Environmental FACT SHEET

Canadian Sheet Steel Building Institute

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Lightweight Steel Framing - Looking Forward to the Benefits

The CSSBI is committed to the advancement of lightweight steel framing as an environmentally-friendly "green" building product that reduces energy consumption and waste, improves indoor and outdoor air quality and conserves water and natural resources for both new and existing commercial and residential buildings.

Consider the overwhelming benefits of using lightweight steel framing in building construction; it is a product that is produced to consistent properties and dimensions, will not rot, shrink, swell, split, warp or provide a food source for mold, bacteria or insects, and is fully recyclable and non-combustible. Steel also has the highest strength to weight ratio of all structural building materials, and is a structural substitute for both dimensional lumber and reinforced concrete in building applications. From the perspective of supporting a healthy indoor air environment, steel framing is inert. It won't release or offgas any volatile organic compounds, since it is free of resin adhesives and other chemicals like those used to treat wood framing products. Read on to find out more about other significant environmental benefits that lightweight steel framing can offer.

The Infinite Life of Steel Framing

All steel building products including steel framing are 100% recyclable. One of the key sustainable attributes of steel is its ability to be recycled without any loss or degradation of its inherent material properties, allowing it to exist for an infinite number of product life cycles.

The steel industry is the single largest recycler in North America. Over 88 million tonnes of steel were recycled in North America in 2012.While some countries report steel recycling rates as high as 85%, Canada's 2012 recycling rate was in excess of 60%, which translates into over 7 million tonness being recycled that year.

Steel benefits from the most comprehensive and accessible collection infrastructure of any material, and not just in North America, but around the world. Steel is easily and economically extracted from other materials in the solid waste stream through magnetic separation, keeping a valuable commodity out of the country's landfill sites.

The use of steel scrap is an essential component of the steel manufacturing process. The traditional basic oxygen furnace (BOF) steelmaking practice ensures that there is a minimum of about 30% recycled steel scrap in every ton of steel framing produced. However, over the past 50 years, economic and environmental considerations have driven technological advances in electric arc furnace (EAF) steelmaking technology. The EAF technology utilizes >95% recycled steel scrap in each furnace charge and currently accounts for about 40% of Canada's steel production.

Using recycled steel for building construction also takes pressure off renewable resources. For example, framing a typical 2000 ft^2 (186 m^2) house out of steel only requires the equivalent of about six scrapped automobiles, while the same house framed in wood requires lumber from 40-50 trees, which is about an acre's worth of forest.

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Steel recycling is important for the environment since it affects the sector's energy performance. The EAF and BOF process together recycle huge amounts of scrap steel in making new steel every year, thus conserving significant energy and other natural resources, while reducing emissions. Using old steel products and other forms of ferrous scrap to produce steel lowers a variety of steelmaking costs and reduces the amount of energy used in the process by 75 percent. It is estimated that for every ton of steel recycled, about 2,500 pounds of virgin iron ore is saved, along with 1,400 pounds of coal, and 120 pounds of limestone. In the U.S., recycled steel saves the nation enough energy to power about 20 million homes for one year.

Thermal Performance of Steel-Framed Homes: Proof is in the Field

One of the more common concerns amongst home buyers and building officials when it comes to steel framed homes is their energy efficiency. There is a difference between the insulating value in walls and ceilings and the thermal performance or energy efficiency of a home. Energy efficiency depends on the entire home acting as a system, from the basement to the attic including the space conditioning equipment. Most of the energy lost in the home is due to air filtration, while most of the heat loss is attributed to air leakage through the building envelope.

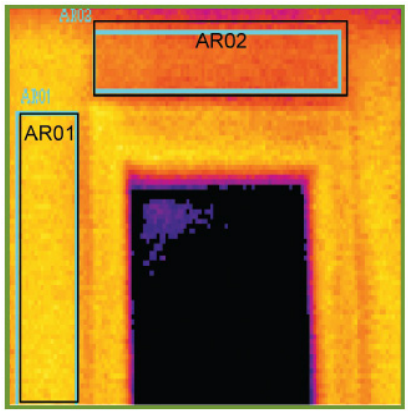
In general, the effect of a structural component in an exterior wall is to act as a "thermal bridge", that is, it provides a path for conducting heat rapidly. Both wood framing and steel framing act as thermal bridges. **It is important to note that an exterior wall made from either type of material can be designed to provide the desired thermal performance.**

