination between the steel fabricator, Walters Group, the

A key connection on the OCAD building was between the steel columns and the caissons supporting them. There was little margin for error to set the anchor rods.

rebar contractor and the formwork contractor, as well as with PCL, the general contractor.

"It wasn't just a matter of dropping off a set of plates at the site one day and saying, 'Will you cast these in for us,' " Sandford said. "The formwork had to be cut in proportion for these plates and the rebar had to be connected to them. Normally, the formwork trade and the rebar trade are a little bit disconnected from structural steel."

In addition to the massive plates holding the steel trusses, the other key connection on the building was between the steel columns and the caissons supporting them. The anchor rods the columns were connected to had to be set on the right angle and, because the columns came in on a slope, there was little margin for error. "You couldn't just twist them off by a couple of degrees or they wouldn't fit above," Sandford said.

While anchor rods can be a problem on a lot of jobs, here it would be magnified because there was no way to fix it if it was wrong. Sandford credited the two years of planning that went into the job with eliminating most of the problems. But it was also people who made it work, he added.

The trades had to closely co-ordinate their efforts and they were helped by a site superintendent for PCL who had a knack for anticipating problems before they arose, he said.

BEST PRACTICES

The key to avoiding the problem is good surveying and layout, proper documentation at the front end and good co-ordination between the trades, says Bird Construction's Jim Brennan. "It doesn't matter how much planning you do; however, there can still be workmanship and accuracy issues with the anchor rods."

There has to be a certain amount of tolerance built into the design, says Carruthers and Wallace's Paul Sandford, "You can't pretend one trade will be perfect so the next trade doesn't have to worry about it."

In the case of connecting the base plate of a column to the anchor rods, "if the plate has to be oversized or if you have to design it for a bit of twisting or torsion because of potential misplacement, the cost is peanuts compared to going back and fixing it. If you are casting anything large, you are not going to be able to do it or you will wind up tripling your costs or tearing the whole thing down," Sandford said. It is also a good idea to get the trades to accept each other's work, Sandford said, so there will be fewer problems.

THE FUTURE

Steel and concrete are destined to work together for many years. Whether for aesthetic or sustainable reasons, there is a growing trend to expose the steel structure which will also impact on the appearance on these interactions.

Designers are experimenting with different ways of combining the two materials, sometimes losing sight of the strengths of each of the materials such as in the Charles de Gaulle airport in Paris. The key to a successful combination is keeping the essential qualities of each material in mind. More research on the composite action of the two materials would further bolster their partnership for the future.

Photo credits: Canam [1, 8], Sylvie Boulanger [2, 3, 4, 5, 7], CISC [6], PCL [9, 11-13], Terri Meyer Boake [10].

The erection of the two-storey steel trusses required a complicated connection between the steel trusses and the concrete core, involving massive steel plates, embedded in the concrete. This interconnection required close co-ordination between the steel fabricator, the rebar contractor and the formwork contractor, as well as with the general contractor.

Photo credit: S. Boulanger

Windsor Station Heritage Building, Montreal

THE CANADIAN MATRIX: A CATEGORY APPROACH FOR SPECIFYING AESS

Sylvie Boulanger, Terri Meyer Boake

Since the turn of the millennium, architects have let their hair down when expressing the framing members within their overall scheme to the point where the steel structure becomes the architecture, or architecturally exposed structural steel (AESS).

Although architects look like they are having fun, it has created a paradigm shift in the sequential communication that usually takes place in a more conventional building where the steel structure is hidden. The architect now wants direct access to the fabricator's shop to verify and comment on the edges and surfaces of the imagined product, and the engineer is dealing with aesthetic aspects that impact the structural integrity of the frame. That leaves the fabricator and the erector somewhere in the middle between aesthetic and technical requirements.

The paradigm shift would not be a big deal if everyone understood what the other wanted! But it turns out that a "nice looking connection" or a "smooth surface" has very different meanings whether you are talking to an architect, an engineer or a fabricator. Such a situation creates a misalignment of expectations in terms of what can be accomplished within a specific budget envelope. Welds that are contoured and blended are not the same price as ASTM A325 hexagonal bolts for example.

For those reasons, CISC formed a national Ad Hoc Committee on AESS (see inset) and focused on differentiating Categories because not all AESS need be created equal. For example, viewing distances, coating thicknesses and connection types should matter (see images). To facilitate communication, Categories and their associated Characteristics are presented in a Matrix. In total, three AESS documents reference the Matrix: A Sample Specification, an addition to the CISC Code of Standard Practice and a Guide.

CATEGORIES AND CHARACTERISTICS OF THE MATRIX

The Committee felt that baselines needed to be established that could characterize each of the Categories, and that each Category would reference recognizable building types as a point of visual orientation. The initial point of technical reference was selected as Standard Structural Steel (SSS) as defined in CSA S16 as it was already an established and well-understood baseline in

Photo: T. Boake

Distance plays a factor. O'Hare International Airport. The steel at the ceiling level is not capable of receiving the same scrutiny as that at the pedestrian level.

construction Specifications. A set of Characteristics was then developed that was associated with each Category. Higher-level Categories include all of the Characteristics of the preceding Categories, plus a more stringent set of additional requirements.

AESS 1 – Basic Elements, would be the first step above Standard Structural Steel. This type of application would be suitable for "basic" elements, which require enhanced workmanship. This type of exposed structure could be found in roof trusses for arenas, warehouses and canopies (see Fig. 2 right) and should only require a low cost premium in the range of 20% to 60% due to its relatively large viewing distance as well as the lower profile nature of the architectural spaces in which it is used.

1.1 The surface preparation of the steel must meet SSPC-SP 6. Prior to blast cleaning, any deposits of grease or oil are to be removed by solvent cleaning, SSPC-SP 1.

1.2 All of the sharp edges are to be ground smooth. Rough surfaces are to be de-burred and ground smooth. Sharp edges resulting from flame cutting, grinding and especially shearing are to be softened.

1.3 There should be a continuous weld appearance for all welds. The emphasis here is on the word "appearance". The welds themselves need not be continuous. Intermittent welds are made continuous, either with additional welding, caulking or body filler. For corrosive environments, all joints should be seal welded. The seams of hollow structural sections would be acceptable as produced.

1.4 It is assumed that bolted connections will use standard structural bolts. When bolting, the heads should all be located on one side of the connection, but they need not be fastidiously aligned. There should also be consistency from connection to connection.

1.5 Weld splatters, slivers, surface discontinuities are to be removed as these will mar the surface and it is likely that they will show through the final coating. Weld projection up to 2 mm is acceptable for butt- and plug-welded joints.

AESS 2 – Feature Elements, included structure that was intended to be viewed at a Distance > 6 m. It was suitable for "feature" elements that would be viewed at a distance greater than six metres. The process requires basically good fabrication practices with enhanced treatment of weld, connection and fabrication detail, tolerances for gaps, and copes. This type of AESS might be found in retail and architectural applications where a low to moderate cost premium in the range of 40% to 100% over the cost of Standard Structural Steel would be expected.

2.1 Visual Samples – This Characteristic was noted as an optional requirement for this and all subsequent Categories due to issues of suitability, cost and scope. Visual samples could be a 3-D rendering, a physical sample, a first-off inspection, a scaled mock-up or a full-scale mock-up, as specified in Contract Documents. Visual samples could range from small pieces of fabrication that might include connections or finishes, to full-scale components. Not all projects would benefit from the construction of large-scale mock-ups, hence making this Characteristic optional. In some cases it is suggested that an agreement to incorporate full-scale mock-ups in the final project would make practical and economic sense. Again this decision would depend on the particular job requirements.

2.2 One-half standard fabrication tolerances as compared to the requirements for standard structural steel in CSA S16 will be required for this Category. This is to recognize the increased importance of "fit" when assembling these more complex components. Large tolerances can lead to a sloppier appearance and lack of uniformity in the connections and potentially, problems in the erection of complex geometries. This has direct impact on the erection process and the potential cost implications of making site modifications to members that do not fit.

2.3 Fabrication marks (number markings put on the members during the fabrication and erection process) should not be apparent, as the final finish appearance is more critical on these feature elements.

2.4 The welds should be uniform and smooth, indicating a higher level of quality control in the welding process. Ultimately this would indicate that more of the welds might be carried out in the fabrication shop to reduce site welding where the conditions may not be optimum. This can impact the design of joints as well as the transportation of potentially larger pre-assemblies and the erection on site. This does not infer that high-quality site welding is not possible, only that it might incur a cost premium over shop welding.

AESS 3 – Feature Elements, included structures that would be viewed at a distance ≤ 6 m. The Category would be suitable for "feature" elements – where the designer is comfortable allowing the viewer to see the art of metalworking. The welds should be generally smooth but visible and some grind marks would be acceptable. Tolerances must be tighter than normal standards. As this structure is normally viewed closer than six metres it might also frequently be subject to touching by the public, therefore warranting a smoother and more uniform finish and appearance. This type of structure could be found in airports, shopping centres, hospitals or lobbies and could be expected to incur a moderate cost premium that could range from 60% to 150% over Standard Structural Steel.

