NO 32 FALL 2008

ADVANTAGE STEEL

RESIDENTIAL CONSTRUCTION, PART TWO: THE STAGGERED TRUSS SYSTEM

A TALE OF TWO LEEDS

ALBERTA REGION PRESENTS "COURSES BETWEEN COURSES"

QUALITY STEEL FABRICATION ASSURED

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CANADIAN INSTITUTE OF STEEL CONSTRUCTION

FROM THE EDITOR

In this issue, we launch an exciting, topical and important new column, For Green's Sake, as a forum to discuss all that is green with steel from production at the mill to the built environment. Since 1990, steel is the only industry to increase production while reducing its net overall emissions!

In keeping with things green, *A Tale of Two LEEDs* examines two recent projects which demonstrate that sustainability can be a successful priority even when working in challenging urban or rural environments.

Other advances in our industry are discussed in *Quality Steel Fabrication Assured*. CISC is moving to apply guidelines to the fabrication and erection of steel structures produced by our members. The forum at our AGM illustrated the benefits of certification. Look for a scorecard on the progress of our members to this goal in future issues.

There are many advantages to BIM technology. It can save time and money while managing risk effectively. It is highlighted in *Alberta Region Presents "Courses Between Courses"*.

We continue our series on residential construction with *Part Two: The Staggered Truss System*. This system, originally developed in the 1960's, is making a comeback. Faster construction time, reduced floor-to-floor height, and more column–free space are some of the advantages of this system. The article includes a wealth of sources for further research.

Not to be missed are our regular columns. *Ask Dr. Sylvie*, focuses on irregular sections. Seismic Corner asks: "Are your roof diaphragm forces insurmountable?" While *What's Cool, What's Hot, What's New* helps keep you up-to-date, such as, did you know we have moved?

Michael I. Gilmor, P.Eng.
President CISC

IN THIS ISSUE

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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

IRREGULAR SECTIONS

I received several questions on irregular sections, so I thought I would regroup them into a three-part question just as in the previous edition for questions related to big tubes!

1. MONOSYMMETRIC SECTIONS

In Table 1 and 2 of CAN/CSA-S16-01, the criteria for the stems of T-Sections are based on (b/t). Would it be (h/w) for the stem's slenderness? In BS5950 and ANSI/AISC-360-05, (h/w) are also used instead. In CAN/CSA-S16-01, I could not find the clauses for the bending of shapes other than doubly symmetric sections. Would it be in another reference? - K.M.

You could not find them because they do not exist in CAN/CSA-S16-01. With respect to stems of T-Sections, according to S16-01 Clause 11.3.1(b), the width "b" is the full nominal dimension. Also see Figure 2-8 of the CISC Commentary on CAN/CSA-S16-01 (S16S1-05) - page 2-28 of the Handbook (9th Edition). With respect to the bending of singly symmetric (or monosymmetric) sections, this specialized topic is not covered by S16. However, Clause 13.6(e) refers to the **Guide to Stability Design Criteria for Metal Structures** for providing a rational method of analysis of such sections. This publication has detailed information on the bending of monosymmetric sections, on top of being an excellent reference document for your library. You can order it from us at **www.cisc-icca.ca/publications/technical/design/stability**

It is a bit pricey but well worth it (I don't know how many times I provided this book as a reference for topics not covered in S16, for engineers "seeking reliable, in-depth coverage of stability problems and research"). The first version was edited in 1960. Theodore (Ted) V. Galambos, a very famous professor emeritus in civil engineering at the University of Minnesota, is the editor. Still hesitating? Glance at the table of contents: **www.stabilitycouncil.org/html/guide.htm**

2. BUILT-UP SECTIONS

I'm trying to calculate the basic geometric properties of an older-type built-up section built in the 1940's using a W or S shape, and a channel placed on top. Do these formulas exist or do I have to start from scratch? - R.S.

The section properties of this particular built-up section do exist in **Part Six of the Handbook**, entitled Properties and Dimensions. Check out page 6-140 of the 9th Edition for the equations enabling you to calculate the moment of inertia (I_{xx}, I_{yy}, I_{yT}), the section modulus (S_{x1}, S_z, S_{yy}) and the radius of gyration (r_{xx} and r_{yy}). Here's the bonus. You will also find over a dozen different built-up section configurations such as boxes (6 types), built-up I-shapes (5 types) with unequal flanges (unequal flange thicknesses or widths, plate or channel or W-shape with reinforced top and/or bottom flanges, flanges made of channels rather than plates), monosymmetric sections made of channels and/or angles (2 types) and a star-shaped section (1 type). If you don't have the most recent version, go to: **www.cisc-icca.ca/publications/technical/design/handbook**

And for the grand finale, there is a table (pages 6-136 and 6-137) that provides a longer list of properties and sections for several configurations of W shapes and channels which includes values for mass, shear centre (Y), torsional constant (J) and warping constant (C_w). Hopefully, you will be lucky enough to find your configuration in this list. And if all else fails, get the **Stability Guide** (see previous question).

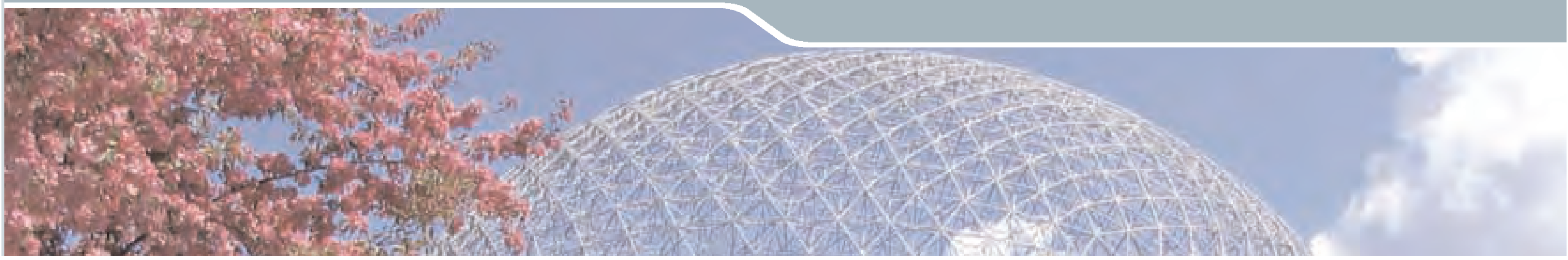
Incidentally, if you want to get the equations that can help you calculate shear centres, torsional constants and warping constants for several steel members (open and closed cross-sections; mono- and doubly-symmetric), download the following document from the Technical Resources on our website: **www.cisc-icca.ca/files/technical/techdocs/updates/torsionprop.pdf**

3. TAPERED BEAM AND COLUMN SECTIONS

We are checking the adequacy of an existing rigid-frame building that has tapered beam and column sections with rigid connections. Do you know of any reference that could help us with the analysis of this type of structure? For example, what kL/r would you use for checking the tapered column? The "r" at mid-height? - J.L.

I haven't found anything "nice and quick". Either you perform a 2nd order analysis in SAP or a similar analysis program, or you do something more empirical.

There is a very useful discussion in the all too famous **Guide to Stability Design Criteria for Metal Structures** (Section 3.3 TAPERED COLUMNS, pp 80-87 + Section 3.4 BUILT-UP COLUMNS pp 87-91). I believe I've already mentioned this Guide! **www.cisc-icca.ca/publications/technical/design/stability/**



I've found several research projects that suggest a methodology for obtaining an equivalent "k" factor, but nothing definitive. Since this type of column is more common in pre-engineered buildings or SBS (Steel Building Systems), you might consider getting information from CSSBI (Canadian Steel Sheet Building Institute): www.cssbi.ca

HOLE SIZES

What are typical suggested hole diameters for anchor rods? - G.H.

Another secret of the Handbook revealed. Look up the table SUGGESTED ANCHOR ROD HOLE SIZES at the bottom of page 4-153 of the Handbook (9th Edition). The hole diameters are either 6 or 12 mm larger than the actual rod diameters; for rod diameters ranging from 20 to 64 mm in the table.

Note: the expression "anchor rod" has replaced "anchor bolt" in order to avoid confusion with bolts produced to ASTM A325 and A490 (See ASTM F1554).

LATERALLY UNSUPPORTED ANGLES

I was wondering if there were more recent recommendations for calculating the bending resistance of angles which are not supported laterally. I have a document with tables indicating the maximum loads that can be applied but it is a 1984 document and there are no explanations on how the values were obtained. Is there anything more recent and complete? - C.B.

The AISC Specification for Structural Steel Buildings (ANSI/AISC 360-05) provides a method for calculating flexural strength limits of single angles in section F10 (pages 16.1-57 to 16.1-60). The calculations need to be made for three limit states: yielding (plastic moment), lateral-torsional buckling and flange local buckling. Actually, because you are eager to understand what you are doing (a very positive attitude for a junior engineer), I recommend you read the Commentary (pages 16.1-279 to 16.1-283), which is more explanatory. www.aisc.org/2005Spec

F_U OF OLD BOLTS

I would like to know if a table exists somewhere listing the different grades of steel for bolts over the years. I am looking specifically for the F_U of bolts used in 1964? - C.G.

You will never believe the luck you have. We actually have a 1961 version of the ASTM A325 specification for high-strength bolts. I continue to be amazed at what we have in our archives. As you know, at that time, allowable stress methods were used so F_y is the value one can more easily find from sources of information of that era. In fact, an older standard is just about the only place you can find F_u. Here are different values of F_u as a function of bolt diameter:

- 1/2, 5/8, 3/4 inch diameter bolts = 120 ksi (827 MPa)
- 7/8, 1 inch diameter bolts = 115 ksi (793 MPa)
- 1-1/8 to 1-1/2 inch diameter bolts = 105 ksi (724 MPa)

You'll notice that these values are very similar to the values we use today! The only difference is the range: 120 ksi for 1 inch or less diameter bolts, and 105 ksi when over 1 inch. Please also note that when you are verifying your building, you can use the ϕ values of the most recent CSA S16 standard. Imagine: the first ASTM A325 specification came out in 1951! Actually, I contacted and searched several sources; it seems no one has the original 1951 version. Maybe eBay? Maybe for my birthday (January 16th)?

