Environmental Education Centre

RALPH KLEIN LEGACY PARK, CALGARY, ALBERTA

Canadian Wood Council
Conseil canadien du bois

wood WORKS!
Project of the Canadian Wood Council

INTRODUCTION

The Environmental Education Centre is the architectural showcase for the Shepard Wetlands, a constructed wetland that lies within the newly designated Ralph Klein Legacy Park on the outskirts of Calgary. The Shepard Wetlands act as a management, filtration and cleaning system for the city's storm water. The centre sits on piles within the wetland itself, appearing alternately to hover or float with the rise and fall of the water level in the retention pond.

The 20,800sf (1932m^2), two storey building includes classrooms, exhibition space, administrative and support facilities, and provides a location for interactive public education on wetlands, water issues, sustainability, and environmental ethics and values. The smaller upper floor contains the offices of Ducks Unlimited, and provides access to viewing terraces and vegetated roof areas.

The majority of the structure consists of exposed concrete, glulam beams and joists that integrate structure with architecture. Long span glulam beams support heavy patio and vegetative (green) roof loads.

Cover Photo: Charles Hope Photography

Photo (Left): Simpson Roberts Architecture Interior Design

Photo (Right): Steve Nagy Photography

ARCHITECTURE

This was a most unusual project, in that both the building and the environment around it were conceived and developed simultaneously. What is now the Shepard Wetlands was previously a flat and rather featureless stubble field. The material excavated to create the pond, was used to sculpt the surrounding landscape.

Originally, the Environmental Education Centre was conceived as a ‘cabin by the lake’, but during the early visioning sessions it was decided that the educational objectives of the project could be better realized by having the building and its visitors fully engage the wetland environment. Thus, the concept evolved into that of an island, surrounded by water and accessed by bridges. Beneath the structure, visitors can walk among the bulrushes and touch the water, while from the roof terraces they can glimpse the distant snowcapped Rockies from which that water originally came.

In such a context, it was a given that the contribution of the building to sustainability should be as great as possible, while being sympathetic to its surrounding environment. The choice of wood as a primary structural material was a natural next step, and the project was designed to capitalize on the considerable knowledge and experience of the province’s glulam industry. Apart from its environmental attributes of low embodied energy, durability and long term storage of sequestered CO_2, the visual qualities of the material allowed the structure to be completely exposed, and thus reinforce the connection of the building to the natural environment. Expressing the structure was seen as part of a broader strategy through which the building itself becomes part of the educational experience. Not only do the exposed connections communicate to visitors how the structure was built, but exposed ducts and water lines communicate how it is serviced. Exposed connections require not only design consideration to ensure that they are both efficient and elegant; but also a high level of craftsmanship in their execution. The glulam fabricator provided expertise in both of these areas.