3.1 The Mill marks are to be removed so as not to be visible in the finished product.

3.2 Butt and plug welds are to be ground smooth and filled to create a smooth surface finish. Caulking or body filler is acceptable.

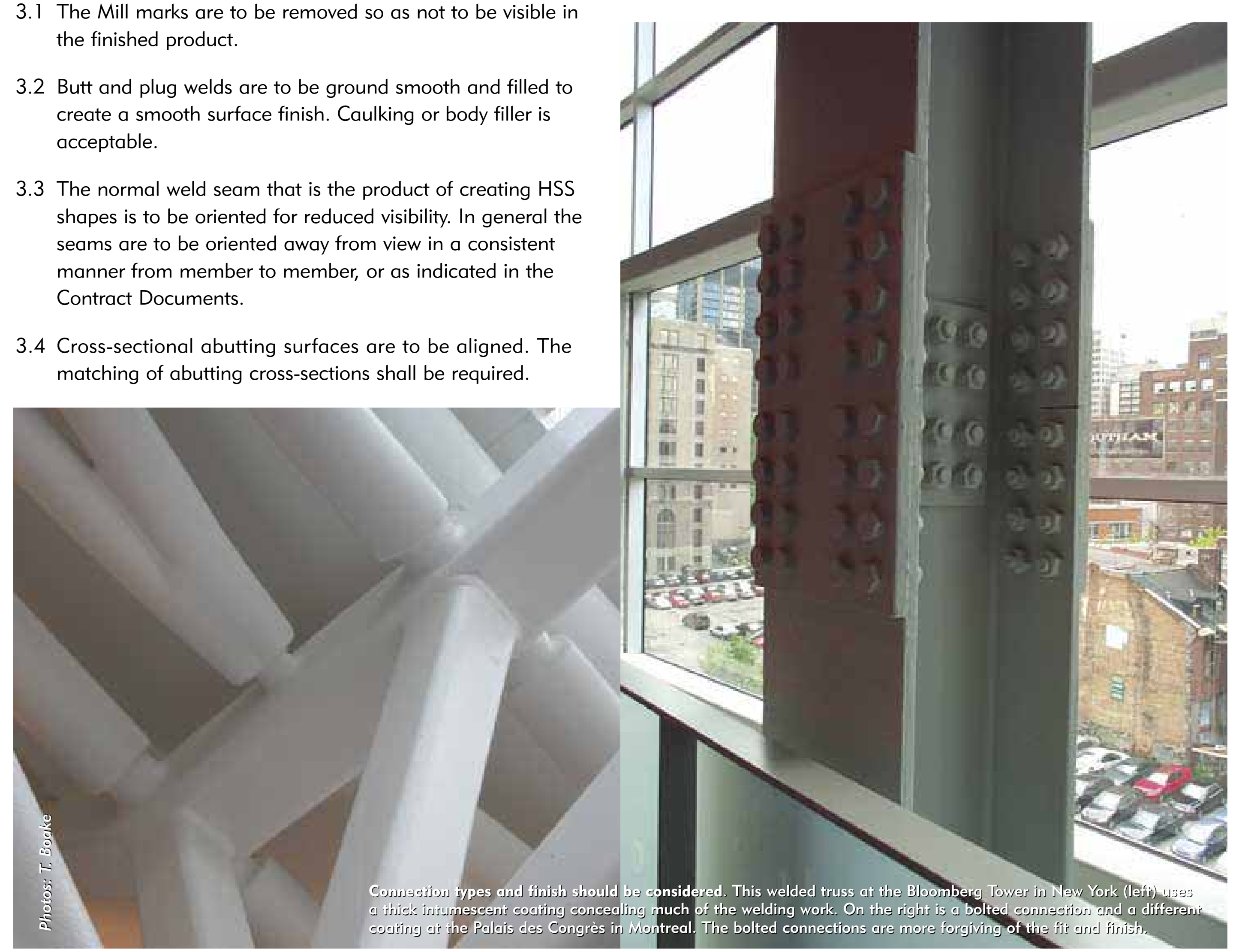
3.3 The normal weld seam that is the product of creating HSS shapes is to be oriented for reduced visibility. In general the seams are to be oriented away from view in a consistent manner from member to member, or as indicated in the Contract Documents.

3.4 Cross-sectional abutting surfaces are to be aligned. The matching of abutting cross-sections shall be required. Offsets in alignment are considered to be unsightly in these sorts of Feature Elements at a close range of view.

3.5 Joint gap tolerances are to be minimized. This Characteristic is similar to 2.2 above. A clear distance between abutting members of 3 mm is required.

3.6 AESS 3 Feature Elements may require all welded connections. This is noted as optional; acknowledging that a particular aesthetic might purposefully choose bolted connections. Alternatively if an entirely welded appearance is desired, hidden bolts may be considered.

AESS 4 – Showcase Elements, or "dominant" elements would be used where the designer intends that the form be the only feature showing in an element. All welds are ground and filled edges are ground square and true. All surfaces are sanded and filled.



Photos: T. Boake

Connection types and finish should be considered. This welded truss at the Bloomberg Tower in New York (left) uses a thick intumescent coating concealing much of the welding work. On the right is a bolted connection and a different coating at the Palais des Congrès in Montreal. The bolted connections are more forgiving of the fit and finish.

Tolerances of these fabricated forms are more stringent, generally to half of standard tolerance for structural steel. All of the surfaces would be "glove" smooth. The cost premium of these elements would be high and could range from 100% to 250% over the cost of Standard Structural Steel – completely as a function of the nature of the details, complexity of construction and selected finishes.

4.1 The normal weld seam in an HSS member should not be apparent. This may require grinding of the weld seam.

4.2 Welds are to be contoured and blended. In addition to a contoured and blended appearance, welded transitions between members are also required to be contoured and blended.

4.3 Steel surfaces are to be filled and sanded. Filling and sanding are intended to remove or cover any steel surface imperfections, again due to the close range of view of the members. This particular point can incur a high cost premium and is a particular case in point that all AESS need not be created equal. Procedures such as this are not required where the members cannot be seen.

4.4 Weld show-through must be minimized. The back face of the welded element caused by the welding process can be minimized by hand grinding the backside of the weld. The degree of weld-through is a function of weld size and material.

AESS C – Custom Elements, was created to allow for a completely custom selection of any of the Characteristics or attributes that were used to define the other Categories. It would allow complete flexibility in the design of the steel, but would therefore require a high level of communication amongst the Architect, Engineer and Fabricator. The premium for this type of AESS could range from 20% to 250% over regular steel. A wide range may seem odd for "custom" elements, but the lower bound of this Category also includes specialty reused steel for sustainable purposes, and steel that might be purposefully less refined in its Characteristics.

DESIGN PROCESS IMPLICATIONS

The Categories need to be specified at the design stage. A building could, for example, include two Categories within the exposed portion of the project: AESS3 for the lower part of the atrium, and AESS2 for the upper, more distant portion. The Matrix approach helps qualify what is expected within each Category. Hence, the structural engineers need to include the AESS Specification in the Structural Steel Division of their contract. The Categories are specified following close communication between Architects and Engineers, which then need to appear directly on Architectural and Structural Documents. The Fabricator then makes a cost estimate based on these Categories and relays the AESS2 and AESS3 labels on their shop drawings and later on the erection plans.

BACKGROUND

By 2003, AISC produced its AESS Guide. During the same period, concerns about AESS were also emerg-ing in several regions of Canada. Regional CISC initiatives eventually culminated into the na-tional CISC Ad Hoc Committee on AESS in 2005. The idea was to create a dynamic industry dialogue, including architects and engineers, in the hopes of providing a series of documents that would assist in re-visioning the design, specification, and construction process for AESS.

In the following two years, CISC did adapt components of what AISC had developed but it also introduced an underlining Category approach and reduced its scope. The committee committed to the elaboration of a Sample Specification (for engineers), an addition to the CISC Code of Standard Practice (for fabricators) and a Guide (for architects). Common to all these documents would be a unique Matrix of Categories and Characteristics used by all.

In parallel, several roundtables were held in Montreal, Toronto and Vancouver, which would typically involve architects, engineers and fabricators. Those sessions helped shape the orientation and direction of the Committee's work on the documents. For example, the Matrix was extremely well received and confirmed we were on the right track. They also told us that the Specification should be part of the Engineer's contractual documents rather than the Architect's. And they couldn't wait to use the material.

IN A NUTSHELL

The Category approach emphasizes that when dealing with AESS, one-size-does-not-fit-all which led to a set of fabrication requirements above and beyond those necessary for strength and safety. This prompted a new approach to specifying AESS that includes different Categories of AESS, each Category's Characteristics, and the use of a Matrix to compare the Categories. The Categories recognize the different levels of workmanship and finish of the steel surface to suit the specific architectural expression of the building. It is hoped these documents will make it easier for architects and engineers to specify those requirements to fabricators at bid time and to communicate their needs during the entire design process so their vision of the final form, fit and finish of the structure becomes reality. These documents are:

- **A Sample AESS Specification**: Architecturally Exposed Structural Steel (AESS), a suggested AESS subsection of Section 05120 that includes the distinc-tive Matrix chart. This is the standard Specification Subsection that is proposed for inclusion in the overall project Specification document.
- **An Appendix in the CISC Code of Standard Practice** - Architecturally Exposed Structural Steel (AESS). The Appendix includes definitions and materials, related to scope, that clarify the terms of reference of the Specification outlined above as well as the Matrix.
- **A Guide for Specifying AESS**. This docu-ment will not form part of the con-tractual Specification, but will be used to clarify the intentions of the Specification, Matrix, and Appendix. This document will contain images, examples and more detailed information about protective systems (against fire and corrosion) and coatings.