COMMENTS FROM READERS

HELICAL WELDS (ISSUE NO. 31)

Several of my clients are satisfied using pipes with helical welds given their availability and pricing. Why do you portray them as being unacceptable for exposed structural steel? - R.T.

We are not saying they are unacceptable. We are saying that if a client does NOT want them, they should specify that wish in the bid document.

HSS TRUSS CONNECTIONS (ISSUE NO. 31)

You mention that the engineer always needs to consider eccentricities in their HSS truss design. Since when has this been a requirement? - J.R.

We are saying that you should check the ranges of validity to verify whether you CAN ignore eccentricities. If you are within that range, your job is nearly done. If you are not, consider adjusting your design to avoid expensive details. If that's not possible, you then will need to account for those eccentricities in your design.

SEISMIC CORNER
ARE YOUR ROOF DIAPHRAGM FORCES INSURMOUNTABLE?

Alfred F. Wong, P.Eng.

This article aims to compare roof diaphragm forces in several Seismic-Force-Resisting Systems (SFRS) used in single-storey buildings subject to relatively high seismic hazard.

Sheet steel deck products were introduced initially to serve as gravity-load-supporting and cladding components. It was quickly discovered that sheet steel decks, in combination with purlins, joists and girders, could effectively resist and distribute lateral forces through diaphragm actions, eliminating the need for in-plane roof bracing in most applications. Today, steel deck roofs are the norm for steel-framed buildings, including single-storey buildings consisting of concrete and masonry perimeter bearing walls.

NBCC 2005 introduced numerous changes to the provisions for earthquake loads and effects. With respect to roof and floor diaphragm designs, forces have been increased substantially for many common applications. The diaphragm force increase for single-storey buildings, in particular, has caught the attention of many. Some are shocked to find a twofold increase or more in roof diaphragm forces for some of the traditional forms of construction. In compliance with capacity design principles, NBCC 2005 requires diaphragms and their connections to remain elastic while the yielding elements in the SFRS undergo inelastic deformation. Specifically, diaphragms and their connections are required to resist forces associated with the capacity of the yielding elements instead of the forces calculated from the minimum base shear that has been reduced by incorporating Force Modification Factors, R_d and R_o. Hence the capacity of the yielding elements in the vertical SFRS controls the diaphragm design forces. However, these design forces need not exceed those corresponding the elastic base shear (i.e. V based on $R_dR_o=1$).

The example below illustrates the relationship between the type of SFRS and the diaphragm design forces for a single-storey building in Vancouver. Three seismic-force-resisting schemes are considered, and the diaphragm forces and design solutions are compared. These seismic-force-resisting schemes are:

A) Steel Ductile Eccentrically Braced Frame (DEBF) as shown in Figure 1

B) Steel Tension-only Limited-Ductility Concentrically Braced Frame as shown in Figure 2 and

C) Concrete Tilt-up Wall Construction in which the perimeter walls (mainly 160 mm solid wall panels) resist the lateral loads as well as supporting the roof in lieu of steel edge beams and columns.

This relatively simple building has a flat roof supported by steel roof decking, open-web steel joists and girders. In Schemes A and B, the building is clad in a traditional system consisting of sheet steel siding and steel girts. Design parameters that are common to all 3 schemes are shown in Table 1 whereas Table 2 gives the parameters and forces that are scheme-dependent. The diaphragm design forces and the diaphragm (or bracing) systems required are also illustrated in Figure 3 for comparison. Detailed

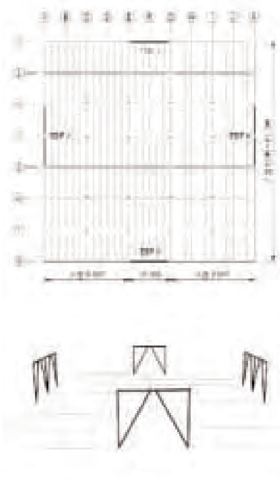


Figure 1
Scheme A - Ductile Eccentrically Braced Frame

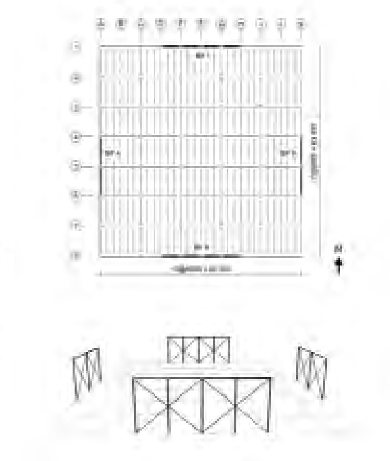


Figure 2
Scheme B - Tension-Only Limited-Ductility Concentrically Braced Frame

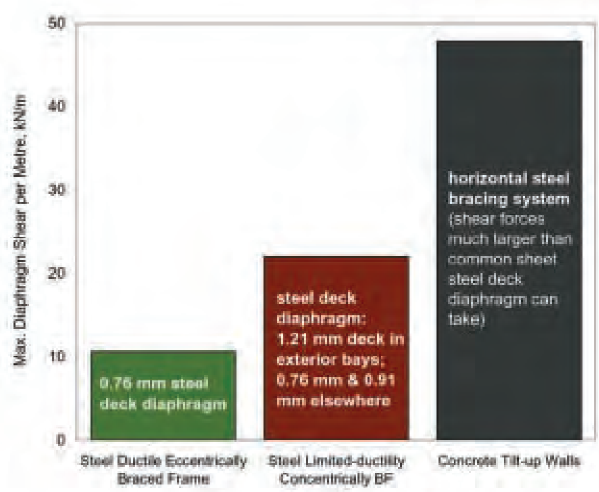


Figure 3
Summary - Roof Diaphragm Forces and Systems

locality	Vancouver
building height, mm	9000
Importance Factor, I_E	1.0
Accel. Site Coeff., F_a	1.0
Vel. Site Coeff., F_v	1.0
Higher Mode Factor, M_v	1.0
$S(0.2) = F_a S_a(0.2)$	0.94
$(2/3)(S(0.2)I_E)W/R_d R_o$	$0.63W/R_d R_o$
$S(0.5) = F_v S_a(0.5)$	0.64
T_a, sec	< 0.5
$S(T_a)M_v I_E W/R_d R_o$	$> 0.64W/R_d R_o$
Min. Earthquake Force, V	$0.63W/R_d R_o$

Table 1
Common Design Parameters

Parameter Description \ **Seismic-force Resisting System**		**Steel *Ductile Eccentrically Braced Frame***	**Steel *Tension-only Limited-ductility Concentrically Braced Frame***	**Concrete Tilt-up Walls (*Conventional Construction*)**
weights for diaphragm force calculations (kN)	roof + 25% snow	5455	5455	*5455
	ext. walls (upper) perpendicular to motion	140	140	2130
	total	5595	5595	*7590
ductility mod. factor, R_d		4.0	2.0	1.5
overstrength mod. factor, R_o		1.5	1.3	1.3
yielding elements in *SFRS*	north-south direction	W200x36 link beams	round HSS102x8.0 braces	-
	east-west direction	W310x39 link beams	round HSS 89x8.0 braces	-
diaphragm shears to consider in exterior bays (kN)	*minimum force*	366	825	*1470
	based on $R_d R_o$=1	-	-	*2870
	capacity based	670	1388	-
	S16 upper limit	1630	1630	-
	governing shear	**670**	**1388**	***2870**
max. unit shear (kN/m)		**10.6**	**22.0**	***47.8**
diaphragm / horizontal bracing system required		**0.76 mm deck welded to supports / screw side seams**	**1.21 mm deck in ext. bays; 0.76 & 0.91 mm elsewhere – welded to supports / screw side seams**	**horizontal steel bracing**

* excluding effects due to weight of horizontal bracing

Table 2
Roof Diaphragm Parameters and Forces

design calculations required to verify ductile behaviour in accordance with CSA Standard S16 are shown elsewhere.

Clearly, Scheme A is the most efficient and offers the most economical roof diaphragm solution. The deck thickness required for gravity load support also satisfies the diaphragm design requirements. The link beams in the DEBF are designed to attain the shear yielding mode of behaviour, and the capacity of the DEBF in the east and west walls governs the maximum diaphragm design forces. Although the capacity-based diaphragm shear stipulated in S16 (670 kN) is much larger than the factored shear based on NBCC minimum earthquake force (366 kN), it is substantially smaller than the upper limit permitted in S16 (1630 kN).

Capacity-based forces also govern the diaphragm design in Scheme B. This diaphragm is subjected to higher forces than Scheme A due to the lower Force Modification Factors associated with Limited-ductility bracing systems. Thicker decks are required in regions of higher shear forces. This type of SFRS is a more viable alternative for applications where the seismic forces are lower because of lower seismicity, smaller roof size or both.

It is rational to calculate the deformation for capacity-protected diaphragms from capacity-based forces and the ultimate diaphragm deflection multiplier should then be taken as $1/I_E$ (instead of $R_d R_o/I_E$) because these diaphragms are not permitted to yield. However, the NBCC has not made this fact apparent.

The diaphragm forces for Scheme 3 are much larger than those which roof diaphragms built of common sheet steel deck products can resist. A horizontal steel bracing system must be provided. Roof diaphragms in Scheme-3 type of structures typically experience very large seismic forces due to the compounding effects below:

1. Its lower system ductility and inability to limit diaphragm forces through inelastic actions
2. Its larger mass due to the much heavier walls (perpendicular to seismic motion)
3. Its shorter fundamental period, T_a, due to the much stiffer shear wall system.

For this example, all 3 schemes have T_a values shorter than 0.5 seconds. In this case, the value of T_a is irrelevant because the design spectrum for Vancouver has gentle slopes allowing the upper limit for Minimum Force (i.e. $(2/3)S(0.2)I_E W/R_d R_o$) to intersect the spectrum where the period exceeds 0.5 seconds. For some other localities, such as Montreal and Ottawa where the design spectra have steeper slopes, the higher stiffness of the shear walls alone attracts larger seismic forces.