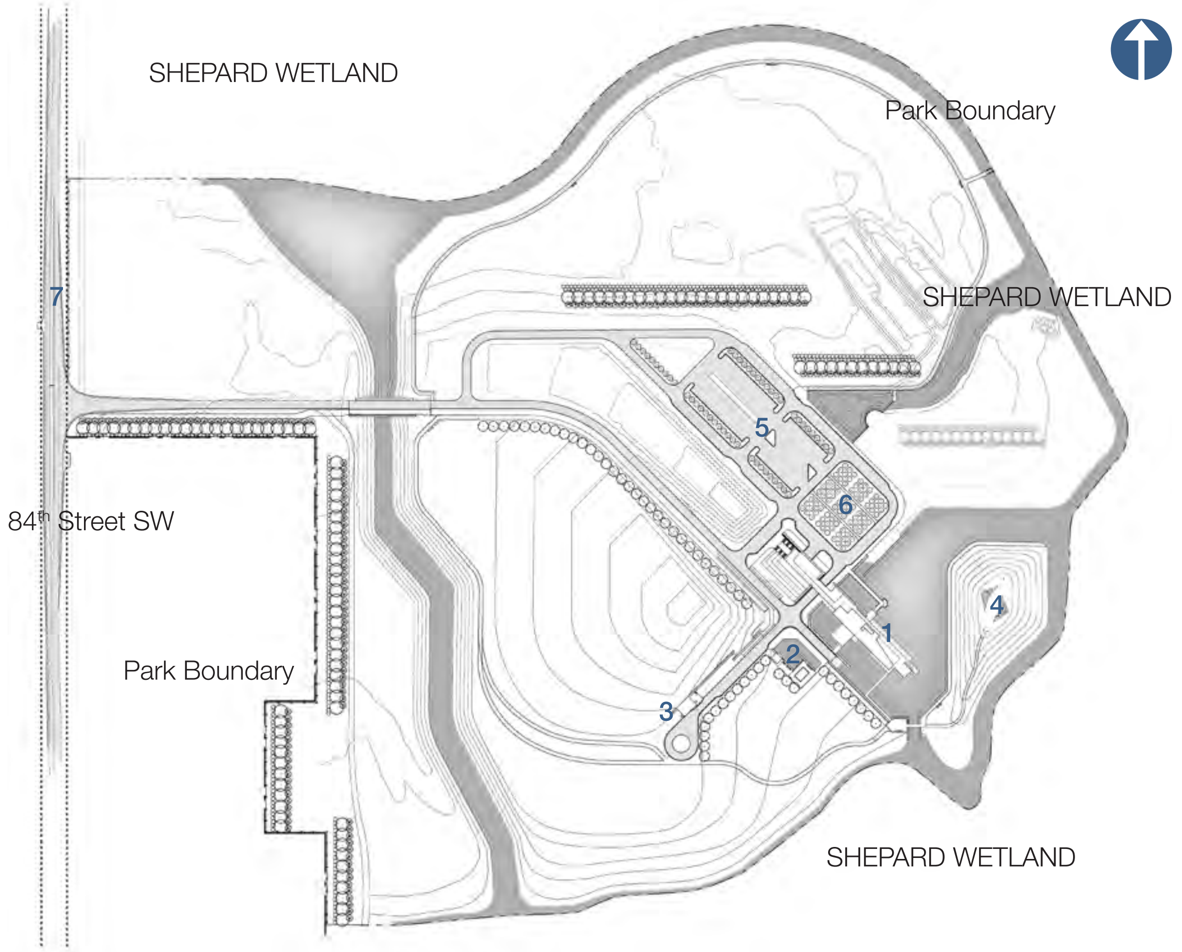


FIGURE 1 Site Plan

1 Envitonmental Education Centre
2 Irrigation Building
3 Site Services Building
4 Beverly Pepper ‘Sentinels’
5 Parking
6 Orchard
7 Causeway