It is felt that these documents will help make AESS more competitively priced by eliminating a great range of fabrication and installation work that may be quite unnecessary. As an increasing number of AESS projects are constructed, we begin to realize that AESS is not all created equal, nor should it be specified to be so.

Note: CISC's AESS documents, plus the longer version of this article presented at NASCC 2008, are or will be available for download from the Canadian Institute of Steel Construction's web site: www.cisc-icca.ca/aess.

ACKNOWLEDGEMENTS

CISC is grateful that AISC has allowed the Committee to access the May 2003 Modern Steel Construction Supplement on AESS. It provided the possibility to use some text and images from the Supplement and integrate them into CISC's efforts to produce their own documents.

The authors would like to acknowledge all the Regional Committees who took time to review the documents within their local area and provide comments. The Alberta Region did a particularly thorough job in their feedback documents.

Finally, we thank the members of the Committee and the participants of the roundtables who assisted so greatly in the development of the new CISC Sample Specification (as part of the Structural Steel Division), Appendix I for the CISC Code of Standard Practice, the AESS Category Matrix and the upcoming CISC Guide for specifying AESS.

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THE NEW CISC CATEGORY MATRIX FOR SPECIFYING ARCHITECTURALLY EXPOSED STRUCTURAL STEEL (AESS)

Terri Meyer Boake (from left 1-3) | Sylvie Boulanger (4)

The CISC Category Matrix encompasses 4 Categories (AESS1 through AESS4). Each category represents a set of characteristics, which clarifies what type of work will be performed on the steel, the tolerances to be met, and if a visual sample is needed. For AESS1, the associated characteristics are 1.1 through 1.4, for AESS2, they are 1.1 through 2.4, and so on. The categories are selected by the architect. They are specified at bid time, as an AESS subdivision of the Structural Steel division (05120) in the engineer's documents. The categories appear on architecture, engineering, detailing and erection documents. In general, it is expected that AESS2 (for elements viewed at a distance) and AESS3 (for elements viewed at close range) will be the categories most commonly specified. For more detailed information, see www.cisc-icca.ca/aess.

TABLE 1 - AESS CATEGORY MATRIX

Id	*Category* / *Characteristics*	AESS C Custom Elements	AESS 4 Showcase Elements	AESS 3 Feature Elements *Viewed at a Distance ≤ 6 m*	AESS 2 Feature Elements *Viewed at a Distance > 6 m*	AESS 1 Basic Elements	SSS Standard Structural Steel *CSA S16*
1.1	Surface preparation to SSPC-SP 6		√	√	√	√	
1.2	Sharp edges ground smooth		√	√	√	√	
1.3	Continuous weld appearance		√	√	√	√	
1.4	Standard structural bolts		√	√	√	√	
1.5	Weld spatters removed		√	√	√	√	
2.1	Visual Samples		optional	optional	optional		
2.2	One-half standard fabrication tolerances		√	√	√		
2.3	Fabrication marks not apparent		√	√	√		
2.4	Welds uniform and smooth		√	√	√		
3.1	Mill marks removed		√	√			
3.2	Butt and plug welds ground smooth and filled		√	√			
3.3	HSS weld seam oriented for reduced visibility		√	√			
3.4	Cross sectional abutting surface aligned		√	√			
3.5	Joint gap tolerances minimized		√	√			
3.6	All welded connections		optional	optional			
4.1	HSS seam not apparent		√				
4.2	Welds contoured and blended		√				
4.3	Surfaces filled and sanded		√				
4.4	Weld show-through minimized		√				
C.1							
C.2							
C.3							
C.4							
C.5							
	Sample Use:	Elements with special requirements	Showcase or dominant elements	Airports, shopping centres, hospitals, lobbies	Retail and architectural buildings viewed at a distance	Roof trusses for arenas, retail warehouses, canopies	
	Estimated Cost Premium:	Low to High (20-250%)	High (100-250%)	Moderate (60-150%)	Low to Moderate (40-100%)	Low (20-60%)	None 0%

NOTES

1.1 Prior to blast cleaning, any deposits of grease or oil are to be removed by solvent cleaning, SSPC-SP 1.

1.2 Rough surfaces are to be deburred and ground smooth. Sharp edges resulting from flame cutting, grinding and especially shearing are to be softened.

1.3 Intermittent welds are made continuous, either with additional welding, caulking or body filler. For corrosive environments, all joints should be seal welded. Seams of hollow structural sections shall be acceptable as produced.

1.4 All bolt heads in connections shall be on the same side, as specified, and consistent from one connection to another.

1.5 Weld spatter, slivers, surface discontinuities are to be removed. Weld projection up to 2 mm is acceptable for butt and plug welded joints.

2.1 Visual samples are either a 3-D rendering, a physical sample, a first off inspection, a scaled mock-up or a full-scale mock-up, as specified in Contract Documents.

2.2 These tolerances are required to be one-half of those of standard structural steel as specified in CSA S16.

2.3 Members marked with specific numbers during the fabrication and erection processes are not to be visible.

3.1 All mill marks are not to be visible in the finished product.

3.2 Caulking or body filler is acceptable.

3.3 Seams shall be oriented away from view or as indicated in the Contract Documents.

3.4 The matching of abutting cross-sections shall be required.

3.5 This characteristic is similar to 2.2 above. A clear distance between abutting members of 3 mm is required.

3.6 Hidden bolts may be considered.

4.1 HSS seams shall be treated so they are not apparent.

4.2 In addition to a contoured and blended appearance, welded transitions between members are also required to be contoured and blended.

4.3 The steel surface imperfections should be filled and sanded.

4.4 The backface of the welded element caused by the welding process can be minimized by hand grinding the backside of the weld. The degree of weld-through is a function of weld size and material.

C. Additional characteristics may be added for custom elements.

AESSmatrix/sb/070412 NotesRev071005

Photo courtesy of Deutsch Associates Architects/Photographer: Jessie Shotwell

RESIDENTIAL CONSTRUCTION
PART ONE – HYBRID STEEL AND HOLLOW-CORE SYSTEMS

Peter Timler, P.Eng.

In the article entitled, "Multi-Storey Residential Buildings Framed in Steel" (Advantage Steel, No. 25, Spring 2006), a number of floor framing systems were described in general. In this, the first of a three-part series, the use of hollow-core pre-cast with several specific steel framing systems is discussed in more detail.

Hollow-core pre-cast planks have been available and used for decades in combination with structural steel framing, mainly as planking to form the floor deck by being placed on the top of the steel framing members. In the 1960's this replaced expensive forming for a poured-in-place concrete slab. Later the use of cold-rolled steel deck, first as a form and later as a part of a composite deck provided for composite beams and girder floor systems. Mechanical systems could be placed through the natural openings in open-web steel joists and truss systems where used, otherwise, openings often needed to be placed in the rolled sections in order to reduce the overall floor-ceiling space demand.

However, in order to compress the overall depth even more, other solutions were developed in which the steel member is embedded within the depth of the pre-cast plank. One very early use was for the Century Hotel complex in Los Angeles in the 1970's. British Steel developed a special rolled section featuring a lower flange wider than the top flange. This provided an easy landing for the pre-cast plank and was an alternative to welding a wider plate to the bottom of a standard W-shape section.

More recently, the collaboration of a general contractor/developer, structural engineer and steel fabricator in the USA zeroed in on a composite form of pre-fabricated construction that would greatly outpace cast-in-place construction for residential projects at competitive pricing. Following extensive testing, their concept of compositely integrating a modified steel wide-flange section placed transversely within the depth of 8" pre-cast concrete planking units to form the floor plate of the structure became a patented building system under the name Girder-Slab® (see Figure 1). Typically the steel girders span about 20 feet. However, unlike other patents that restrict the construction or manufacturing of the product or assembly, Girder-Slab® Technologies, LLC. arranged for their technology transfer to be non-proprietary. This means any supplier of pre-cast hollow-core planking and steel fabricator could participate in this method of construction – competition is maintained, bringing the best economic advantage to these projects. This is accomplished by a transfer of the patent rights, on a project-by-project basis, in exchange for a sales commission or licensing fee paid to the owners, Girder-Slab® Technologies. The fee then becomes part of the steel fabricator's bid price.