Besides the above-mentioned advantages, steel braced frames offer choices. The designer selects the optimum number of braced bays as well as the most appropriate type of SFRS for a given set of seismic forces. It should be noted that steel braced frames of Conventional Construction type of SFRS are very common in regions of relatively low seismicity.

Valerio Dewalt Train

South view, Staybridge Hotel

RESIDENTIAL CONSTRUCTION
PART TWO – THE STAGGERED TRUSS SYSTEM

Michelle Ponto

In the Spring 2006 issue of Advantage Steel , Mike Gilmor discussed various ways in which multi-residential buildings could be constructed using steel. Peter Timler followed up on the subject with Residential Construction, Part One: Hybrid Steel and Hollow Core Systems earlier this year. This article is part two of the three-part series and focuses on the Staggered Truss System, a system that also relies on the use of steel and often features hollow-core planks.

The system was originally developed in the 1960s at MIT with US Steel to reduce floor-to-floor heights needed for residential occupancies. Staggered truss framing has been used in a number of buildings in Canada including: the Delta Bow Valley Hotel in Calgary, Chateau Lake Louise expansion, a hotel in Edmonton, a hotel in Niagara Falls and a small addition for a project in Saskatoon. Its main advantages include reduced floor-to-floor height, 20-25% faster construction time, more column-free space, and a lighter overall structural system. Currently projects using the Staggered Truss System are located in Chicago for a Staybridge Suites hotel, and this hotel is the first building to use the system in Chicago.

BUILDING EFFICIENT AND COST-EFFECTIVE TRUSSES

With the Staggered Truss System, the building consists of storey-high trusses that span the width of the structure and are vertically staggered on every other column line. The system transfers lateral loads from the trusses to the floor rather than using interior columns, which helps create more column-free space and reduces the foundation weight. But as the trusses are modeled after one governing truss and all other trusses are designed and fabricated in exactly the same way, the real cost and time savings begin with the system design.

"The trusses are all identical, so when you are building, the issues of construction sequencing can be minimized or eliminated. It really speeds up on-site construction," said Tabitha Stine, Director of Technical Marketing for the American Institute of Steel Construction. "The structure starts by placing the columns. The trusses then slide in between. You then set your planks to span from truss to truss."

Examples of early Canadian Steel Truss Construction

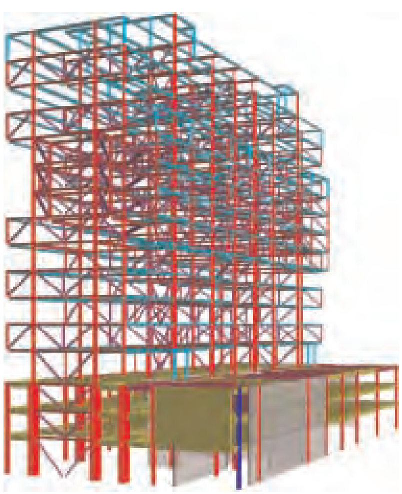
Examples of early Canadian Steel Truss Construction

The Staybridge Suites project has been in development since 2002 and Stine was involved with the original conceptual study. The project is a "signature" staggered truss building as it pushes the system to the limit while still staying efficient and cost-effective. The system is successful because the trusses take less time to erect and are identical; it takes less time to fabricate.

"Seventy percent of the steel package cost was fabrication and erection. Only 30% was actual material cost. You may be making the trusses heavier in certain areas by going with the truss that carries the heaviest load and repeating that truss everywhere, but overall you are saving in fabrication and erection," said Stine.

Because the Staggered Truss System supports a pre-cast hollow-core concrete plank floor, no time is wasted pouring concrete on site. This aids in the speed of construction and helps eliminate stop time due to cold-weather winter conditions. But when it came to the Staybridge Suites building, cold climate was not the only limitation. The project was also located on a tight urban site with no laydown place for materials.

"Because the trusses are made offsite and are exactly the same, the system can operate in areas with little work space. Basically, the truck pulls up to the site, lifts the trusses directly off the trailer and then places them by sliding them between the columns," said Stine.



Structural Affiliates International, Inc.

3D Rendering of Staybridge Hotel south view

GOING OUTSIDE THE BOX WITH OPEN SPACES

When it comes to planning, there is no difference in the Staggered Truss System compared to other systems. The architect lays out the building as with any other type of project. The engineer then takes the architectural layout and makes the staggered trusses work with it. One of the benefits of the Staggered Truss system is that the engineer can standardize the design to a few typical trusses even if floor plans aren't in a perfect rectangle.

"There are many architects who want to make areas of the building cantilever beyond the main part of the structure. This is what happened with the job here in Chicago. The building is not a rectangular building, but one typical truss configuration was still used and repeated," said Stine. "In order to create the cantilevered balcony area in the plan, the center line was mirrored in certain areas while using the same truss configuration."

The Staybridge Suites project called for various masses making the need for flexible, column-free areas essential. With the Staggered Truss System there are no interior columns. All columns are near the perimeter which means the space can have a variety of areas ranging from a large ballroom to small meeting rooms. While this works out for the current Staybridge Suites architectural plan, it also helps with future renovations as there are no columns to get in the way.

Trusses can span 40 to 80 feet depending on structural needs. It's not unusual to have a 60 x 60 foot column-free area with the staggered truss system. The system provides a large amount of free-open space.

SPECIAL CONSIDERATIONS

With this system the trusses are designed with top and bottom chords that are horizontal, diagonal web members and a vierendeel panel, usually at the centreline of the truss. This means there is no diagonal in the mid panel of the truss which creates an opening for a central corridor.

This opening is usually positioned to accommodate the hallway so that the remaining truss can be hidden in the inter-suite partition. The corridor doesn't have to run along the centre of the structure, but it does have to be in a straight line so the trusses can be placed in the walls. Trusses are typically 8 inches thick.

TO GET YOU STARTED WITH STAGGERED TRUSS DESIGN

Sylvie Boulanger

Canada is due for its next staggered truss building. It has been over a quarter of a century since buildings relied on this system. The renewed interest is well deserved, technically and economically speaking, and merits attention in our northern environment. Whether you are an architect or an engineer, be the first of this millennium in Canada to use and benefit from the staggered truss system for your next hotel or residential complex. You will find inspiration with the following sources of information.

ARCHITECTS

For architects who want to know more about the system, a very useful overview source is available in Architectural Record, case studies included: **archrecord.construction.com/resources/conteduc/archives/0202aisc-1.asp**

You can consult the articles in **Modern Steel Construction** listed below.

ENGINEERS

For structural engineers who want to know more about the system, several sources are available.

A Canadian example of the staggered truss system provides a useful list of "best practices" on page 5 of the article:

Staggered Truss and Stub Girder Framing Systems in Western Canada
www.cisc-icca.ca/advantagesteel (see Advantage Steel 25)

This article provides the background research on the system, and really presents the nuts and bolts - the origin - of staggered trusses.

The Staggered Truss System—Structural Considerations
By John B. Scalzi in Engineering Journal, October 1971
www.aisc.org/ej (click on downloadable PDFs; 1971-Q4)

Other useful Engineering Journal articles free for download:

Calculation of Wind Drift in Staggered-Truss Buildings
R. E. Leffler, 1st Quarter, 1983

Design Solutions Utilizing the Staggered-steel Truss System
Michael P. Cohen, 3rd Quarter, 1986_

Erecting the Staggered-truss System: A View from the Field
Hassler, 4th Quarter, 1986_

The most recent design guide containing current methods of construction can be downloaded (free for AISC members, 60$US for non-members) at this address:

Steel Design Guide 14: Staggered Truss Framing Systems
By Neil Wexler, PE, Feng-Bao Lin, Ph.D. PE
www.aisc.org/design_guides

A "Steel Wise" article provides a poster of practical details to visualise the answers to questions such as: How deep is the truss? What is a typical bottom chord member? How is the truss connected to the column? How is the slab supported? What is a typical web member? How do I support the roof level?

Anatomy of a Staggered Truss
Bobbi Marstellar, P.E and Tom Faraone, P.E.
www.modernsteel.com/steelwise.php

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Staggered Truss System Proves Economical For Hotels
Aine Brazil, P.E., September 2000

Aladdin Hotel
Robert J. McNamara, May 1999

Complex Apartments
Beth S. Pollak and Michael Gustafson, September 2004

Staggered trusses systems may not be economical for projects above 20 stories in high-seismic regions. In taller buildings, the following article concludes that special attention to diaphragm details and the Vierendeel opening is required to improve the seismic behaviour of staggered truss systems.

Seismic Behavior of Staggered Truss Systems
Jinkoo Kim and Joonho Lee
First European Conference on Earthquake Engineering and Seismology, 2006
hibs.skku.ac.kr/labpds/up/2006/inter-lec-achieve-200603.pdf

This article by Ashraf Habibullah presents information on modeling, analysis and design capabilities of ETABS for Staggered Truss Systems. The program includes a wide variety of dynamic analysis options. It is also possible to model the staggered truss structure as a simple two-dimensional frame or a complete system.
http://www.csiberkeley.com/Tech_Info/TrussTechnicalNote.pdf

Do not hesitate to contact your regional director who would then involve the **Project Analysis Division** of CISC to provide a cost estimate and to assist you in realizing your first staggered truss building. It is an efficient system for certain configurations of hotel and apartment buildings.

