
Cirque du Soleil Headquarters in Montreal | Photo: Terri Boake


Detailing of the Prince Edward Viaduct Safety Barriers in Toronto | Photo: Terri Boake


The Architecturally Exposed Structural Steel frame on the National Works Yard in Vancouver. Omicron Architecture Engineering Construction Services Ltd. | Photo: Terri Boake


Stratus Winery in Niagara-on-the-Lake, Ontario Photo: Terri Boake


Semiahmoo Library and RCMP Headquarters in Surrey, British Columbia | Photo: Terri Boake

# THE 3 Rs OF STEEL DESIGN: REDUCE, REUSE, RECYCLE

*by Terri Meyer Boake BES., B.Arch., M.Arch., LEED AP*

As the effects of global warming become more apparent, the green building movement continues to show growing momentum. There is little doubt that incorporating more sustainable practices into the design of buildings has increased the general level of complexity of every project, and guidance is needed to help designers make the appropriate choices.

While there is no single *"right answer"* when making material selections in green building design, structural steel systems have been chosen in many recent green and LEED™ certified examples. Steel is able to respond to the underlying *"waste not"* premise of sustainable design to *reduce, reuse and recycle* our limited natural resources. Although recycled content can vary from mill to mill, the Basic Oxygen Furnace uses 20 to 25% recycled content and the Electric Arc Furnace up to 90% recycled steel. Therefore a significant percentage of the steel sold today comes from recycled, post-consumer content, rather than from newly mined ore. Steel can support the *"Cradle to Cradle"* [1] idea of sustainable design as described by famed activist William McDonough, through design for disassembly and pre-visioning a closed loop for steel that avoids contributing to the waste stream.

REDUCE!

## REDUCE MATERIAL

Steel has the ability to create sections that take advantage of distancing the material from the neutral axis in the production of structural steel shapes. This is the case for wide-flange sections, HSS sections and open-web steel-joists systems, which allows for streamlined use of the material that is not possible in rectangular structural members that must use solid cross sections. This lightness of structure translates into not only less general use/weight of the material, but reduced transportation and foundation costs. HSS sections can additionally reduce the amount of coating material required when comparing the surface area of wide-flange sections vs. a hollow section of equal carrying capacity.

## REDUCE LABOUR

The industrialized nature of the shop fabrication and construction process of structural steel systems can reduce site work and simplify erection procedures, which translates into reduced labour and travel associated $CO_2$ costs.

The new LEED™ Gold Stratus Winery in Niagara-on-the-Lake, by Les Andrew Architect Inc., chose to use steel as the structure for the main portion of the building that houses the wine making process.

The project makes a point of choosing steel products as a means to increase its sustainability. The building works towards achieving a *"long life"* through the choice of durable materials. All of the structural steel and the exterior panels of the building (including the roof) are galvanized. This adds to their longevity and eliminates the need for re-painting or re-surfacing in the future. The project called for flexibility, and this was achieved by designing a large-span steel-framed building with a mezzanine suspended from the frame. This design opens up the floor space and allows for ease of modification for future process designs. The main steel structural frame of the building has been designed to accommodate the present structural loading, as well as connections needed for future expansion plans. This building contained 49% post-consumer and 29% post-industrial recycled content, which was useful in obtaining LEED™ credits in the Materials and Resources Category.

## REDUCE TRANSPORTATION

With rising fuel costs and the movement to reduce carbon emissions, mills and fabricators across Canada are also able to assist in limiting travel distances to the construction site, thus reducing the embodied energy of the material. To obtain LEED™ credits for regional materials, both the source of the steel and fabricator must be located no further than 500 miles from the project if the material is trucked, or 1,500 miles if the material is shipped by rail or water. Currently, the distance between the source and the fabricator is not included in the calculation. Check out the locations of CISC fabricator members at **www.cisc.ca** to find the fabricators closest to your project.

## REDUCE FINISHES

The use of Architecturally Exposed Structural Steel (AESS) brings attention and care to its design and detailing. Because the AESS is the architectural expression, and requires no further covering or cladding finishes, it also reduces the use of *"other materials"*. This saves resources, the labour to install coverings, and associated energy. Fire-resistant intumescent coating systems allow for exposed steel expression in a multitude of building occupancies.