Figure 1: Girder-Slab® Composite Construction Animation

The Girder-Slab® System of construction marries the benefits of shop-controlled pre-fabricated construction of pre-cast floor elements with precision steel spanning members that assemble with relative ease and speed in essentially any weather condition. Traditional spans within residential construction may be supported without major structural elements being below the finished ceilings. Due to the greater spanning capabilities of the floor plate elements, a lighter structure results, potentially providing additional benefit to foundation works as well. Thus, low floor-to-floor profiles are achievable with steel-framed construction – a critical factor for developments in areas with overall building height restrictions (i.e. maximum residential density is preserved in the projects).

By using a single trade for erection, the burden on local labour market is lessened and reduces the associated risks of manpower shortages, especially for larger urban projects. In general, four levels of assembled floor plates may precede the grouting operations thus allowing erection to proceed unimpeded during colder days if necessary. In many cases, heating and hoarding may be entirely avoided. Once the floor panels are in place, a clean and open working environment is established since no shoring is required. This enables the early access of other trades into the workspace thereby adding to the schedule benefit by a significant margin.

A number of different projects in Canada have been examined and considered suitable for this method of construction without loss of architectural flair or functionality. The Girder-Slab® method of construction could also meet the functional performance requirements of the project quite easily. As a general rule, depending on storey height, estimated capital cost savings on structural construction ranged from $5 - $10 per square foot. Again, in many cases, the schedules for structural construction were determined to be shorter by a number of months (providing additional cost benefit to the owner). This has bolstered the confidence of numerous developers, and their design and construction teams, to move forward with projects utilizing this method of construction. Project sizes range from several floors and a few hundred thousand square feet to many floors around a million square feet.

Hopefully, the Grand Coastal Resort and Spa in Campbell River, BC, will be the first project to proceed using the Girder-Slab® System in Canada. With structural design by Trilogy Structural Engineering of Nanaimo, BC, the project maximizes clear spans, in one direction within the units, to just over 33 feet. To accommodate the architectural requirements, a lateral load-resisting system consisting of steel moment frames is dispersed throughout the structure (see Figure 2). The developer gravitated to this method of construction for the following reasons. Firstly, it could reduce the construction period in comparison with CIP concrete construction, thus allowing handover to fractional unit owners more quickly than current market projects. Secondly, being a coastal project constructed of stable building materials (steel and concrete), no maintenance costs related to moisture ingress during construction or shrinkage post construction were indicated. Thirdly, there would be savings on a global scale for the project when insurance costs during construction were considered, etc. Lastly, it had been concluded that the net environmental impact from construction would be the least with this method of construction, (i.e., a more positive sustainable result primarily through more efficient use of construction materials with lower carbon emissions net effect, in comparison with CIP concrete construction).


Figure 2: Grand Coastal Resort and Spa Structural Model – Campbell River, BC

The Girder-Slab® is a method of construction that offers the conventional freedom with space layout and numerous ways to reduce cost, schedule and environmental impact as has been demonstrated by over 40 projects already completed in the USA (see Figure 3).


Figure 3: Marriott Hotel – Gaithersburg, MD

For more information on how the CISC may assist with your project's development, please contact the CISC office for your region. Information on the Girder-Slab® method of construction is available at: www.girder-slab.com.

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ARCHITECT: Busby, Perkins and Will
STRUCTURAL ENGINEER: Read Jones Christofferson Ltd.
GENERAL CONTRACTOR: Dominion Fairmile Construction Ltd.
CISC STEEL FABRICATOR, Detailer & Erector: George Third & Son Ltd

The "Telus Building C" originally completed in 1919, was redesigned with the removal of five floors to create a large indoor atrium. The 26 metre-high space incorporates a bracing system comprised of two vertical uprights with horizontal ribs holding each of the east and west glass walls in place.

The space is enclosed within a new structurally-siliconed double-glazed system, which is supported by structural steel framing at either end. Four steel elliptical columns support cast steel arms that reach off to hold the cladding supported with vertical tension rods. Aluminum 'claws' at the ends of these arms grip the horizontal mullions of the curtain wall. Horizontal steel trusses provide additional wind resistance. This unique design solution provides a highly original aesthetic in a visible communal space.

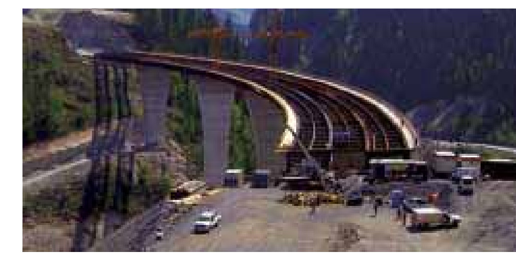
The interior space of the atrium features two glass and steel access bridges, and is punctuated by a dramatic open-air folded-plate steel stairway, cantilevered off an additional elliptical column, connecting levels three through six. The stairway has a thin profile and makes for an expressive structural element.

Acting as a thermal chimney, the atrium also enhances the performance of the complex's natural ventilation system, utilizing natural sunlight as a heating source and to draw air through the surrounding buildings. The new atrium also substantially increases the building occupants' access to natural light.

Award of Merit
YVR Link Project

OWNER: Vancouver International Airport Authority
ARCHITECT: Kasian Architecture Interior Design
STRUCTURAL ENGINEER: Read Jones Christofferson Ltd.
GENERAL CONTRACTOR: Ledcor Construction Ltd.
CISC STEEL FABRICATOR, DETAILER & ERECTOR: Wesbridge Steelworks Ltd.

ENGINEERING AWARD



Award of Excellence
Kicking Horse Canyon - Park Bridge

OWNER: B.C. Ministry of Transportation
STRUCTURAL ENGINEER: Parsons Corporation
GENERAL CONTRACTOR: Flatiron Constructors Ltd.
CISC STEEL FABRICATOR & DETAILER: Rapid-Span Structures Ltd.
STEEL ERECTOR: KWH Constructors Corp.

This new bridge, which replaces the existing Park Bridge, was built high above the river to connect into new sections of highway on both sides of the canyon. A steel structure was the chosen as the preferred option as it was believed to be more suited to the remoteness and difficulty of site access, as well as the fast-track schedule.

The bridge is just over 400-m long and at its highest point about 90 m above the canyon floor. It has six spans ranging from 50 m to 80 m and the roadway alignment is on 6% longitudinal grade and is horizontally curved with a constant radius of 550 m. The bridge deck is just over 23 m wide and it is designed to accommodate two lanes of traffic in each direction. The superstructure consists of four main steel girders and three substringers that are supported on intermediate cross-frames. The main girders are 3 m deep and they are spaced 7 m apart. Five concrete piers support the bridge, ranging in height from 40 m to 90 m, and were built using the cast-in-place jump form system.

One of the most unusual features of this bridge is that it is a horizontally curved steel plate girder superstructure built by incremental launching. It is believed to be the largest of its type in North America built using this method.

ENGINEERING AWARD

Award of Merit
Atacama Cosmology Telescope

OWNER: Princeton University
STRUCTURAL ENGINEER: Dynamic Structures
GENERAL CONTRACTOR: Dynamic Structures
CISC STEEL FABRICATOR, DETAILER & ERECTOR: Dynamic Structures

QUEBEC REGION DESIGN AWARDS

COMMERCIAL/INSTITUTIONAL PROJECTS

Winner
Centre de recherche en oncologie (CRCEO), Old Quebec

Jury Mention: For an elegant and user-friendly result, thanks to the lightness and versatility of steel in a historic and sensitive clinical context

ARCHITECT: CONSORTIUM: Amiot Bergeron; Lemay Guy Harvey; Bélanger Beauchemin Architectes
STRUCTURAL ENGINEER: CONSORTIUM: BPR; Genium
CONTRACTOR: J.E. Verreault et Fils ltée
OWNER: CHUQ
MANAGER: CHQ
FABRICATOR AND DETAILER: Constructions PROCO inc.

The urban integration of this building, located in the heart of Old Quebec on a cramped, steep-sloped site, posed an unusual challenge and is a success in itself. Built on top of a concrete parking garage, it had to be lighter than anticipated, because the initial program became more demanding as the need for space exploded. The steel frames of the top two storeys are covered with stainless steel cladding, in a nod at tradition. The openings in the volume are a negative image of the dormer windows of the neighbourhood's sloping roofs. The vestibule anchors an atrium with vertical and curved steel trusses. The steel is linked to the architectural expression of the main public spaces, modulating the composition of the walls and elegantly framing the inserted wooden members. Steel, glass and stone form a harmonious combination from the main entrance and set the tone for the visitor's route.

Honourable Mention
Expansion and redevelopment of the École de technologie supérieure, Montreal

Jury Mention: For a successful reconciliation with the existing structure and an original solution using moment frames, transfer beams and steel seismic shock absorbers.

ARCHITECT: Côté et Talbot, architectes
STRUCTURAL ENGINEER: Nicolet Chartrand Knoll ltée
CONTRACTOR: Pomerleau inc.
OWNER: École de technologie supérieure
FABRICATOR AND DETAILER: Nico Métal inc., Canam Canada

COMMERCIAL/INSTITUTIONAL PROJECTS

Honourable Mention
New glass wall, Le Windsor, Montréal

Jury Mention: For a perfect structural-architectural integration providing both transparency and fire protection in a challenging steel-and-glass building.