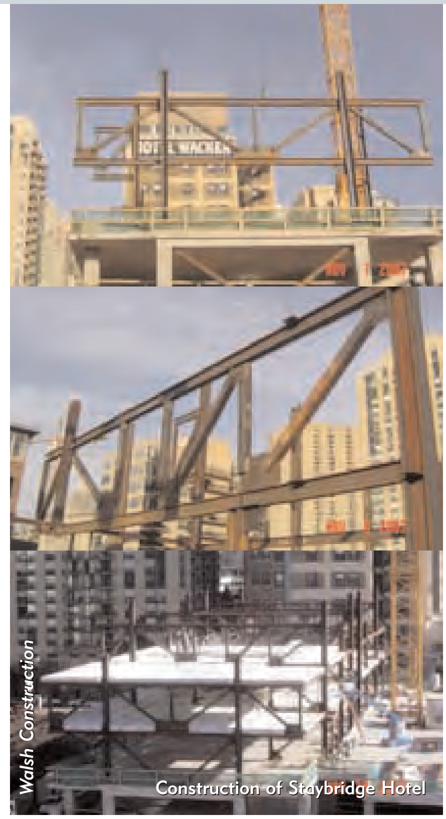
In addition to wall placement, lateral load also needs to be taken into consideration. The trusses can handle the lateral loads for a structure up to 20 to 25 stories in height depending on the overall width of the structure. Once the building exceeds that height, a supplemental lateral-load-resisting system is usually required. In the longitudinal direction, stability is typically achieved with rigid frame action using spandrel steel beams

"The taller the structure, the heavier the lower floors become that are supporting these heavy lateral loads and it can become uneconomical," said Stine. "A braced frame or shear wall at the elevator tower, exterior moment frames or braced frames, or other elements can be used to take the extra load."

FLEXIBILITY FOR TODAY'S AND FUTURE TENANTS

Staybridge Suites will be the first of many hotels to use the Staggered Truss System in Chicago. While Stine admits the Chicago building won't have the same 20-25% erection savings as a typical Staggered Truss building due the various unique masses, the other advantages such as the vast amount of column-free space and the easy erection due to lack of required laydown area made this system the right choice for the project.

"The solution is to look at your site, your fabricators, general contractor, and your schedule to massage the system for its most efficient use. This way you'll stay on time and on budget," said Stine.


Walsh Construction

Construction of Staybridge Hotel

A TALE OF TWO LEEDS

John Leckie

One is institutional and in a remote location; the other is commercial and in an urban setting, but design teams for both buildings had one goal in mind: sustainability. Hence, it is not surprising that the new Kuujjuaq Air Terminal in Nunavik and the Hagen Head Office in Baie d'Urfé, Québec, each received a CISC Design Award in the Green Building Category.

While the design and environmental conditions were different, architects for both projects were instrumental in encouraging and convincing the owners to think green and go green, with LEED (Leadership in Energy and Environmental Design). In the past several years, the LEED rating system has pulled away from the pack to become a front-runner as a benchmark for green design in buildings.

The Canada Green Building Council has adapted the system developed in the United States and tailored it to our Canadian climate, construction practices and regulations. The system looks primarily at five categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources and indoor air quality.

Steel, like all the other building materials, possesses both positives and negatives when it comes to the LEED process. Steel is infinitely recyclable, contains high levels of recycled material (25-90%) and is reusable, which scores well in a LEED evaluation. On the downside, steel is a conductor. Fortunately, special attention to connection details with the building envelope and a nominally thick concrete slab on a steel deck will satisfy thermal bridging and thermal mass requirements.

Steel has been used in a number of LEED-certified buildings in recent years, and in many of these it played a prominent role.

KUUJJUAQ AIR TERMINAL, NUNAVIK

One project where steel touched all the bases was the new air terminal in Kuujjuaq, a community of about 2,500, in the northern Quebec region of Nunavik.

The existing terminal, about 30 years old, was too small and Transport Canada decided to replace it with a new 1,200-square-metre building, about three times the size of the existing structure. The initial goal was to design the building in the spirit of the LEED rating system but Transport Canada later decided to go for a LEED certification.

"LEED was not developed with the Arctic in mind," says the project architect, Alain Fournier, a partner in the Montreal-based firm of Fournier Gersovitz Moss & Associés Architectes. "We had to adapt the rating system to our needs and to the needs of the Arctic to the point of sometimes reinterpreting the criteria needed to meet a LEED credit's requirements."

In the beginning, the target was a silver certification, the third of four levels set out in LEED but Fournier expects the building will achieve a gold level. (The four levels are certified, silver, gold and platinum.)

Arctic construction, of necessity, has generally been ahead of the rest of the country in building according to the energy efficiency and water consumption criteria now found in the LEED standards. Also, construction in a location where materials and supplies can only come in by ship three times a year requires a degree of organization on the part of the contractor far beyond that required on projects in southern Canada. Everything that is required for the project must be included in those three shipments. The alternative is to fly in anything that has been overlooked but that can be prohibitively expensive.

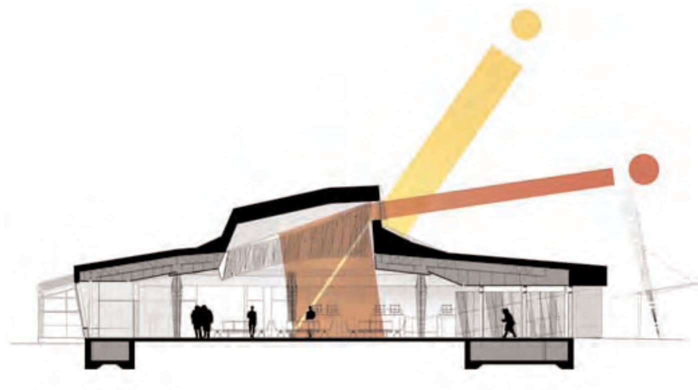
With the first ship arriving in early August and a construction season that only allows exterior work until about mid-November, the building envelope has to be closed in quickly. As well, there are no concrete suppliers or even commercial concrete mixers in the area around Kuujjuaq. Steel was easier to ship, faster to erect and did not have the quality control issues of concrete so it was a relatively easy choice as the primary structural material.

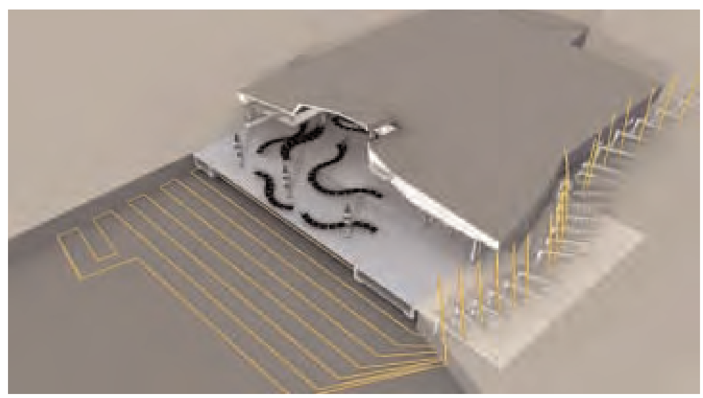
"We tried to select a building system that involved a sort of Meccano-type construction that could be put up very quickly," Fournier says. "That does not necessarily mean a prefabricated building and, in this case, it was not."

One of Transport Canada's objectives was to integrate and reflect Inuit culture as much as possible as part of the design. "Our approach was not just to hang a few prints or stick a few carvings in the building," Fournier says. "We tried to go a little beyond that." The site was tight, very long and narrow, and the function of the terminal itself dictated a long and narrow design, so the basic metaphor for the building became the classic icon of Inuit culture in the north, the kayak.

"The building has a sweep to it with the slope of the roof basically trying to hark back to the shape of the kayak," Fournier says. That feeling is enhanced by the clerestory windows, centred over the main waiting hall, which are located where the cockpit of the kayak would be. The windows are angled to reflect light down into the main waiting area.

At that latitude, rays from the sun are coming in almost horizontally for much of the year. In addition to affecting the design of the clerestory windows, that factor also affected placement of the solar panels used for the building. In the south, the panels might have been placed on the roof at a 45 degree angle but in Kuujjuaq, they are part of a solar wall. The use of the solar panels at all is a bit of an experiment. "Theoretically solar panels perform better in very cold weather so it remains to be seen how much energy we will be getting from this," Fournier says.





Instead of suspending the building on stilts, as is often done in a northern environment, the building was built on grade and uses a series of thermosyphons to avoid melting the permafrost: a network of steel pipes running under the building and extracting the heat to release it into the atmosphere through the curving row of tubular sections which have both a structural and a cooling role

KUUJJUAQ AIR TERMINAL, NUNAVIK

OWNER: Transport Canada

MANAGER: Public Works and Government Services Canada

ARCHITECT: Fournier Gersovitz Moss & associés architectes

STRUCTURAL ENGINEER: Genivar

GENERAL CONTRACTOR: Laval Fortin Adams

CISC FABRICATOR AND DETAILER: Sturo Métal Inc.

Photos & images: Fournier Gersovitz Moss & associés architectes

The roof and the walls of the building are clad in prepainted steel, the walls a bluish purple shade and the roof a pure white with a very high albedo as one of its primary characteristics. Kuujjuaq is further south than much of Nunavik and some summer days can get quite warm. Rather than install air-conditioning, the designers opted for a roof that would reflect as much of the heat from the sun as possible.

Unlike most buildings in the Arctic, including the building it was replacing, the new terminal is built on grade, instead of being suspended on stilts to prevent the heat of the building from thawing the permafrost.

While there were a number of operational reasons for putting the building on grade — convenience for passengers and baggage handlers topping the list — it created significant difficulties for the architects because thawing the permafrost under the building could create major problems.

The solution was a series of thermosyphons, a network of steel pipes running under the building and extracting the heat to release it into the atmosphere. "It is essentially a passive cooling system," Fournier says.

Normally, these pipes would have been concentrated into stacks at one end or the other end of the building but allowing for possible future expansion made this impossible. The solution was to line the pipes up in a curving row and use them as a support for the entrance canopy, thus giving the pipes a structural role in addition to their cooling role.

Overall, the energy efficiency of the Kuujjuaq terminal is 42 per cent better than the standard performance and, in terms of water efficiency, it is 35 per cent above standard. By changing the original plan of building on one of the airport's taxiways and later demolishing the old building, the designers managed to save $1 million and the original building, which is now destined for other uses in the community. It was moved to a temporary location during construction and will be moved off-site later. Moving the building also provided the opportunity to decontaminate the area around the former terminal where there had been a fuel supply system in place.