The National Works Yard in Vancouver, a LEED™ Gold facility designed by Omicron Engineering used exposed steel on the façade to support the large overhangs that provide solar shading to the south side of the building. In addition, on the interior of the building, the articulated steel creates architectural expression in the lobby and atrium area. The large steel supported overhangs also allow the operable windows to remain open in rainy weather. The choice of steel assisted in ensuring that there was over 30% recycled content in the building materials, as well as over 50% of the materials able to be obtained locally, reducing transportation and associated $CO_2$ emissions.

Not all exposed steel need be designed to use custom members and specialized systems. The Semiahmoo Library and RCMP Headquarters in Surrey, British Columbia, that obtained a LEED™ Silver rating, used a fairly straightforward open-web steel-joist system, steel decking and a wide-flange/HSS support system in an expressed fashion to create the lightness of the interior environment. The clerestory glazing system highlights the white finish on the exposed steel.

## DURABILITY

Structural steel, if properly designed, detailed and coated, is a durable material for both interior and exposed exterior applications. Durability is one of the uniquely Canadian credits in our version of LEED™ Canada 1.0 for New Construction. However, there are many current projects that exploit the durable characteristics of steel that have not sought environmental certification.

As could be seen in the Stratus Winery, galvanized steel has become a popular finish and is responding to issues of aesthetic choice as well as durability for exterior applications. The Cirque du Soleil Headquarters in Montreal, designed by Architect Dan S. Hanganu, uses simple standard steel sections with a galvanized finish as the solar control devices to reduce heat gain in the building, as well as provide visual interest to the façade.

Galvanized steel was also chosen as the finish for the varied steel elements that were used in creating the Prince Edward Viaduct Safety Barriers by Dereck Revington Studio. In this case, the safety barriers are permanently situated in a harsh exterior environment. Their location, hanging high over the Don Valley below, makes it extremely difficult to carry out unwarranted maintenance. The materials were able to be locally obtained and fabricated, also limiting travel distances to the project.

## REUSING STEEL

From a purely sustainable point of view, when looking at the three Rs, it is preferable to simply reuse materials. This eliminates the expenditure of energy (fossil fuel + $CO_2$) that arises from the reconstitution processes. Steel also follows the *"Cradle to Cradle"* [1] initiative to *"design for disassembly"*. Bolted connections present little challenge to disassemble, and welded connections can be cut without distorting or severely limiting reuse of the members. The Crystal Palace, designed by Sir Joseph Paxton in 1851, was perhaps the first building to be purposefully designed with industrialized cast and wrought iron components, where quick assembly, and subsequent disassembly was the overriding project intention.

A number of recent buildings that have achieved recognition have employed reused steel as part of their green design plan. The Student Life Centre at the University of Toronto, Scarborough Campus, by Dunlop Architects Inc., used steel beams that were salvaged from the demolition of portions of the ROM, and incorporated the members into the new building. *(See article Advantage Steel No. 20, Summer 2004)* The Tohu Chapîteau des Arts, for the Cirque du Soleil, used salvaged steel beams from buildings in the Montreal docklands to create the exposed structure in the outer ring (lobby) area of their LEED™ Gold building.

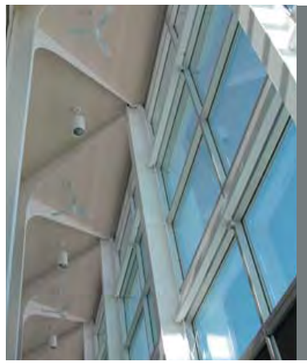
But perhaps the most rigorous example is the Angus Technopole in Montreal which designed their program around the complete, in situ reuse of an old steel-framed warehouse building. In the case of Angus and Tohu not only was the steel reused, but the original finishes and markings were maintained so that occupants would be made more aware of the sustainable use of the members. These two innovative projects were selected to represent Canada in the International Green Building Challenges in 2000 and 2005, respectively.

A recently launched website, **www.reuse-steel.org** further explains the advantages of this process, as well as begins to provide a resource for locating existing steel as it comes to the market and is available for purchase.

## DOWN THE ROAD

If in the fullness of time, the rapidly growing complexes of box stores can no longer afford to fill their shelves, the steel used in those buildings can be reconstituted into other products or easily disassembled and reused wherever the need might arise. In the life of a steel section, there really are no limits.

[1] McDonough, William. "Cradle to Cradle". For more information visit: **www.mbdc.com/c2c_home.htm**



St. John Ambulance's Provincial Headquarters in Edmonton, Alberta was awarded a LEED™ Silver rating. The height of the east facing atrium/lobby was supported by an architecturally exposed structural steel system that used unique Y shaped columns, comprised of plate members, to support and provide character for the three storey energy efficient Vision Wall system.