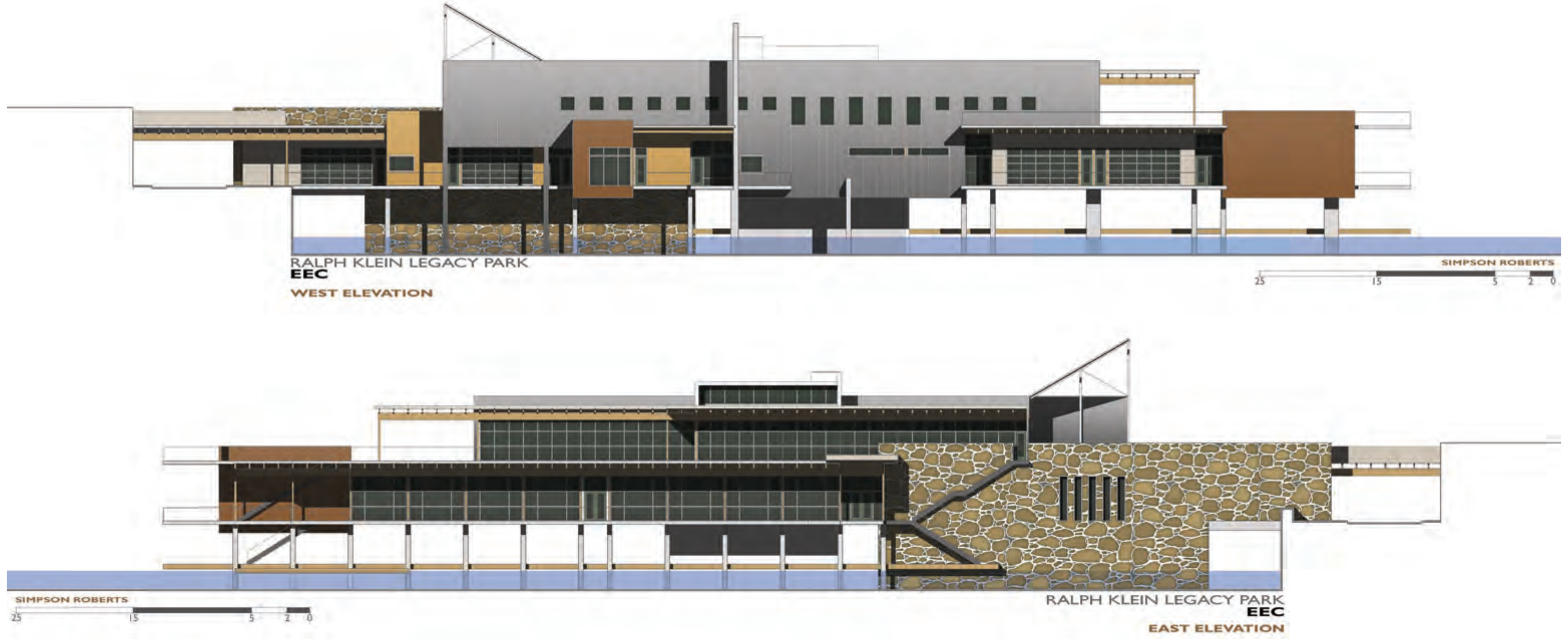


FIGURE 2 Elevation

With respect to the mechanical and electrical services, it was necessary to carefully orchestrate the routing of ducts, pipes and conduits to maintain a clean appearance. This was nowhere more important than beneath the building, where ramps give visitors access to the water, and where the soffit of the main floor concrete deck is exposed to view.

The considerable structural loads that are imposed by the accessible vegetative roofs, and the unusually high lateral resistance requirements of a structure resting on piles over water, translated into a building with large and closely spaced vertical and horizontal structural elements. Thus, glulam is the dominant material expression in the building, the other main materials are concrete piles and decking, gabion walls of local stone, and high performance aluminum framed curtain wall.

To maintain the integrity of the curtain wall, and minimize heat bridges, slab extensions for exterior decks and balconies are insulated from the interior slabs.

STRUCTURE

The wetland location provided a unique structural challenge. The sub-structure is in concrete; with bored piles transitioning into slender columns that rise to support the main floor slab, on which the two storey building is constructed. Shorter piles supporting concrete ramps and walkways beneath the building. These walkways are set at a height approximately 2ft (610mm) above mean water level, and are designed to flood at times of high volume discharge. The main floor slab is set at a level about 3ft (930mm) above the 100 year flood plane.

Lateral stability is provided by concrete stair and elevator shafts that rise through the building. The second floor accommodation is located in the centre of the elongated plan with exterior terraces to the north and south. This enables the stair and elevator shafts to be optimally spaced for maximum effect. There are also a number of strategically located concrete shear walls around the perimeter of the building, the largest of them on the north side where it is concealed within a gabion wall. The exterior terraces feature two kinds of vegetative roofs, one 'extensive' with a soil depth of 6in

Photos: Steve Nagy Photography

(150mm), the other 'intensive' with a soil depth of 12in (300mm). Extensive vegetative roofs use a narrower range of species, including smaller plants, along with grass and moss, while intensive roofs can have larger plants, as well as trees and shrubs. Extensive roofs usually require less maintenance and are less expensive than intensive roofs.

Above the main floor slab, the concrete columns transition into glulam posts. In a few instances, where loads are particularly high, concealed steel columns or beams are used. The glulam posts sit directly above the piles and the concrete columns beneath the building. Their spacing is a response to the arrangement of the program on the main floor.

Although this makes for a structural grid that is somewhat irregular, with spacing as much as 26ft (7.9m) in classroom areas, the basic module is 16ft (4.8m). The structure is essentially a straightforward post and beam system. Glulam columns support glulam beams, which in turn support glulam joists the largest of which are more than 18in (450mm) deep and spaced at 16in (400mm) centres. More typically, the joists are 5 1/8in (130mm) wide by 18in (450mm) deep, spanning between glulam beams 27 5/8in (700mm) deep. The largest glulam members are beams 14 1/8in (360mm wide and 31 5/8in (800mm) deep.

At the sides of the building, the cantilevered decks were easiest to construct using joists that ran over the top of the perimeter beams, rather than being framed into them. However, this configuration reduced the rigidity of the floor system and needed to be compensated for by framing the beams into the sides of the columns. In these perimeter locations, where there are glazed walls, double beams are used. The interior beams carry the joists that cantilever to support the exterior deck. The secondary exterior beam is essentially a fascia suspended below the joists and tied back to the glulam columns. The joists supporting the balconies, together with any other exposed glulam members, were specified as exterior grade. All the glulam material is Douglas fir.