HAGEN HEAD OFFICE, BAIE D'URFÉ, QUÉBEC

The Hagen Head Office project illustrates the need to start thinking about the LEED process right from the start. The owners — pet-food makers Rolf. C. Hagen Inc.— had already chosen a site and a developer and had developed a concept plan before the architects Rubin & Rotman Associés of Montreal came on board.

"The owners expressed interest in environment and conservation but they had no knowledge of the LEED program or any other organized approach to sustainable architecture," says Rick Rubin, a partner with the architectural firm. "Once we introduced them to the concept, they fell in love with it and decided to go after it wholeheartedly."

The site for the 5,600-square-metre, three-storey building was a heavily treed site along the Trans-Canada Highway near Montreal. "As consultants we would rather not denude a natural habitat," Rubin says. "We would rather redevelop a brownfield site. Once we had inherited the situation, from a LEED and environmental perspective, we wanted to make the best use of what we had."

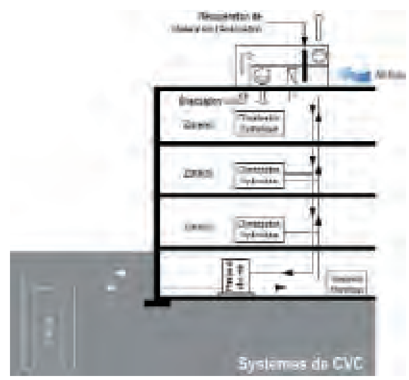
The maples, oaks, lindens, ash and red maples that could not be saved were cut down and incorporated into the building as soffits, wall panels, furniture components and interior decoration. "We would have liked not to cut them down in the first place but, since the building had to go on that site and it was a treed site, we made the best effort to take advantage of what we had," Rubin says.

Aside from the basement foundation walls and the reinforced concrete ground-floor slab, the structure of the building is steel. For this type of building, steel would be the typical choice even if LEED wasn't involved but the 90 per cent recycled content of some of the structural steel used for the project meant it was an important component in the sustainable aspect of the building design.

Part of the design philosophy for the building was to keep the use of material to a minimum. To that end, much of the structural steel was left exposed. "It creates certain challenges by not cladding the vertical columns with drywall," Rubin says. "You can't accommodate wiring and electrical outlet boxes that would normally go on a column." Some low-voltage control wiring goes through the columns and some thermostats were mounted on the steel columns. "It was a little challenge but not enough of a constraint to have us abandon our ideas."

The building is designed around a central atrium that forms the main vertical traffic corridor. It also serves as the "lungs of the building" with fresh air brought in by the mechanical ventilation system distributed to the various floors by fans in the ceiling. Some of the energy-saving features of the building include a geothermal loop, heat pumps, a heat bank, radiant slabs, open-grid ceilings and low R-value carpeting. Glazing of the building ranges from clear to semi-opaque and opaque to allow as much natural light in as possible while controlling the intensity and the potential heat buildup. Aside from the exposed structural steel elements, treatments in the interior include polished concrete floors, brickwork, wood facing and glass walls.

LEED certification is moving rapidly into the mainstream as a desirable and achievable goal for owners, developers, and architects to provide a built environment that is more sustainable. There are as many ways of achieving the goal as there are ways to design buildings but steel will often play a prominent role because of its ability to be reused and recycled without losing strength, its high strength-to-weight ratio, its deconstructabillity and adaptability. Its use can often be justified from a social, environmental and economic standpoint – the best of all possible worlds. The design teams of the Kuujjuaq air terminal and the Hagen head office demonstrated how each, with their own set of constraints, strived to reach that goal.

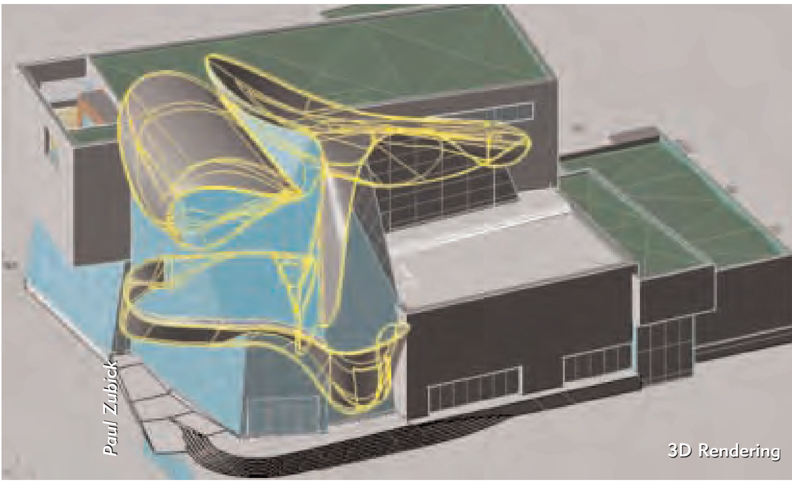


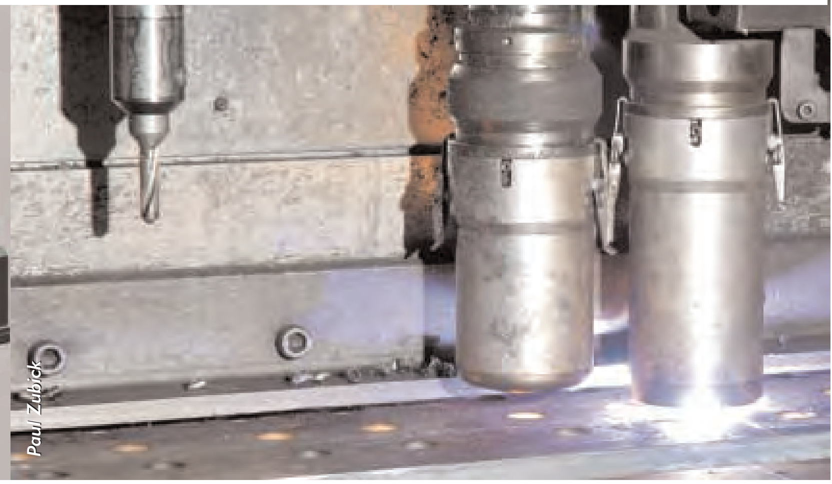
HAGEN HEAD OFFICE,
BAIE D'URFÉ, QUÉBEC

OWNER: R.C. Hagen Inc.
ARCHITECT: Rubin & Rotman Associates
STRUCTURAL ENGINEER: BCA Consultants
GENERAL CONTRACTOR:
Broccolini Construction Inc.

Photos & images:
Rubin & Rotman Associates

Exposed structural steel elements, open-grid ceiling tiles and low R-value carpeting are some of the energy-saving features of this building





ALBERTA REGION PRESENTS "COURSES BETWEEN COURSES"

Don Buchanan

Reprinted from the May 2008 Issue of The PEGG, with permission.

What is building information modelling? What kinds of collaborative or high-tech approaches are there for design, detailing and construction phases? How are steel fabricators boosting throughput with high-tech tools or other innovations?

The Alberta Regional Committee of the Canadian Institute of Steel Construction took on these questions and others at a professional development event on March 27 in Edmonton.

"Building information modelling, or BIM, is not just about 3-D modeling software," said Peter Timler, P.Eng."BIM is about various kinds of collaborative work. It includes software tools, but it also encompasses any steps or approaches that help to reduce redundant steps or operations at any phase of a project."

"It's all about teamwork, integration, collaboration and streamlining. The more effective you are in using high-tech tools or collaborative approaches, the more likely your project will come in on time and on budget."

Paul Zubick, P.Eng., vice-president-contracts for Waiward Steel Fabricators, said Alberta's structural steel sector is pushing the high-tech envelope. The sector may even be leading the way for all construction trades in Alberta when it comes to adopting new technologies.

"For example, 3-D detailing software is used for day-to-day troubleshooting on many construction projects. When you bring people together and mix-and-match various 3-D modelling tools used in different aspects of a project, it can help to avoid costly and time-consuming on-site problems."

Mr. Zubick noted that the use of integrated 3-D modeling for the new Edmonton Art Gallery helped identity significant geometric clashes. "The modeling showed a clash between the very complex structural steel framing and both the glazing panels and the sprinkler system," Mr. Zubick said.

"The key factor is that these clashes were identified before manufacturing, whereas conventional approaches would very likely have led to major cost and scheduling issues if the clashes had not been discovered until on-site construction."

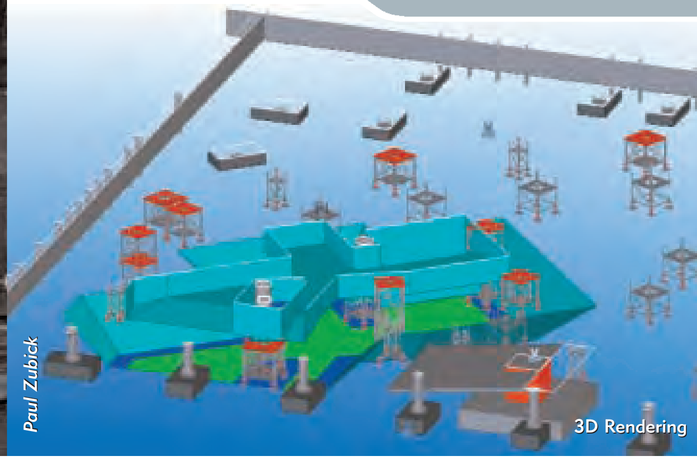
He also noted that the EnCana project in Calgary – the strikingly designed office complex dubbed the Bow and now under construction – combined building information modeling with other modern construction technology to pinpoint accurately the correct locations for anchors that connect the steel frame to the concrete foundation.

"These types of anchor locations are traditionally surveyed and located from coordinates taken from design drawings, and they are notoriously difficult to locate accurately. For the EnCana project, the anchor locations were imported from the steel fabricator's 3-D building model directly to the general contractor's total station surveying equipment, ensuring accurate location of these critical interface anchors."

FABRICATING GOES HIGH-TECH

For work on the fabricating shop floor, Mr. Zubick noted that Waiward is interested not only in high-tech solutions to processing issues, such as plasma cutting and robotics, but also in creative solutions to materials-handling issues.