ARCHITECT: Béique Legault Thuot architectes
STRUCTURAL ENGINEER: Nicolet Chartrand Knoll ltée
STRUCTURAL GLASS ENGINEER: CPA Verre Structurel inc.
CONTRACTOR: EBC ltée
MANAGER: Magil Laurentienne
GLASS SUBCONTRACTOR: Vitreco Inc.

INDUSTRIAL PROJECTS/BRIDGES

Winner
Bridge over the Churchill River, Labrador

Jury Mention: For meeting the technical challenge thanks to the adaptability of steel under changing launch conditions, thus limiting the bridge's environmental footprint.

STRUCTURAL ENGINEER: Roche ltée Groupe-conseil
CONTRACTOR: Mariner Engineering & Construction
OWNER: Transportation & Works NL Labrador
FABRICATOR AND DETAILER: Structal-Bridges, a division of Canam Group

The Newfoundland and Labrador Department of Transportation and Works had been hoping for several years to complete Trans-Labrador Highway 500 linking Labrador to the rest of Canada. The 360 m bridge built on this axis is one of the longest engineering structures in eastern Quebec. The triangulated structure adopted required a much more complex design than normal. In addition, contrary to what was foreseen, it was impossible to use temporary supports, thus making it necessary to modify the design during construction. It was also essential to be innovative regarding the launch mode: the design of a launch nose reducing the stresses in the superstructure as well as the number of interventions and temporary reinforcements were some of the keys to this achievement. The Warren-type structure, including 3 spans made of Grade 350W galvanized steel, each 120 m long, did not affect the shores or the watercourse.

Honourable Mention
Bridge on Autoroute 15 Southbound over Rivière aux Mulets, Ste-Adèle

Jury Mention: For a durable steel solution noted for its simplicity, sobriety and efficiency. The clarity of the design allowed the rapid and economic replacement of an obsolete concrete bridge.

STRUCTURAL ENGINEER: Ministère des Transports du Québec, Direction des Structures
CONTRACTOR: Hervé Pomerleau inc.
OWNER: Ministère des Transports du Québec, Direction des Laurentides-Lanaudière
SITE SUPERVISOR: GENIVAR
FABRICATOR: Structal-Bridges, a division of Canam Group
DETAILER: Structal-Bridges, a division of Canam Group, GENIFAB

Honourable Mention
Imprimerie Quebecor, Mirabel

Jury Mention: For striking a delicate balance between the industrial and administrative spaces by using steel, and accommodating the large vertical spaces and the exceptionally heavy presses.

ARCHITECT: Dubois Girard architectes
STRUCTURAL ENGINEER: Les Consultants GEMEC inc.
CONTRACTOR: Omnia Technologies Inc.
OWNER: Quebecor Média
FABRICATOR AND DETAILER: Les Constructions Beauce Atlas inc.
STEEL ERECTOR: Montacier inc.

PROJECTS OUTSIDE QUEBEC

Winner
Mandarin Oriental Hotel, Boston

Jury Mention: For its daring erection and connections, as well as a simple solution to the technical difficulties.

ARCHITECT: CBT/Childs Bertman Tseckares
STRUCTURAL ENGINEER: McNamara/Salvia Inc.
CONTRACTOR: Suffolk Construction Co. Inc.
OWNER: CWB Boylston LLC
FABRICATOR AND DETAILER: Supermetal Structures Inc.
STEEL ERECTOR: JF Stearns Inc.

The Mandarin Oriental Hotel in Boston will soon be part of the great family of prestigious hotels of the same name. The 15-storey building will have 136 rooms and 12 luxury suites, all designed for extraordinary comfort and elegance. The complexity of the site, the strict depth limitations imposed on the steel members and the client's stringent requirements gave rise to many technical challenges. The project will have required 650 transfer beams, 90 non-standard welded plate girders, numerousbracing discontinuities and more than 6200 tonnes of steel. These gigantic and heavy pieces (up to 60 tonnes each) required special transportation and erection methods, including the use of two cranes and temporary columns. Very close cooperation resulted in better solutions, particularly regarding the lintel structures.

SUMMER 2008 ADVANTAGE STEEL 29

Honourable Mention
Experimental Media and Performing Arts Center, New York

Jury Mention: For the successful integration of a complex steel framework into a multi-material structure, resulting in an imposing building.

ARCHITECT: Nicholas Grimshaw and Partners, David Brody Bond, LLP
STRUCTURAL ENGINEER: Buro Happold Consulting Engineers
CONTRACTOR: Turner Construction Company
OWNER: Rensselaer Polytechnic Institute
FABRICATOR: Supermetal Structures Inc.
DETAILER: Supermetal Structures Inc., TECHDESS inc.

GREEN BUILDINGS

Winner
New Air Terminal of Kuujjuaq Airport, Nunavik

Jury Mention: For an appropriate response to a northern site and an Inuit context. This steel project demonstrated exceptional interdisciplinary harmony while meeting the many environment criteria.

ARCHITECT: Fournier Gersovitz Moss architectes & associés
STRUCTURAL ENGINEER: GENIVAR
CONTRACTOR: Laval Fortin Adams
OWNER: Transport Canada, Quebec Region
MANAGER: Public Works and Government Services Canada
FABRICATOR AND DETAILER: Sturo Metal Inc.

The compact and aerodynamic form of the new Kuujjuak air terminal in Nunavik is inspired by the shape of a kayak. Steel stood out as the most appropriate material to meet the environmental criteria. In this northern region, all building materials must be shipped to the site by boat between June and September during a very short construction season. All materials must be easy to ship. Choosing steel made it possible to build the structural frame in the fall of 2006 and leave it exposed until the following spring. The envelope is partially covered with preformed steel cladding, and the roof is made of white steel to reflect light in summer. The building was designed to the most stringent requirements for construction and LEED (Silver) certification. It also features several innovations including a passive earth cooling system connected to the canopy and an openwork enclosure allowing light penetration through to the centre.

RESIDENTIAL PROJECTS/RENOVATIONS

Honourable Mention
Résidence Fortin-Doyon, Lévis

Jury Mention: For a contrasting integration of steel and an esthetic and refined mastery of detail

ARCHITECT: Anne Carrier Architectes
STRUCTURAL ENGINEER: CIMA+
CONTRACTOR: Ronam Construction\
OWNER: André Fortin and Julie-Suzanne Doyon

Honourable Mention
Encadrex residential loft, Montreal

Jury Mention: For a sober use of steel meeting severe architectural constraints.

Architect: Smith Vigeant architectes
Structural engineer: Nicolet Chartrand Knoll ltée
Owner: Encadrex
Contractor: Construction Yergeau Cart

JURORS' FAVOURITE

Winner
CGC Shed, Montreal

Jury Mention: For rethinking the importance of industrial equipment – a unique steel solution well off the beaten path.

ARCHITECT: George Elbaz Architect
STRUCTURAL ENGINEER: DSM Consultants
CONTRACTOR: Construction Première
OWNER: CGC Inc.
FABRICATOR AND DETAILER: Acier Robel inc., Canam Canada
SUPPLIER: Altitube Steel Inc., Sherwin-Williams Canada, Industrie Dry-Tec Coating inc.

Located in the Port of Montreal, the CGC Shed is a gypsum powder warehouse with an area of 7000 square metres (75,000 ft2) built for CGC Inc., a manufacturer of construction materials for walls and ceilings. The building's special features are its height and slope. A concrete enclosure could have been built to resist the strong horizontal pressures of the gypsum by means of heavy concrete walls. Instead, the decision was made to rethink the industrial facility in light of its simplest function. Why not let the gypsum powder accumulate like a mountain and lay the structure around it? The result is a light, high-roofed structure with walls sloping 45 degrees, made of big 40 m joist girders supported on large tubular columns. The foundations were designed to resist only the lateral seismic and wind loads. To withstand the corrosive environment, a zinc-rich organic paint and a polyurethane polyester finish were applied in the shop.

YOUNG ARCHITECTS/ENGINEERS

Winner
David Drouin - Pavillon Ferdinand-Vandry

Jury Mention: For his close cooperation with other team members in a large-scale institutional project, in addition to his many technical and administrative responsibilities.

YOUNG ENGINEER: David Drouin, Jr. Eng. - Quirion Métal inc.
SPONSOR: André Mercier, Eng. - Les Consultants FBG inc.

It could almost be said that David Drouin was born with a steel spoon in his mouth. He is probably one of the rare junior engineers graduating from McGill University to hold a valid steel erector's competency card. But it took more than this to become the structural steel Project Manager for Pavillon Ferdinand-Vandry of Université Laval, a vast health sciences education complex with a four-year construction schedule. On this project, David Drouin and his sponsor André Mercier jointly assumed responsibility for connection design and erection drawings. As Project Manager at Quirion Métal, he coordinated with the Production Manager, the Chief Detailer and the Estimator, in addition to setting priorities in the production plant. Given the scope of the project, he needed good communication with steel erectors, as there were up to 35 of them on the site. In Phase 1, over 1200 tonnes of steel were fabricated and erected in less than 8 weeks.