Although steel is more conductive than some other building materials, it is only one of several components within a building envelope that can be designed to provide an effective thermal barrier. To validate this, the American Iron and Steel Institute (AISI) sponsored research at the National Association of Home Builders (NAHB) Research Centre to develop R-values for typical steel-framed walls. The research demonstrated that the R-value for steel framed walls is not considerably affected by the thickness of the steel studs because steel stud web thicknesses are small, thereby limiting heat conduction. In addition, in climate zones where higher R-values are required, the use of exterior insulative sheathing, such as extruded polystyrene or polyisocianurate, is considered an effective thermal break that will significantly increase the wall system's thermal resistance.

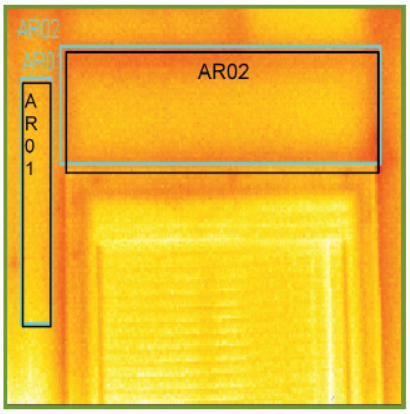
Furthermore, it is known that the thinner steel thickness and "C-channel" shape of steel framing allows for high quality insulation to be inserted into spaces normally occupied by low R-value wood. Unlike kiln-dried wood framing, which contains a moisture content up to 19%, steel remains straight and true once tensioned, regardless of contact with moisture, and does not warp or shrink. In the long term, this reduces the chance of air gaps forming in the building exterior, thereby minimizing heat loss and conserving energy.

To compare the thermal performance of wood versus steel framing under realistic conditions, thermal modelling case studies involving infrared (IR) thermography have also been conducted in Canada on virtually identical homes built in the same subdivision and framed in steel and wood. These studies have confirmed that the thermal performance of steel framed homes is similar to wood framed homes. The results of the IR tests demonstrated that the temperature differential at framing components in opaque walls, built-up members and sill connections was minor and they were comparable in both systems. Lintels in steel-framed homes actually performed better because of the ability to incorporate a greater amount of insulation due to the shape of the steel components as mentioned above. When detailed with expanded polystyrene (R-5) and expanded foam insulation in the stud cavities, the steel homes used 7% less energy than their wood counterparts which were built to the same nominal R-value.

Thermal images of a wood framed and steel framed lintel. Images were obtained from two identical homes, one steel framed one wood framed, located on the same street, and inspected on the same evening with outside temperature of -6°C, and no wind.



Wood-Framed Home
The temperature difference between the insulation (AR01) and the window header (AR02) is 1.9°C



Steel-Framed Home
The temperature difference between the insulation (AR01) and the window header (AR02) is 0.4°C

Taking all the information above into account, it should be noted that light steel frame construction can be used for residential construction to meet the high energy requirements of the Government of Canada's R-2000 program. R-2000 homes are built to demanding standards for energy efficiency and indoor air quality that far surpass others in the marketplace and go way beyond building code requirements. There are also several examples of steel-framed homes in Canada that not only meet R-2000 standards but that have also garnered the Canadian Home Builders' Association's EnviroHome designation, which is given to a select number of new home projects across Canada that go beyond even R-2000 requirements.

Minimized Construction Waste - A Welcome Site!

Steel framing is one building material that will not likely be found in landfill or buried at a construction site. In contrast to many other building materials, steel is routinely collected in aggregate quantities from construction and demolition sites since any scrap generated on the job-site has resale value.

Unlike wood framing, the consistency of steel framing members contributes to waste minimization as there is no need to discard material due to splitting, warping or twisting. Waste is also minimized in the construction phase since builders can order steel framing members to specific lengths, resulting in less cutting being required. It is estimated that building a 2000 ft2 (186 m2) wood-frame house generates approximately 50 ft3 (1.4 m3) of landfill waste, while a comparable steel house generates 80-90% less waste, the majority of which is fully reclaimed and recycled once again.

Panelized steel framing systems and methods have become more prevalent in North America, especially for multi-family residential buildings, since these reduce framing and construction lead times, facilitate in-fill building construction and reduce the overall environmental impact to the building site. Since wall and floor panels and roof trusses arrive at the site pre-assembled, there is no onsite cutting required prior to installation; this means no debris, dumpsters and large stacks of lumber strewn around the site.