Detailing of structural connections was carried out by the glulam fabricator to meet the aesthetic requirements, while performing structurally within the overall concept. The load requirements and general arrangement was provided by the structural engineer.

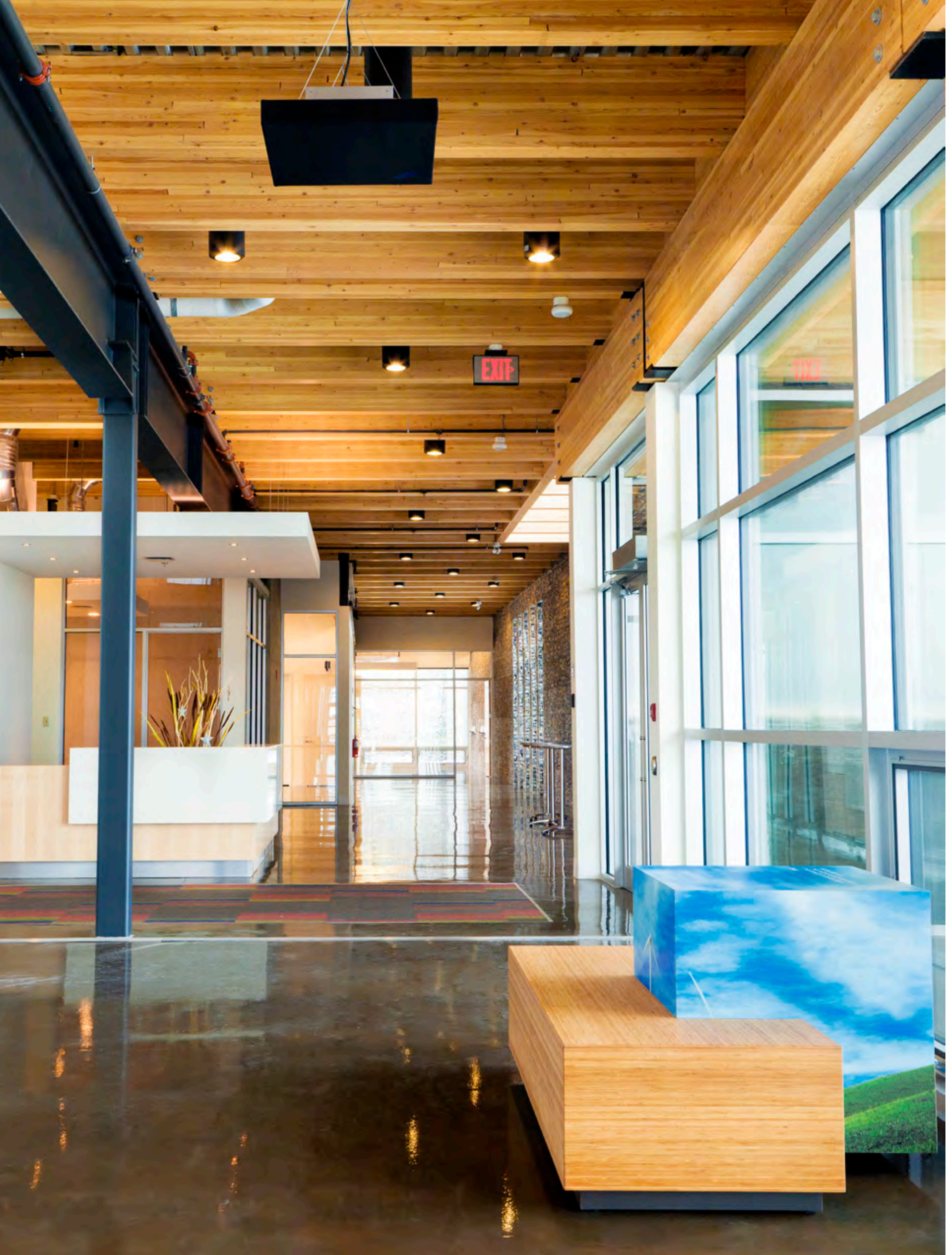
FIRE AND LIFE SAFETY

The Environmental Education Centre is classified under the National Building Code of Canada as an assembly occupancy for educational purposes (Group A - Division 2). Thus, it was permitted to be up to two storeys in height; when built using combustible and/or non-combustible construction; with the maximum permissible building area of 25,834sf (2400m^2) established on the basis of the installation of an automatic sprinkler system throughout the building. The floor assembly was required to be a non-rated fire separation, and its unusual construction addresses two design issues; creating a ceiling plenum for air distribution as well as bringing the inside floor elevation level with that of the exterior green roof. From bottom to top, the construction consists of: glulam joists; a perforated metal deck that acts as an air diffuser; 13in (325mm) deep metal studs at the same spacing as the joists, creating the air plenum; conventional profiled metal deck: and a 5in (125mm) concrete topping.