Modern Robot at Work


Paul Zubick

3D Rendering


M & G Steel Ltd.

Modern Robot at Work

"In the past we found that approximately 70 per cent of our labour costs related to material handling, while 30 per cent related to processes. So last year we implemented a customized rolling cart system to move steel and fittings through the shop, rather than the traditional method of using overhead cranes. The cart system allowed us to improve throughput by at least 20 per cent."

Mike Sharp, president of Peddinghaus Corporation, told the audience that using the latest computer-numerically-controlled system will definitely improve throughput. "By implementing high-speed carbide drilling, laser measuring and other high-tech tools, fabricators can increase productivity and reduce labour costs."

MORE ABOUT BIM SOFTWARE

"BIM software can be an extremely relevant and helpful tool for engineers and fabricators," said Carl Taylor, North American business manager for Tekla Inc." By using BIM software, a project owner or builder can achieve faster delivery or completion, optimum pricing and less conflict along the way."

Mr. Taylor clarified, however, that building information modelling software and "virtual building" are not new to the structural steel industry, especially for fitting project components together and assessing design and detailing issues. But ongoing improvements in 2-D and 3-D software tools are significant, and project owners and builders should not hesitate using BIM tools to the maximum.

"These days, you see laptops and 3-D modelling software in use on many more construction sites than in the past. This is the wave of the future. For example, you can figure out issues and complex erecting problems on-site using 3-D tools, which is not always possible when using 2-D drawings."

The costs of investing in BIM tools or approaches at the design and detail phases are justified, said Mr. Taylor. "Pinpointing issues or conflicts in the model is one of the first benefits that architects, engineers and general contractors are seeing from using BIM.

"When models from different disciplines are combined, it's relatively easy to see conflicts, such as pipes hitting beams. Identifying conflicts early on is an obvious saving compared with making the fix on site later."

Mr. Taylor also suggested using 3-D modelling can significantly reduce the time it takes for project review processes. "In one case at a General Motors plant in Ohio, the engineer and detailers agreed on a shop drawing review process in which the detailed 3-D model was submitted in phases, instead of 2-D shop drawings. The engineers and the detailer communicated via the 3-D model.

"This reduced time per submission to two or three days and enabled the project to meet the deadline."

DECISIONS, DECISIONS AND RISK MANAGEMENT

In his closing comments at the event, Mr. Timler summarized that BIM can lead to earlier decision-making, and generally allows a project to proceed "faster, better, cheaper and cleaner." He also suggested that BIM approaches can help owners and builders to manage risk effectively.

In addition to any BIM efforts, Timler also suggested that project owners can help themselves to manage risks by consulting the Canadian Institute of Steel Construction in the early stages of a project. "We can provide guidance on the availability of steel, estimated costs and construction options using steel. In our association's view, steel has a number of sustainability advantages."

Mr. Timler noted that the Vancouver Convention Centre is a good example of a project where the CISC was able to provide some helpful guidance in terms of overall project management, communications and production issues. "This was a highly complex site in a seismic zone, with poor soil conditions, congestion issues and a demanding schedule. The project team took some of our advice, which helped them identity issues early on and gain early approvals at different stages of the project."

Continued on page 24

Photo courtesy of Deutsch Associates Architects/Photographer Jessie Shotwell

Continued from page 21

THIS EVENT WAS MADE POSSIBLE THROUGH THE GENEROUS SUPPORT OF THE FOLLOWING SPONSORS. THE CISC ALBERTA REGIONAL COMMITTEE GRATEFULLY ACKNOWLEDGES AND THANKS THEM FOR THEIR FINANCIAL SUPPORT.

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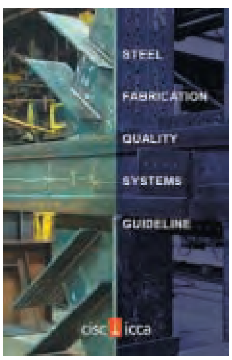
QUALITY STEEL FABRICATION ASSURED

Mike Gilmor

Today, more than ever, consumers demand assurances that the food and the products they buy and the services that surround them are not only safe, but that there are in place means to ensure that they are safe. In a world of increasing globalization, it is not just standards but the assurance that there has been conformance to those standards that is necessary. In the language of standards, this is known as "conformity assessment".

Steel structures fabricated to CSA Standards must be fabricated and erected by organizations certified to Division 1 or 2 of CSA Standard W47.1. Certification to CSA W47.1 requires, among other aspects, that welders be tested every two years. This is appropriate and proper given that it is a manual skill, but it is also the strictest of like standards worldwide.



In 2002, CISC published its Steel Fabrication Quality Systems Guideline for which a third-party audit by an accredited auditor was encouraged. However, recently the CISC Board of Directors mandated that all CISC fabricator members have, by June 2010, an audited third-party Quality System programme that meets or exceeds the CISC Guideline. Auditors must be one of the organizations accredited by the Standards Council of Canada.

The goal is to provide all clients with a quality product, delivered on time at a competitive price. CISC members have developed a solid reputation for high quality construction with hard work in order to establish and maintain that reputation for high quality workmanship. Thus with this programme CISC members will be able to consistently deliver the highest quality products and services.

To assist its fabricator members accomplish this, CISC held a Quality Assurance forum at its Annual General Meeting in June presented by Rob McCammon of IWL Steel Fabricators; Paul Zubick, Waiward Steel Fabricators; Bob Partridge, CWB Group; and Alan Lock, CISC Atlantic Region. Here are some of the highlights from that forum.

While the CISC Guidelines are based on ISO principles and format, CISC exceeds ISO in the following areas:

1. Contract, erection, detail drawings
2. Specifications and amendments
3. Welding according to requirements of CSA W59
4. References Section 5 of the CISC Code of Standard Practice
5. Mill test reports
6. Defined Organization Structure
7. Requires certification to CSA W47.1
8. Special properties (i.e. Impact Category)
9. Incoming materials shall be inspected
10. Workmanship and tolerances to CSA S16
11. Material must be traceable
12. Restocked items must be traceable
13. Surface condition
14. Orientation of holes and detail components
15. Examination of weldments
16. Surface preparation and finish
17. Procedures for loading, shipping, storage

The actual certification process involves the following four steps:

1. Documentation Review - Say what you do
2. Self-Audit & Management Review - Implement & do what you say
3. Initial Registration - Prove it
4. Annual Surveillance - Improve it

The benefits that this process offers Owners, Architects, Engineers and General Contractors are:

1. Easy identification of certified fabricators - they are all CISC members.
2. No additional cost to you - in fact it will save you money in the long run.
3. Assurance that bidders have demonstrated their ability to produce a quality product and have a commitment at the highest level to maintaining that quality.
4. The job will be done right the first time – reduces back-charges, reduces fieldwork, saves time, money and headaches.
5. Speeds erection and completion of the steel sub-trades work.
6. Deals with established fabricators with a reputation for superior and reliable work.
7. Meets the customers' expectations the first time around.

Look for the score card on the progress of our members toward this goal in upcoming issues of *Advantage Steel*.

Image of book cover left: *Steel Fabrication Quality Systems Guideline* available through the CISC web site: http://www.cisc.ca/content/publications/publications.aspx
photo credit CISC

ONTARIO REGION DESIGN AWARDS

ARCHITECTURAL AWARD

Award of Excellence
Southbrook Vineyards

OWNER: Southbrook Vineyards
ARCHITECT: Diamond & Schmitt Architects Inc.
STRUCTURAL ENGINEER: Blackwell Bowick Partnership Ltd.
GENERAL CONTRACTOR: Merit Contractors, Niagara
CISC FABRICATOR: Mirage Steel Limited

The architect presented a vision of a pristine white wing with razor-sharp edges floating above a glass box. From the outset steel was the only option considered for the construction of the columns. In order to reinforce the sense of the roof as a floating plane, the columns wanted to be impossibly slender. Fixing the column bases achieved a visual slenderness of 26:1.

Steel also offered the opportunity to develop slender moment frames embedded in the masonry walls and cabinetry to resist lateral loads perpendicular to the long axis of the building. Loads parallel to the landscape wall are resisted by engaging the masonry infill wall with moment connected steel beams.

Award of Merit
Peace Bridge Plaza

OWNER: Fort Erie Public Bridge Authority
ARCHITECT: Norr Limited Architects & Engineers
STRUCTURAL ENGINEER: Blackwell Bowick Partnership Limited
GENERAL CONTRACTOR: Bird Construction
CISC FABRICATOR: Burnco Manufacturing Inc.
CISC DETAILER: Base Line Drafting Services Inc.

ENGINEERING AWARD

Award of Excellence
Rogers Sportsnet

OWNER: Rogers Sportsnet
ARCHITECT: Ware Malcomb
STRUCTURAL ENGINEER: Halsall Associates
GENERAL CONTRACTOR: EllisDon Corporation
CISC STEEL FABRICATOR: Benson Steel Limited
CISC STEEL DETAILER: Benson Steel Limited
CISC STEEL ERECTOR: Benson Steel Limited

The main part of this project was removal of a major column at the ground-floor level of the Isabella Tower (a 12 storey plus 4 basement level building), carrying 9600kN of surface gravity. Twin steel trusses were selected as the solution for this project because they offered the greatest potential for a fast-track construction schedule at the lowest cost. Occupancy was maintained in the floors above during the renovations.

The project involved the development and integration of precise methodologies that included structural modeling, analysis, design, construction methods and monitoring techniques for the precise preloading of the transfer trusses. It is an exceptional example of engineering steel design and construction excellence.

Award of Merit
Toronto Life Square

OWNER: PenEquity Management Corporation
ARCHITECT: Baldwin & Franklin Architects Inc.
STRUCTURAL ENGINEERS: Halcrow Yolles
GENERAL CONTRACTOR: PCL Constructors Canada Inc.
CISC FABRICATOR: Walters Inc.
CISC DETAILER: Walters Inc.
CISC ERECTOR: Walters Inc.