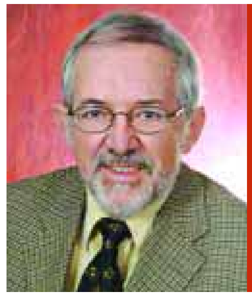
TRIBUTE AWARD

Architecture Category

For its remarkable promotion of structural steel in successful projects such as Le 1000 De La Gauchetière, the Bell Centre and the CDP Capital Centre, either alone or in a consortium.

Awarded to:
Lemay associés [architecture, design]
Louis T. Lemay, President and Chief Executive Officer

Founded in 1957 and celebrating its 50th anniversary this year, Lemay knows steel. Among Lemay's leading projects, several have contributed to the firm's renown and a great many have combined architecture and structural steel. For example, one can mention Le 1000 de la Gauchetière (1993), the Bell Centre (1996), the Agmont America plant (1997) and Complexe Les Ailes (2002), as well as several consortium projects, such as the Canadian Space Agency (1993), the CDP Capital Centre business offices (2003), Centre des technologies de l'aluminium in Saguenay (2003) and the Jewish General Hospital Sir Mortimer B. Davis Pavillion (2006). It is interesting to note that Lemay received six awards during the first decade of the Design Awards, including most of the above-mentioned buildings and the redevelopment of the Acadie interchange (2004). Lemay knows how to highlight the strength of steel to create lasting value. Implementing this philosophy is only possible with the support of the President and Chief Executive Officer, Louis T. Lemay, son of cofounder Georges-E. Lemay.

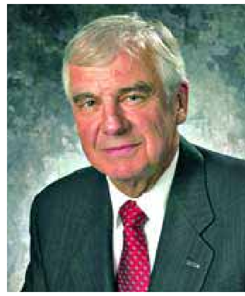


Engineering Category

For his outstanding advancement of structure steel in his university career, particularly through educational publications, teaching and research.

Awarded to:
André Picard, Université Laval
Professor Emeritus, Department of Civil Engineering

Since 1971, Professor André Picard has taught at Université Laval, where he obtained his Bachelor's and Master's degrees in Engineering. He holds a doctorate from the Imperial College of Science, Technology and Medicine in London. In particular, he was the originator and coauthor of the textbook "Calcul des charpentes d'acier" published by the CISC, the first edition of which appeared in 1981. Regardless of the edition, no Quebec structural engineer can do without it. Upon publication, this work of reference established the use of French vocabulary in the structural steel industry. Through his peerless pedagogical approach, André Picard has enabled hundreds of young people and practitioners to understand and design steel structures better. On several occasions, he has been a speaker at CISC continuing education courses for structural engineers while pursuing his research on connections, stability and bridges.



Industry Category

For having furthered the use of structural steel in his career as a contractor, and for his leadership, vision and support of the Association.

Awarded to:
Marcel Dutil, Canam Group Inc.
Chairman of the Board and Chief Executive Officer

It all started in 1963 when Marcel Dutil was superintendent for Canam Steel in Saint-Gédéon. Then came the founding of Manac in Saint-Georges and the Canam Manac Group in 1973. Marcel Dutil has received many distinctions for his leadership and qualities as a contractor: he is a Member of the Order of Canada, a Chevalier de l'Ordre national du Québec and boasts three doctorates Honoris Causa. Today, he is Chairman of the Board and Chief Executive Officer of the Canam Group. It has been a giant leap from a few dozen employees to three thousand in 2007. His visionary role has certainly helped the Group pass through hurricanes and storms, although he has not achieved this on his own. By instilling a family spirit in the organization, he built a team that has specialized in steel solutions. Also, by supporting the association, he has contributed to the industry's rise.

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

CANSTRUCTION NOVA SCOTIA

For the third year in a row, Dalhousie engineering students have defied gravity — and expectations — with an uncanny contribution to Canstruction Nova Scotia.

Mentored by Associate Professor Yi Liu, the civil engineering team won the structural ingenuity award and Halifax Shopping Centre people's choice award for their contribution, "The Curl," assembled using 2,000 cans of tuna. CISC Atlantic Region continues to be a proud sponsor of the Dalhousie team.

Nineteen teams participated in the exhibitions, which were held at different shopping centres in the province earlier this fall. Feed Nova Scotia collected more than 48,000 cans of food and $30,000 in donations through the exhibition.

Team members included students **Josh DeYoung**, **Alan Daniel Grant**, **Sandra Soon**, **Lynsey Poushay**, **Sabine Strohan**, **Susan Tibbo**, **Julie Briand**, **Dane George** and engineering technician **Mark MacDonald**. In 2005, Dalhousie's civil engineering team, led by Dr. Liu, received an honourable mention in the International Construction competition held in Los Angeles.

NATIONAL TRANSPORTATION SAFETY BOARD (NTSB) INVESTIGATION: FRACTURED GUSSET PLATES IN COLLAPSED I-35W BRIDGE GROSSLY UNDERSIZED

While the investigation into the I-35W Bridge collapse continues, NTSB in Washington has issued a safety recommendation in a letter to the Federal Highway Administration (FHWA). NTSB makes the following recommendation to the FHWA: "For all non-load-path-redundant steel truss bridges within the National Bridge Inventory, require that bridge owners conduct load capacity calculations to verify that the stress levels in all structural elements, including gusset plates, remain within applicable requirements whenever planned modifications or operational changes may significantly increase stresses.". This letter is available at http://www.ntsb.gov/Recs/letters/2008/H08_1.pdf .

The letter also states: ".... These gusset plates were roughly half the thickness required." The results of the calculations are documented in the FHWA's interim report, Adequacy of the U10 & L11 Gusset Plate Designs for the Minneapolis Bridge No. 9340 .... This report is available at http://lyris.asce.org/t/4399223/29032902/1985/0/>

FABRICATOR M & G STEEL'S 20TH BIRTHDAY

M & G Steel Ltd. recently celebrated their 20th year operating in the structural steel industry. This event was marked with a party for employees and suppliers held at the Credit Valley Golf and Country Club. A key part of the firm's success is their emphasis on Project Management. Some of their projects are the Honda Assembly Plant (Alliston, ON), RCMP Regional Headquarters (Milton, ON), Butterfly Conservatory (Niagara Falls, ON – a Steel Design Award recipient), Art Gallery of Ontario – Building Features (Toronto, ON) and Bermuda College in sunny Bermuda.

Congratulations to a great team headed by founding principals **John Mark** and **Mel Grimes**!

HANDBOOK OF STEEL CONSTRUCTION

9th Edition, 3rd Printing 2007 - $175.00 + GST

The CISC Handbook contains detailed information required for the design and detailing of structural steel in SI metric units. This Ninth Edition has been updated to reflect changes to the CSA S16-01 Standard, the National Building Code of Canada 2005 and the steel section data. Tables are based on steel grades: CSA-G40.21 350W, ASTM A572 grade 50, ASTM A992 and ASTM A500.

Organized in eight parts, it features the consolidated version of S16-01 and Supplement #1 (S16S1-05 including the new companion loads); CISC Commentary; design tables for bolts, welds, connections, beams and columns; updated properties and dimensions of structural steel shapes (including revised designations and dimensions for the heavier W920 sections); CISC Code of Standard Practice for Structural Steel, 6th Edition 2000; miscellaneous data; and an index. To download the order form: www.cisc-icca.ca/content/publications/orderform.aspx

EVENTS

2008 CISC Annual Convention
June 4 – 7, 2008
The Algonquin Fairmont, St. Andrews, New Brunswick
www.cisc-icca.ca

IABSE Conference - Information and Communication Technology (ICT) for Bridges, Buildings and Construction Practice
June 4 – 6, 2008
Helsinki, Finland
www.iabse.org/conferences/helsinki2008

Canadian Society for Civil Engineering (CSCE) Conference
June 10 – 13, 2008
Quebec, Quebec
www.csce2008.ca

CaGBC First National Summit and Trade Show
June 11 – 12, 2008
Toronto, Ontario
www.shiftingintothemainstream.ca

IABSE Congress: Creating and Renewing Urban Structures - Tall Buildings, Bridges and Infrastructure
September 17 – 19, 2008, Chicago
www.iabse.org/chicago08

Weld Expo Canada
September 23 – 25, 2008
Toronto, Ontario
www.smecanada.ca/cmw

Construct Canada
December 3 – 5, 2008
Toronto, Ontario
www.constructcanada.com

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* Mount Pearl, Nfld. (709) 745-8060
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www.marid.ns.ca

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* Montréal, Québec (450) 923-9511
www.deltajoists.com

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www.querometal.com

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www.quirionmetal.com

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www.structalponts.ws

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www.sturometal.com

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www.edlau.com

Etobicoke Ironworks Limited S
Weston, Ontario (416) 742-7111
www.eiw-ca.com

Fortran Steel Inc. S
Greely, Ontario (613) 821-4014
www.fortransteel.com

G & P Welding & Iron Works S,P
North Bay, Ontario (705) 472-5454
www.gpwelding.com

Gorf Contracting Limited S,P
Schumacher, Ontario (705) 235-3278
www.gorfcontracting.com