Design for Deconstruction - the Days of the Wrecking all are Over

Design for disassembly, deconstruction and adaptability (also known as sustainable construction) is a construction strategy that is being applied to varying extents to increase the future rates of material and component reuse and minimize construction waste destined for landfills. Deconstruction is the systematic dismantling and recovery of construction materials from a structure at the end of a buildings lifecycle. It is an alternative to traditional "wrecking ball" demolition where virtually all of the building materials end up in a landfill.

Buildings have been designed for disassembly in the past and this process is expected to expand as global deconstruction standards are developed, green building programs specify more stringent reuse of building materials, and governments mandate the practice of building deconstruction and disassembly through legislation to address the reduction of building site waste. Unlike other building materials, steel building components including steel framing lend themselves extremely well to the design for deconstruction methodology, which ultimately involves a series of simple design rules concerning product architecture, materials and fasteners that can be used to put building deconstruction practices into place.

Several provinces have implemented a series of regulations pertaining to the management of waste generated by the municipal, industrial and commercial sectors. The common objective of these regulations is to reduce the quantities of waste currently being sent to landfills by 50% or more in the short to medium term. For example, in Ontario, there are regulations in place that govern the management of waste generated in multi-unit residential, commercial and institutional construction and demolition/deconstruction projects.

As existing landfills reach capacity, disposal costs rise, public opposition to the opening of new landfills mounts, and more restrictive waste regulations are put in place, waste generators will be faced with the challenging dilemma of how to cost-effectively manage construction and demolition wastes. When considering the latter, one of the main obstacles to building material reuse is the difficulty in separating materials and components from the building. Like other fabricated steel building components, lightweight steel framing is well adapted to the design for disassembly concept and is currently more easily extracted, recycled and/or re-used than any other construction materials.

Steel-Framed Buildings Offer a Deeper Shade of Green

Buildings have a profound impact on our natural environment, economy, health, and productivity. In North America, the built environment accounts for approximately one-third of all greenhouse gas emissions, energy, water and material consumption, and generates similar proportions of pollution. Indoor air quality is regarded as one of the top environmental health risks today, affecting the well being, productivity and performance of many people. As concerns increase about sustainability in building design and operation, there is a need to develop a framework for assessing and quantifying buildings.

To this end, several green building programs exist that underscore the suitability of steel framing as a sustainable building material. These include rating systems like LEED-NC, the Leadership in Energy and Environmental Design, which is currently considered the predominant green building rating system in the US and Canada. LEED was first developed by the US Green Building Council (USGBC) and adopted in the USA. In 2004, the Canada Green Building Council (CaGBC) created LEED Canada – NC version 1.0 and subsequent updated versions are now used for Canadian buildings. At present it applies to new designs and major renovations of commercial, institutional or high-rise residential buildings.

Lightweight steel framing stands out as a structural material that will meet multiple green building program objectives based on attributes including high recycled content and high reuse potential, good thermal performance, low building site waste, and the fact that it is an inert material that doesn't release harmful chemicals and resists the growth of mold, mildew and other bacteria. Specifying steel framing for a building project can contribute to sustainable decisions under guidelines of each green building program.

For more information about how steel framing components can contribute to earning LEED points, please refer to the "LEEDing with Steel" document on the CSSBI website.

For more information on steel's involvement in advanced, environmentally conscious products, contact the Canadian Sheet Steel Building Institute or visit www.cssbi.ca

For additional information on the topics above, please refer to the following:

SFA: **www.steelframingalliance.org**
AISI: **www.steel.org**
SRI: **www.recycle-steel.org**
CSPA: **www.canadiansteel.ca**

References:

1. Canadian Steel Producers Association (CSPA), website at: http://www.canadiansteel.ca/index.php/en/initiatives/green
2. "Steel –The Clear Cut Alternative for Building Homes", Steel Recycling Institute
3. "Steel and the Environment – Introduction to Sustainability and Green Building", Steel Framing Alliance Green Brochure, 2008
4. "Improving Energy Performance of Steel Stud Walls", Oak Ridge National Laboratory, Buildings Technology Centre, 2001.
5. L. De Meo et al, "Investigation of the Thermal Performance of Steel and Wood-framed Homes Using Infrared Thermography", 1998
6. M. Gorgelewski, "The Implications of Reuse and Recycling for the Design of Buildings", 2001