GREEN BUILDINGS AWARD

Award of Excellence
Kingston LVEC Arena

OWNER: City Of Kingston
ARCHITECT: Brisbin Brook Beynon Architects
STRUCTURAL ENGINEER: Halcrow Yolles
GENERAL CONTRACTOR: EllisDon Corporation
CISC FABRICATOR: Benson Steel Limited
CISC DETAILER: Benson Steel Limited

The Kingston Large Venue Event Complex joins the list of recently redeveloped arena facilities servicing the growing Ontario hockey and entertainment market. The city's plans for the facility were to incorporate sustainability practices wherever possible.

With this in mind, they created a set of critical design criteria for the building, which included the number of seats, restaurants and types of events that could be accommodated, but also, conformed with their policy for all new public buildings – that they be LEED Silver certified. A combination of critical design considerations, including the use of structural steel, resulted in the project becoming the first LEED accredited arena facility of its type in North America.

Award Of Merit
Southbrook Vineyards

OWNER: Southbrook Vineyards
ARCHITECT: Diamond & Schmitt Architects Inc.
STRUCTURAL ENGINEER: Blackwell Bowick Partnership Ltd.
GENERAL CONTRACTOR: Merit Contractors, Niagara
CISC FABRICATOR: Mirage Steel Limited


KUBES STEEL
WHERE METAL TAKES SHAPE
Big Curves
Big Solutions
Canada's source for Structural and Section; Rolling and Bending.
• Architectural
• Structural
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FOR GREEN'S SAKE

The steel construction industry has implemented several initiatives to reduce its environmental footprint. In this space, we will provide brief overviews of the many ways in which the steel construction industry is going green. Your questions can be sent to Sylvie Boulanger, Director, Sustainable Development, Canadian Steel Construction Council at sboulanger@cisc-icca.ca.

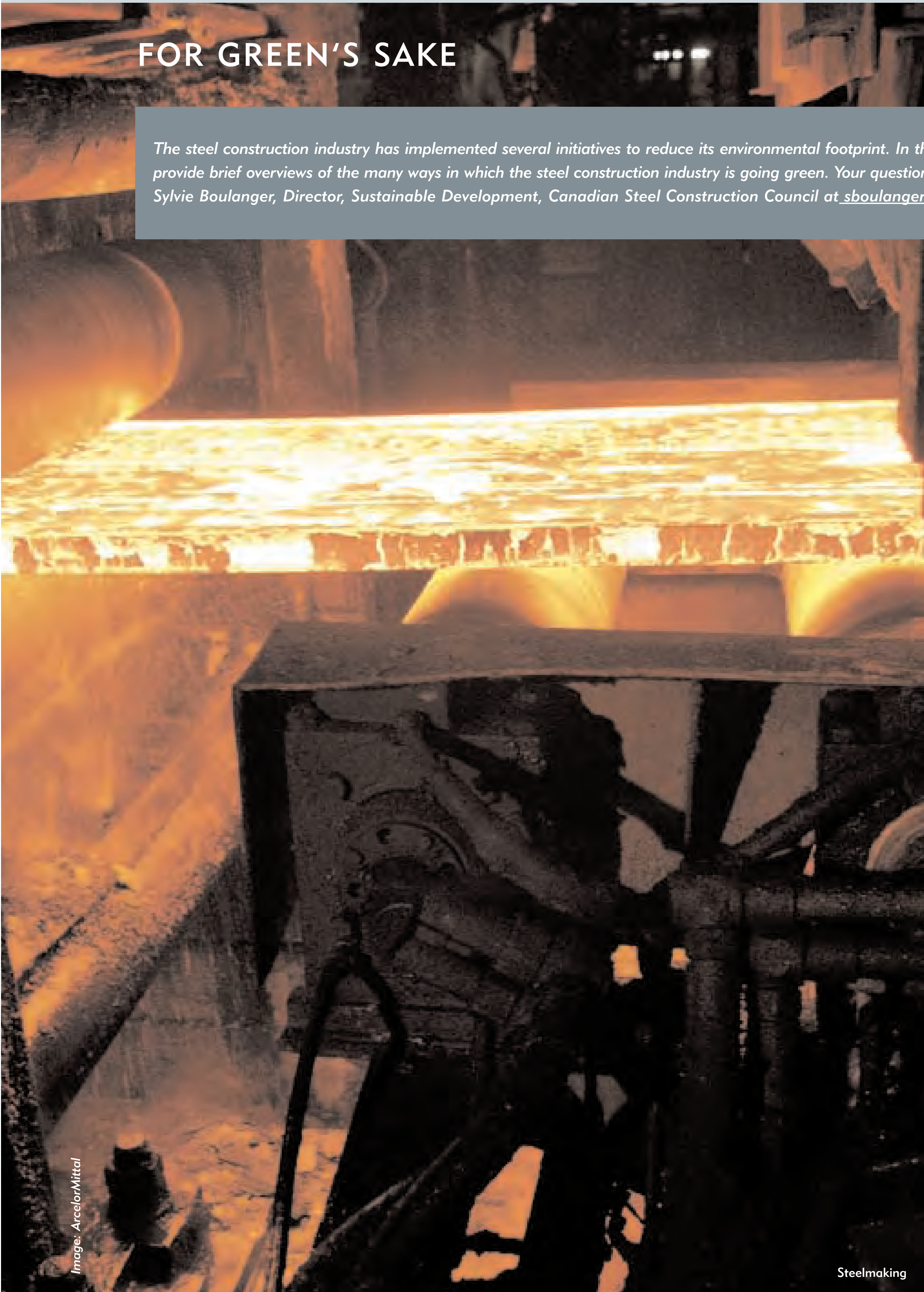

Image: ArcelorMittal

Steelmaking

THE STEEL INDUSTRY'S CO_2 BREAKTHROUGH PROGRAMME
NEW AND IMAGINATIVE GLOBAL APPROACHES IN THE POST-KYOTO PERIOD

Sylvie Boulanger

Since the Kyoto baseline year of 1990, the North-American steel industry has reduced its energy consumption per tonne of steel produced by 29%. It is the only industry that has increased production while still reducing its net overall emissions. Had the Kyoto accord been implemented, the steel industry would have met the goals in the deadline requested.

No industry should sit on its laurels. The limits for reducing energy and emissions for the two steelmaking processes – the basic oxygen furnace (BOF) and the electric arc furnace (EAF) – will soon reach a plateau. A competitive global industry such as steel requires new and imaginative approaches in the post-Kyoto period. Internationally, through the International Iron and Steel Institute (IISI), the steel industry has established the CO_2 Breakthrough Program to fund the development of new steelmaking technologies that do not emit CO_2. The program also includes research and development into technologies that capture and sequester CO_2.

Most of the CO_2 generated by the steel industry comes from ironmaking: the chemical interaction between carbon and iron ore in a blast furnace. This process is called iron reduction. It produces molten iron which is converted to steel. The maturity and efficiency of conventional technology means that, in the most advanced facilities, the iron-reduction process operates close to thermodynamic limits. Using conventional technologies, making substantial further reductions in CO_2 emissions will be next to impossible.

HYDROGEN TO THE RESCUE

Research is currently underway at the University of Utah, under the leadership of Dr. Sohn, to produce iron by Hydrogen Flash Smelting. Hydrogen Flash Smelting is a process during which iron is separated from iron ore ("smelting") at high temperature (above 1300°C) and at very fast reaction times. The unique characteristic is the use of hydrogen as the fuel.

Carbon in some form, coal or coke, is used in today's ironmaking processes. Substituting hydrogen for carbon nearly eliminates CO_2 emissions in the ironmaking process. Ironmaking is the most energy-intensive step in the steelmaking process.

MOLTEN OXIDE ELECTROLYSIS

Another research project is also underway at the Massachusetts Institute of Technology (MIT), under the leadership of Professor Donald R. Sadoway of the Department of Materials Science Engineering, to produce iron by molten oxide electrolysis (MOE), which would generate no CO_2 gases.

At the laboratory scale, production of liquid iron and oxygen gas by electrolysis of iron oxide has been demonstrated. This represents a significant first step towards carbon-free ironmaking by a technology that completely avoids emission of greenhouse gases from the smelter.

The two new ironmaking projects have been demonstrated to be technically feasible at laboratory scale and are being advanced to pilot-scale work. This is long-range R&D that has potential for significant change in the fundamental manner by which steel is made. Although the research is only in the beginning phases, what has been demonstrated thus far is encouraging.

In addition to the University of Utah and MIT projects, there are two other long-range projects that will have a positive impact on the environment. These two projects include: Geological Sequestration of CO_2 at the University of Missouri-Rolla; and Integrating Steel Production with Mineral Sequestration at Columbia University.

With efforts coordinated by IISI, steel companies and steel associations around the world are funding cooperative research with universities, research institutes and other industries to identify and develop new approaches to steel production. The targets are ambitious. However, the timescale for such new technology is 15-20 years. By working together and with the support of government research funding around the world, the timetable and chances of success are improved.

For more information, visit the AISI and IISI websites plus the new sustainable steel website: **www.steel.org**
www.worldsteel.org | **www.sustainable-steel.org**

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

THE BIG MOVE

After 35 years at 201 Consumers Road in Willowdale (Toronto), the three steel industry related organizations that occupied Suite 300 have all moved 9 km north (11 minutes) to Suite 200 at 3760 14th Ave, Markham, Ontario, L3R 3T7. The largest of the three organizations is, of course, the CISC but in addition the Steel Structures Education Foundation (SSEF) and the Canadian Steel Construction Council (CSCC) also moved to, as before, share offices with the CISC. The new offices are located in the Platform building, a six-storey steel framed office building (a previous PAD project) on the northeast corner of 14th and Warden Avenues with access from 14th Avenue. The offices are just south of the 407 ETR and east of the 404/DVP making easy connections to the airport or downtown. Owners, general contractors, architects, and engineers are invited to visit to see and feel for themselves the advantages of a modern steel-framed office building. Of course, CISC members are always welcome!