Given the location of the building within a water body, exiting and emergency access for fire fighting were critical issues. Exiting is dealt with through the placement of two external escape stairs at the north and south ends of the building that permit egress from both levels to the access bridges. There is also an internal enclosed convenience stair (as mentioned previously), that is not classified as an escape stair. This is because anyone exiting from its base on to the perimeter deck must pass in front of large areas of glazing before reaching the access bridges.

The access bridges are positioned to the east and west, the former being a pedestrian bridge of about 100ft (30m) in length, and the latter bridge of about 30ft (9m) in length enabling both delivery vehicles and fire trucks close proximity to the building.

Photo: Steve Nagy Photography



SUSTAINABILITY

The Environmental Education Centre includes some interesting sustainable design strategies particularly in relation to water conservation. Its location within a large constructed wetland offers an unprecedented opportunity for public education in this aspect of sustainable design. Within the building, both dual flush and composting toilets are used – the latter still extremely rare in public buildings anywhere in Canada.

WOOD AND THE LEED RATING SYSTEM

The Environmental Education Centre has been registered under the Canada Green Building Council's LEED NC program for new construction. Although final accreditation cannot be confirmed until the facility has operated for 12 months, it is anticipated that the building will achieve a LEED Gold rating.

The use of wood contributes to a number of LEED credits. Two 'regional material' credits are given when a minimum of 20% by value of the materials used for the building fabric (excluding mechanical and electrical systems) is sourced from within a radius of 500 miles (800km). All the wood used in the building falls into this category. Additionally, a credit is given when a minimum of 50% of the wood is from Forest Stewardship Council certified sources. It is not always possible to obtain FSC material in the required grades for the most heavily stressed (upper and lower) laminations when fabricating glulam beams. Hence in this project, the fabricator blended FSC and non-FSC material in each beam in order to conform to both the LEED requirements for minimum FSC content, and the structural engineers requirements for strength.

Photo: Steve Nagy Photography

With the use of wood as a structural system specifically where it supports exterior terraces and balconies, though not so readily quantifiable, wood's relatively poor thermal conductivity (1/10 that of concrete, and 1/400 that of steel) reduces the thermal bridging heat losses and contributes to the energy performance of the building.

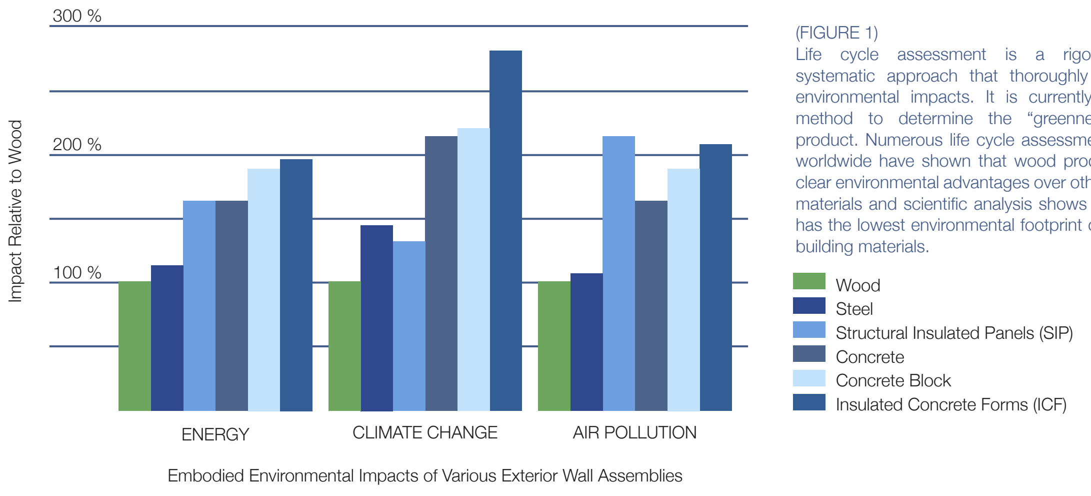
Also, the large areas of exposed wood within the building are treated with a low VOC coating, which contributes to the improved indoor environmental quality of the building.