Lambton Metal Service S
Sarnia, Ontario (519) 344-3939
www.lambtonmetalservice.ca

Laplante Welding of Cornwall Inc. S
Cornwall, Ontario (613) 938-0575
www.laplantewelding.com

Lorvin Steel Ltd. S
Brampton, Ontario (905) 458-8850
www.lorvinsteel.com

M & G Steel Ltd. S
Oakville, Ontario (905) 469-6442
www.mgsteel.ca

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

Maple Industries Inc. S
Chatham, Ontario (519) 352-0375
www.mapleindustries.ca

Mariani Metal Fabricators Limited S
Etobicoke, Ontario (416) 798-2969
www.marianimetal.com

MBS Steel Ltd. J
Brampton, Ontario (905) 799-9922
www.mbssteel.com

Mirage Steel Limited S.J
Brampton, Ontario (905) 458-7022
www.miragesteel.com

Niagara Structural Steel, A Division of Canadian Erectors Limited S,P
1-888-853-4346
St. Catharines, Ontario (905) 684-2022
www.niagarastructuralsteel.com

Nickel City Steel Limited S,P
Sudbury, Ontario (705) 522-1982

Norak Steel Construction Limited S
Concord, Ontario (905) 669-1767

Noront Steel (1981) Limited S,P
Copper Cliff, Ontario (705) 692-3683
www.norontsteel.com

Paramount Steel Limited S
Brampton, Ontario (905) 791-1996
www.paramountsteel.com

Paradise Steel Fab. Ltd.
Richmond Hill, Ontario (905) 770-2121

Pittsburgh Steel Group (A Division of 1226616 Ontario Inc.) S
Vaughan, Ontario (905) 669-5558
www.pittsburghsteel.com

Quad Steel Inc.
Bolton, Ontario (905) 857-6404

Rapid Steel Inc. S
Erin, Ontario (519) 833-4698
www.rapidsteel.com

Shannon Steel Inc. S
Orangeville, Ontario (519) 941-7000
www.shannonsteel.com

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

Skyhawk Steel Construction Limited S
Brampton, Ontario (905) 458-0606
www.skyhawksteel.com

Spec-Sec Incorporated S,P
Rexdale, Ontario (416) 213-9899
www.spec-sec.com

Spencer Steel Limited S
Ilderton, Ontario (519) 666-0676
www.spencersteel.com

Telco Steel Works Ltd. S
Guelph, Ontario (519) 837-1973
www.telcosteelworks.ca

Tower Steel Company Ltd. S
Erin, Ontario (519) 833-7520
www.towersteel.com

Tresman Steel Industries Ltd. S
Mississauga, Ontario (905) 795-8757
www.tresmansteel.com

Victoria Steel Corporation S
Oldcastle, Ontario (519) 737-6151

Walters Inc. S,P
Hamilton, Ontario (905) 388-7111
www.waltersinc.com

CENTRAL REGION

Abesco Ltd. S
Winnipeg, Manitoba (204) 667-3981

Capitol Steel Corp. S
Winnipeg, Manitoba (204) 889-9980
www.capitolsteel.ca

Coastal Steel Construction Limited S,P
Thunder Bay, Ontario (807) 623-4844
www.coastalsteel.ca

Elance Steel Fabricating Co. Ltd S
Saskatoon, S.K. (306) 931-4412
www.elancesteel.com

Empire Iron Works Ltd. S
Winnipeg, Manitoba (204) 589-7371
www.empireiron.com

Falcon Machinery (1965) Ltd.
Winnipeg, Manitoba (204) 927-7000
www.falcongalv.com

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

JNE Welding S,P
Saskatoon, SK (306) 242-0884
www.jnewelding.com

* **Omega Joists Inc.** J
Winnipeg, Manitoba (204) 237-3528
www.omegajoists.com

Precision Industries Ltd. S,P
Prince Albert, SK (306) 763-7471
www.precisionindustrialltd.com

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

Supreme Steel Ltd. S,P
Saskatoon, SK (306) 975-1177
www.supremesteel.com

Weldfab Limited S
Saskatoon, SK (306) 955-4425
www.weldfab.com

ALBERTA REGION

Bow Ridge Steel Fabricating S
Calgary, Alberta (403) 230-3705

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

Canam – Canada, A Division of Canam Group Inc J
Calgary, Alberta (403) 252-7591
www.canam-steeljoist.ws

Capital Steel Inc.
Edmonton, Alberta (780) 463-9177

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

Empire Iron Works Ltd. S,P,J
Edmonton, Alberta (780) 447-4650
www.empireiron.com

Eskimo Steel Limited S,P
Sherwood Park, Alberta (780) 417-9200
www.eskimosteel.com

Garneau Welding Inc. S
Morinville, Alberta (780) 939-2129
www.garweld.com

Moli Industries Ltd. S
Calgary, Alberta (403) 250-2733
www.moli.ca

Norfab Mfg. (1993) Inc.
Edmonton, Alberta (780) 447-5454

Northern Weldarc Ltd.
Sherwood Park, Alberta (780) 467-1522
www.northern-weldarc.com

Omega Joists Inc. J
Nisku, Alberta (780) 955-3390
* Calgary, Alberta (403) 250-7871
www.omegajoists.com

Petro-Chem Fabricators Ltd. S
Edmonton, Alberta (780) 414-6701

Precision Steel & Manufacturing Ltd. S
Edmonton, Alberta (780) 449-4244
www.precisionsteel.ab.ca

Rampart Steel Ltd. S
Edmonton, Alberta (780) 465-9730
www.rampartsteel.com

RIMK Industries Inc.
Calgary, Alberta (403) 236-8777

Spartan Steel Ltd. S
Edmonton, Alberta (780) 435-3807

Supermétal Structures Inc., Western Division S,P
Edmonton, Alberta (780) 435-6633
www.supermetal.com

Supreme Steel Ltd. S,P
Edmonton, Alberta (780) 483-3278
www.supremesteel.com

Supreme Steel Ltd., Bridge Division S,P
Edmonton, Alberta (780) 467-2266
www.supremesteel.com

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

TSE Steel Ltd. S
Calgary, Alberta (403) 279-6060
www.tsesteel.com

W.F. Welding & Overhead Cranes Ltd. S
Nisku, Alberta (780) 955-7671
www.wfwelding.com

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

Whitemud Ironworks Limited S
Edmonton, Alberta (780) 465-5888
www.whitemud.com

BRITISH COLUMBIA REGION

* **Canam – Canada, A Division of Canam Group Inc.** J
Port Coquitlam, B.C. (604) 583-9760
www.canam-steeljoist.ws

Canron Western Constructors Ltd. S,P
Delta, B.C. (604) 524-4421
www.supremesteel.com

Clearbrook Iron Works Ltd. S
Abbotsford, B.C. (604) 852-2131
www.cliron.com

Dynamic Structures Ltd. S,P
Port Coquitlam, B.C. (604) 941-9481
www.empireds.com

Empire Iron Works Ltd. S
Delta, B.C. (604) 946-5515
www.empireiron.com

George Third & Son S,P
Burnaby, B.C. (604) 526-2333
www.geothird.com

J.P. Metal Masters Inc. S
Maple Ridge, B.C. (604) 465-8933
www. jpmetalmasters.com

M3 Steel (Kamloops) Ltd. S,P
Kamloops, B.C. (250) 374-1074
www.m3steel.com

Macform Construction Group Inc.
Surrey, BC (604) 888-1812

* **Omega Joists Inc.** J
Surrey, B.C. (604) 596-1138
www.omegajoists.com

Rapid-Span Structures Ltd. S,P
Armstrong, B.C. (250) 546-9676
www.rapidspan.com

Solid Rock Steel Fabricating Co. Ltd. S
Surrey, B.C. (604) 581-1151
www.solidrocksteel.com

Warnaar Steel-Tech Ltd. S
Kelowna, B.C. (250) 765-8800

Wesbridge Steelworks Limited S
Delta, B.C. (604) 946-8618
www.wesbridge.com

X.L. Ironworks Co. S,J
Surrey, B.C (604) 596-1747
www.xliron.com

CISC DETAILER MEMBERS

9009 - 7403 Québec Inc. B
Lachenaie, Québec (450) 654-0270

ABC Drafting Company Ltd. B
Mississauga, Ontario (905) 624-1147
www.abcdrafting.com

ACL Structural Consultants Ltd. B
Sylvan Lake, Alberta (403) 887-5300
www.acl-corp.com

A.D. Drafting B
Brampton, Ontario (905) 488-8216

Aerostar Drafting Services B
Georgetown, Ontario (905) 873-6565

Automated Steel Detailing Associates Ltd. (ASDA) B,Br,P
Toronto, Ontario (416) 241-4350
www.asda.ca

Base Line Drafting Services Inc. D,B
Concord, Ontario (905) 660-7017
www.bld.ca

B.D. Structural Design Inc./ Dessin Structural B.D. Inc. B,Br,P,J
Boucherville Québec (450) 641-1434
www.bdsd.com