CREDIT TO STRUCTAL

In Issue 31, our coverage of the 2007 BC Steel Design Awards omitted to include CISC Fabricator and Detailer, *Structal - Bridges, A Division of Canam Group Inc.* in the Kicking Horse Canyon - Park Bridge credits. We also failed to recognize the CISC Steel Detailer *Tenca Steel Detailing Inc.* We regret and apologize for these oversights.

In the same issue we referred to the Bridge over the Churchill River in Labrador as being one of the "longest engineering structures in eastern Quebec". When it is in Labrador. We apologize for this. It should have read "east of Quebec".

LIVING STEEL'S THIRD INTERNATIONAL ARCHITECTURE COMPETITION

Canadian architects RVTR Toronto, received honourable mentions from the jury in the 2008 Living Steel international architecture competition. Architects were asked to create energy efficient, single-family detached homes for employees of SeverStal JSC in Cherepovets, Russia. The construction had to minimise greenhouse gas emissions and be able to withstand temperatures ranging from -49C to 39C. The homes also had to be affordable to build and buy.

The Living Steel International Competition for Sustainable Housing awards innovative approaches to sustainable housing. Now in its third year, the competition addresses the economic, environmental and social aspirations of a growing world population.
http://www.worldsteel.org/?action=storypages&id=282

ALTERNATIVE SOLUTIONS FOR STRUCTURAL STEEL FIRE PROTECTION

George Frater, Ph.D., P.Eng., Codes & Standards Engineer at the Canadian Steel Construction Council has published this article in the May Issue 2008 of Canadian Consulting Engineer. As stated, "structural engineers are now in a position to treat structural design for fire as an engineered process, as is done for other load cases such as gravity, wind and earthquake, using codified procedures and sophisticated numerical tools".

To download a PDF of the article: **http://www.cisc.ca/content/technical/fp_coatings.aspx**

COURSES

The 2005 National Building Code of Canada introduces very substantial technical changes, and to reconcile the new NBCC requirements, CSA issued S16S1-05, Supplement #1 to CAN/CSA-S16-01 (CSA S16). All of these changes necessitate a fresh look at the underlying framing decisions to be made by designers. In response, CISC is offering two one-day courses intended to provide an understanding of the design theory and the rationale behind code provisions as well as the application of specific Code formulae and requirements.

Steel-Framed Commercial Building Design

This course will be offered once again in major centres across Canada and will focus on practical and economical solutions for framing a six-storey building. Practical steel framing concepts and integration with architectural and mechanical features will be discussed. The course notes will include design solutions for the wind-resisting system as well as typical members and components of the gravity frame.

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

Vancouver – Richmond, November 3, 2008
Best Western Hotel

Calgary, November 5, 2008
Greenwood Inn

Toronto – Richmond Hill, November 17, 2008
Premiere Convention Centre

Seismic Design of Steel-Framed Buildings

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

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

Vancouver – Richmond, November 4, 2008
Best Western Hotel

Calgary, November 6, 2008
Greenwood Inn

Toronto – Richmond Hill, November 18, 2008
Premiere Convention Centre

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

Steel-Framed Industrial Building Design

We are pleased to announce that work has begun on our new course for the design of Industrial Buildings. This one day seminar will help structural engineers efficiently design practical, cost-effective, steel-framed industrial buildings. Topics will include design codes, loads, framing, wall and roofing systems, crane girders, detailing for fatigue, etc. The course is tentatively slated to begin in Winter, 2009.

EVENTS

CISC – Quebec Symposium on Steel (in French)
November 4, 2008, Montréal, QC
http://quebec.cisc-icca.ca/colloque

Contech – Building Events Trade Show
November 5, 2008 Montréal, QC
http://www.contech.qc.ca/eng/index_batiment.php

Construct Canada
December 3 - 5, 2008 Toronto, ON
http://www.constructcanada.com/

The Steel Conference, NASCC 2009
April 1 - 4, 2009 Phoenix, Arizona
http://www.aisc.org/Content/NavigationMenu/Events_Calendar/About_NASCC2/About_NASCC.htm

CSCE 2009 Annual Conference – On the Leading Edge
May 27 - 30, 2009 St. John's, NL
http://www.csce.ca/2009/annual

Structures Congress 2009
April 30 - May 2, 2009, Austin, Texas
http://content.asce.org/conferences/structures2009/

CISC and SSEF Annual General Meetings
June 17 - 20, 2009 Winnipeg, MB
Fort Garry Hotel

33rd IABSE Symposium on Sustainable Infrastructure: Environment Friendly, Safe
September 9 - 11, 2009 Bangkok
http://www.iabse.org/conferences/bangkok2009/index.php

Ninth U.S. National and Tenth Canadian Conference on Earthquake Engineering: Reaching Beyond Borders
July 25 - 29, 2010
http://www.eeri.org/site/content/view/410/2/

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www.kgsgroup.com

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Techdess Inc. B
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www.montacier.com

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www.scrapmetal.net

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www.algoma.com 1-800 387-7850

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www.ameristeel.esolutionsgroup.ca

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www.pacificsteel.ca 1-800-361-4167

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Pomeroy Engineering Limited, Burnaby	604-294-5800
Pow Technologies, Div. of PPA Engineering Technologies Inc., Ingersoll	519-425-5000
Quinn Dressel Associates, Toronto	416-961-8294
R.J. Burnside & Associates Ltd., Collingwood	705-446-0515
Read Jones Christoffersen Ltd., Toronto	416-977-5335
RSW Inc., Québec	418-648-9512
Saia, Deslauries, Kadanoff, Leconte, Brisebois, Blais, Montreal	514-938-5995
Schorn Consultants Ltd., Waterloo	519-884-4840
SNC-Lavalin Inc., Montréal	514-393-1000
Stantec Consulting Ltd., Mississauga	905-858-4424
Stephenson Engineering Ltd., Toronto	416-635-9970
The Walter Fedy Partnership, Kitchener	519-576-2150
Totten Sims Hubicki Associates, Whitby	905-668-9363
UMA Engineering Ltd., Mississauga	905-238-0007
Valron Engineers Inc., Moncton	506-856-9601
VanBoxmeer & Stranges Engineering Ltd., London	519-433-4661
Weiler Smith Bowers, Burnaby	604-294-3753
Westmar Consultants Inc., N. Vancouver	604-985-6488

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George Graham, C.E.T., Winnipeg	204-943-7501
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Anjelo M. Ricciuto, Concord	905-669-6303
Ronald W. Rollins, Burnaby	604-453-4057
Yvon Sénéchal, Laval	450-663-8668
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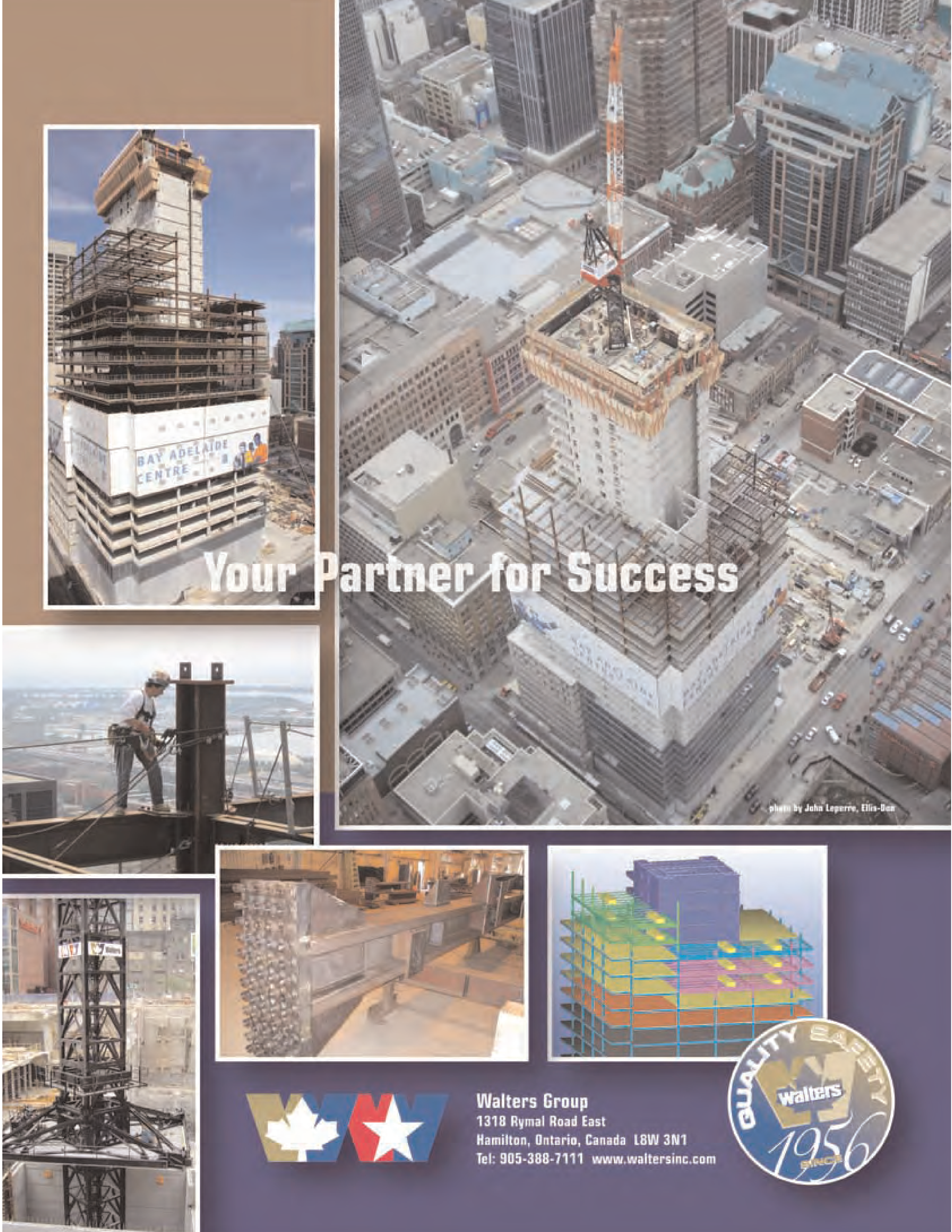
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