The construction, renovation and operation of buildings consume more of the earth's resources than any other human activity. Each year, at least 40% of the raw materials and energy produced in the world are used in the building sector. This produces millions of tons of:

- Greenhouse gases
- Toxic emissions
- Water pollutants
- Solid waste

The most widely accepted method for evaluating these impacts is Life Cycle Assessment (LCA). Life cycle assessment is accepted around the world as a neutral way to evaluate and compare the environmental impacts of different building materials, products and complete structures over their lifetime — from material processing and manufacturing, through transportation, installation, building operation, decommissioning and eventual disposal.

LIFE CYCLE ASSESSMENT: WOOD IS A GOOD CHOICE



(FIGURE 1)
Life cycle assessment is a rigorous and systematic approach that thoroughly quantifies environmental impacts. It is currently the best method to determine the "greenness" of a product. Numerous life cycle assessment studies worldwide have shown that wood products yield clear environmental advantages over other building materials and scientific analysis shows that wood has the lowest environmental footprint of all major building materials.

Photos: Simpson Roberts Architecture Interior Design

Unfortunately, LCA is not yet completely incorporated into many green building rating systems in use in North America. Yet, when it is applied to building construction, in almost every situation life cycle assessment confirms that wood is the most environmentally responsible building material. For these reasons, and because of the local availability of glulam fabrication, wood was a natural choice for the Ralph Klein Environmental Education Centre.

Increasingly important in the evaluation of sustainable design in building construction is the use of carbon accounting. One innovative and rigorous approach, called the Living Building Challenge, was launched by the Cascadia Region Green Building Council in 2007. The Challenge not only requires buildings to be net-zero in their energy and water use throughout their operational life, but also to be carbon neutral in their construction. This means that the carbon impacts of extracting, processing, transporting and installing all building materials, products and systems must be calculated and that their sum must be zero or less. Although the Living Building challenge does offer a path to carbon neutrality through the purchase of carbon offsets, all the Canadian contenders scheduled for completion in 2011 incorporate large quantities of wood.

This is because growing trees use sunlight to sequester carbon dioxide to create cellulose, the main component of wood fibre, and this CO_2 is stored within the wood even when it is converted to construction lumber. The amount of CO_2 required to create a cubic metre of wood varies according to the density of the species in question. However as a point of reference, approximately 0.9 tonnes of CO_2 is used to grow every cubic metre of SPF wood fibre. This carbon remains sequestered as the tree is processed into durable wood products. Even when impacts from the modest energy inputs required for processing and transportation are included wood has a very low carbon footprint compared with other building materials. In many cases, this footprint can be negative, and the presence of wood in a building helps offset the carbon footprint of other building materials.

Although carbon accounting was not a client requirement for this project, calculations for structure carbon footprint were made based on the volume and mass of material used. In this case materials considered were only the glulam beams as the information for other wood products were unavailable at the time. As a result the wood used in the structure sequesters more than 148 tonnes of CO_2e, even accounting for wood production emissions. However, the wood used displaced the emissions that would have been made had other materials been used in place of wood. The substitution effect of using wood results in a net CO_2e reduction of 694 mT. In other words, 694 tonnes of CO_2e are not in the atmosphere because wood was used. As a point of reference, a car built to 2010 Canadian emission standards will emit 1 tonne of CO_2 when driven a distance of 5000 kilometres (so the carbon sequestered in this building is equivalent to about 600 return car trips between Vancouver and Halifax).

The low-embodied energy and carbon sequestration attributes of wood are not recognized by the current LEED rating system; however this project provides an insight into construction methods of the future, when full carbon accounting of building materials will further encourage the use of wood.


Photo: Steve Nagy Photography

PROJECT STATISTICS

Floor Area: 20,800sf (1932m²)
Building Footprint: 14,800sf (1375m²)

PROJECT CREDITS

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www.wood-works.org

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Quebec Wood *WORKS!*: 418-650-6385 ext 310
Wood *WORKS!* National Office: 1-800-463-5091
US Program: 1-866-966-3448

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