Cadmax Detailing Inc./Dessin Cadmax Inc. B,Br
Boisbriand, Québec (450) 621-5557
www.cadmax.ca

Datadraft Systems Inc./ Les Systèmes Datadraft Inc. S,P,J,B
Montréal, Québec (514) 748-6161
www.datadraft.com

Detailed Design Drafting Services Ltd. B
Parksville, B.C. (250) 248-4871
www.detaileddesign.com

Dessins de Structures DCA Inc.
Levis, Québec (418) 835-5140
www.structuredca.ca

Dowco Consultants Ltd. B,Br,P
Surrey, BC (604) 606-5800
Maple Ridge, BC (604) 462-7770
Laval, QC (450) 963-4455
Mississauga, ON (905) 565-9030
www.dowco.com

GENIFAB B,Br
Charlesbourg, Quebec (418) 622-1676
www.genifab.com

Haché Technical Services Ltd./ Haché Services Techniques Ltée B,P
Caraquet, N.B. (506) 727-7800

Husky Detailing Inc. B
London, Ontario (519) 850-9802
www.huskydetailing.com

International Steel Detailing Ltd. B
Nanaimo, B.C. (250) 758-6060
www.intersteel.ca

IRESCO Ltd. B
Edmonton, Alberta (708) 433-5606
www.steeldetailers.com

JCM & Associates Limited B,P
Frankford, Ontario (613) 398-6510

JP Drafting Ltd. B,Br,P,J
Maple Ridge, B.C. (604) 465-3568
www.jpdrafting.com

KGS Group Steel Detailing Division
Winnipeg, MB (204) 896-1209
www.kgsgroup.com

Les Dessins de Structures Steltec Inc. B
Ste-Thérèse, Québec (450) 971-5995
www.steltec.ca

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

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

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

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

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

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

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

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

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

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

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

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

Workpoint Steel Detailing Ltd. S
Surrey, B.C (604) 574-2221

ASSOCIATE - ERECTOR

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

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

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

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

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

ASSOCIATE - SUPPLIER

Acier Picard Inc.
St-Romuald, QC (418) 834-8300
www.acierpicard.com

A/D Fire Protection Systems Inc.
Laval, Québec (450) 661-0006
www.adfire.com

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

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

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

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

Amcan Jumax Inc.
Saint Bruno de Montarville, Québec (450) 441-6011
www.jumax.net
(bolts, Nelson studs, anchors, hot-dip galvanization)

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

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

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

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

Bolair
Mississauga, ON (905)564-2231
www.bolair.ca
Paint spray equipment & accessories, ie: hoses, valves, filters, spray guns, etc.

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

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

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

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

Corrcoat Services Inc.
Surrey, BC (604) 881-1268
(Sandblasters & Coaters)

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

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

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

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

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

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

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

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

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

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

Globec Machinery/Globec Machineries
Quebec, QC (418) 864-4446
www.globec-machinery.com

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

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

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

Kubes Steel Inc.
Stoney Creek, Ontario (905) 643-1229
www.kubessteel.com

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

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

Les Industries Méta-For Inc.
Terrebonne, QC (405) 477-6322
www.meta-for.ca

MAGNUS Inc.,
Ste-Thérèse, Québec (866) 435-6366
www.magnus-mr.ca
(SDS/2 Design software)

Marmon/Keystone Canada Inc.
Langley, B.C. (604) 857-9844
Leduc, AB (708) 986-2600
www.marmonkeystone.com
(Hollow Structural Sections, A106 Seamless Pipes)

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

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

Moore Brothers Transport Ltd.
Brampton, Ontario (905) 840-9872
www.moorebrothers.ca

Pacific Bolt Maufacturing Ltd.
New Westminster, BC (604) 524-2658
www.pacolt.com
Steel fasteners, structural bolts, anchor bolts, tie rods.

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

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

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

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

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

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

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

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

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

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

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

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

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

VICWEST Corporation
Oakville, Ontario (905) 825-2252
Edmonton, Alberta (780) 454-4477
Surrey,B.C. (604) 590-2220
Moncton, N.B. (506) 857-0057
Winnipeg, MB (204) 669-9500
www.vicwest.com
(Steel Metal floor/roof deck, wall and roof cladding)

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

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

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

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

MILL MEMBERS

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

Atlas Tube Canada ULC
Harrow, Ontario (519) 738-5000
www.atlastube.com

IPSCO Enterprises Inc.
Regina, Saskatchewan (306) 924-7700
* Surrey, B.C. (604) 596-3361/1-800-644-3361
* Scarborough, Ontario (416) 321-4949/1-888-576-8530
* Calgary, Alberta (403) 543-8000
Lisle, IL (630) 810-4788
www.ipsco.com

STEEL SERVICE CENTRES

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

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

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

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

Metalium Inc.
Laval, Québec (450) 963-0411
www.metalium.com

Russel Metals Inc.
Lakeside, N.S. (902) 876-7861
Mississauga, Ontario (905) 819-7777
Edmonton, Alberta (780) 439-2051
Winnipeg, Manitoba (204) 772-0321
www.russelmetals.com

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

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

HONORARY MEMBERS

ArcelorMittal International
Hamilton, Ontario (905) 545-3777
www.arcelormittal.com

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

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

Enraz Oregan Steel Mills Inc.
Portland, OR 1-800-468-8913

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

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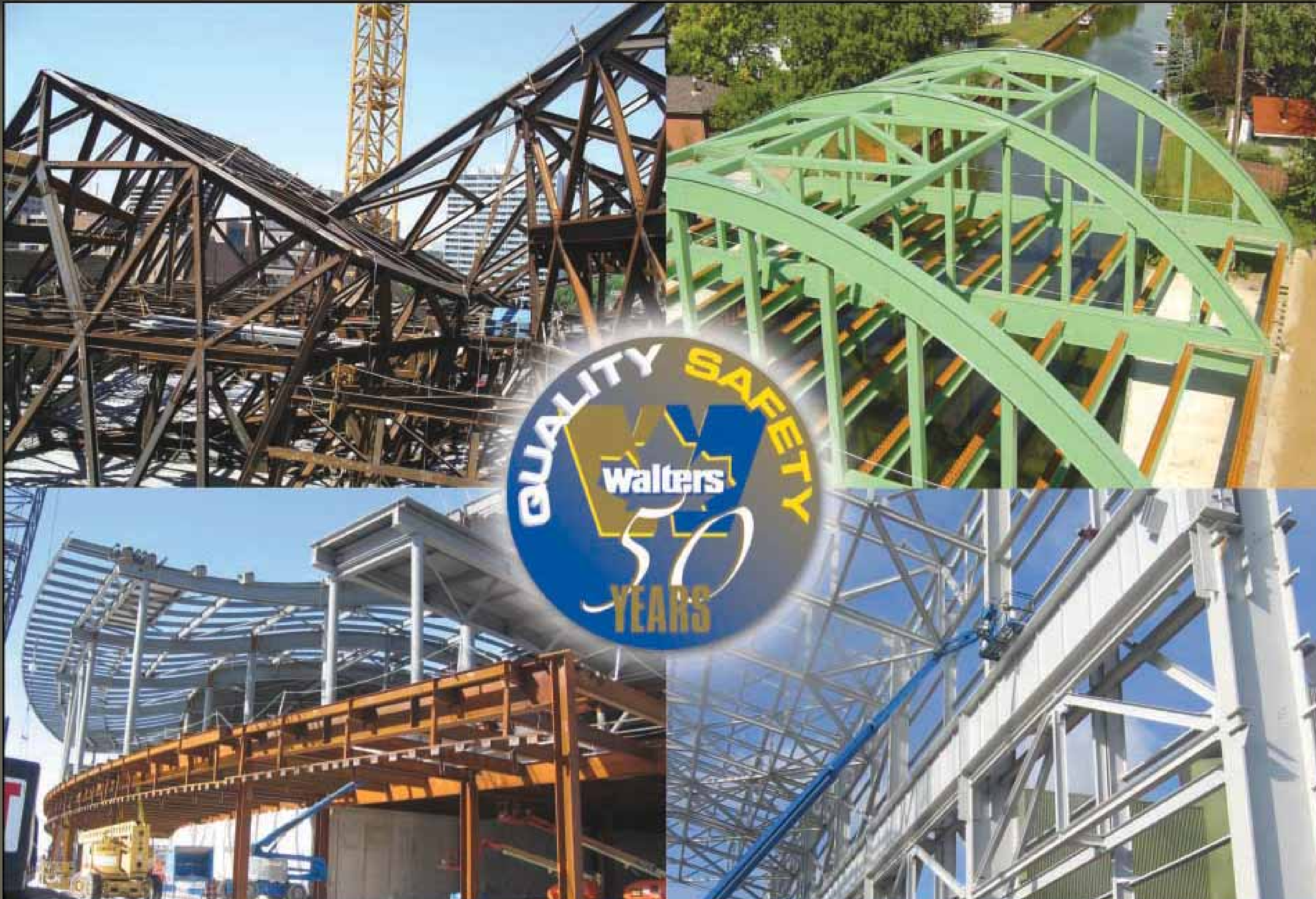
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