GREEN DESIGN FEATURES / LEED PROJECT CASE STUDY
HALIFAX CENTRAL LIBRARY
INTRODUCTION & LEED®

In an effort to build community, the design of the Halifax Central Library was completed in concert with the entire community through a series of highly participative consultations and focus group sessions. The result was a successful unification of its physical design and function. The exterior features a unique series of stacked and cantilevered glass boxes, suggesting a stack of books. The interior of the library reflects the diversity of the exterior with stairs and bridges in the atrium connecting the five storeys, each storey offering something special for the entire community.

The public consultation sessions clearly showed that “green design” is a high priority for the public. The June 2010 Public Consultation meeting generated comments such as; “green design; indoor park; atrium; sustainable; bring outdoors inside; bright, green space; lots of light; rooftop garden; green space on roof; incorporate nature; skylight”. Bright, daylit spaces, and a connection to the landscape were consistent themes that have emerged as significant design elements in the library. Furthermore, embedded in the design are community suggested sustainable design features including responsibly selected materials with low-emissions and high recycled content, lots of access to daylight and nature, water and energy efficiency, passive solar heat retention and the use of the 5 storey atrium for return air, to name a few. Highlighting these features provide an excellent opportunity for educating the occupants and professionals alike.

The metric identified to measure the overall green performance of the building is the Leadership in Energy & Environmental Design (LEED®) Green Building Rating System from the Canada Green Building Council (CaGBC). LEED is a rating system that is recognized as the international mark of excellence for green building in 150 countries. Since 2004, the CaGBC has certified over 1800 LEED buildings in Canada and registered over 5000.

The environmental goals identified by the client, the public, and the team are well represented by LEED. LEED promotes a holistic approach to sustainability by evaluating the design, construction, and operation of buildings in key areas of human and environmental health: sustainable site development, water efficiency, energy efficiency, responsible material selection, indoor environmental quality, and innovative design. Credits and prerequisites are organized into these six categories.

A building is rated based on the total point score achieved, with four levels of certification (certified, silver, gold and platinum). The library is targeting a certification level of LEED “Gold”. LEED Gold requires a minimum of 39 credits. The project is currently targeting 46 credits. This allows for a contingency of credits that may be lost during the CaGBC audit process. The following is a comprehensive case study of Halifax Central Library’s green design features as compiled by Fowler Bauld & Mitchell (Architect), CBCL Limited (Consulting Engineers), Solterre Design (Sustainability / LEED Consultant) and the Halifax Regional Libraries’ communications team.
COMMUNITY & SITE

Located on Spring Garden Road, the busiest commercial/shopping street east of Montreal, the new library has already spurred new development and intensification of nearby urban sites. This site was chosen, in part, to avoid development of inappropriate sites and reduce the environmental impact from the location of a building on a site. This was achieved by not increasing the foot print of the developed land and developing on land that is at least 5 ft above the elevation of the 100 year flood plain.

Less than half of the parking spaces formerly available on the site were replaced in the new underground parking garage. Instead, the library encourages the use of alternative transportation such as walking, cycling and bus access. There is ample bicycle parking both outdoors and in the underground garage, and the site has a dedicated bus stop served by several bus routes. In the parking garage there are three dedicated parking spaces complete with Electric Vehicle charging stations, available free of charge.

The building offers something special for the entire community, including a 300-seat performance space, two cafes, gaming stations, music studios, dedicated space for adult literacy, a First Nations Circle, boardrooms for public and business use and an entire floor dedicated to youth ranging from toddlers to teens. Roof top patios and spaces allow a direct visual connection to surroundings both near and far including the harbour and its approaches, historic Citadel Hill, the adjacent downtown and residential areas, and the forested landscape beyond.

In local magazine The Coast, in its annual “Best In Halifax” 2014 awards program, the new library was voted three Gold prizes by the citizens of Halifax, including Best Library, Best Effort to Improve Halifax, and Best Thing to Happen in Halifax This Year.
LIGHT & AIR

NATURAL LIGHT & VIEWS
The Halifax Central Library achieves exceptional daylight penetration in a number of significant ways. Floor-to-ceiling glass panels on the north and south facades promote glare-free daylight and passive solar heating benefits. Core spaces like elevators, emergency exists and mechanical shafts are near the east and west perimeter allowing solid insulated wall sections at these locations while also minimizing glare and unwanted summertime solar heat gain.

Frit patterns composed of random letters form leaf patterns on the facade creating interest for library visitors and also minimizing bird impacts.

The large open spaces surrounding the central atrium allow views from over 90% of regularly occupied interior spaces and the large skylight at the top of the atrium provides substantial daylight penetration into the core of each level of the building.

ARTIFICIAL LIGHTING
Artificial lighting is state of the art high efficiency fluorescent and LED fixtures selected to integrate into the ceilings and achieve recommended light levels while minimizing the electricity required operating the lights. Lighting controls take full advantage of available natural light with daylight dimming throughout the spaces with access to natural light, and vacancy sensing to automatically switch lights off in all vacant areas.

Exterior lighting is switched based on astronomical time clocks to coordinate with annual sunrise and sunset. Interior lighting energy is reduced by 62% compared with the reference standard while exterior lighting energy is reduced by 91%. Interior lighting energy use is calculated to be less than 26 kWh/sq m per year.

INDOOR AIR QUALITY
Carbon dioxide sensors are used for all densely occupied meeting and program spaces and ventilation is adjusted in real time based on the number of people in a space. Dedicated outside air heat recovery ventilation units (HRV) have the capacity to provide over 36,000 cubic feet per minute (cfm) of fresh air to the building (0.26 cfm per sq ft).

Low emitting materials were used wherever possible. While it is impossible to eliminate Volatile Organic Compounds (VOCs) entirely from a project, efforts can be made to drastically reduce the number of VOCs on site. Paints, sealants, adhesives, and many other construction materials were specifically selected on this project for their low levels of VOCs. Even though maximum VOC content was specified, a few products submitted for review were not LEED compliant and were rejected. These findings confirmed that the design and construction teams needed to be diligent in their efforts to prevent the installation of non-compliant adhesives and sealants throughout the course of the job. The project team also used low-emitting carpet and composite wood products.

Permanent entrance mats at the main doors at Queen and Spring Garden Road are used to capture dirt and particulates in high-volume entryways. Dedicated exhaust for washrooms, kitchenettes and janitors closets control pollutants at the source from these areas.

Indoor air quality testing conducted after the project’s substantial completion showed all pollutant levels at significantly lower concentrations than the LEED thresholds. The indoor air quality was described by one air quality expert, Ms. Sheila Cole, who is a member of the Environmental Health Association of Nova Scotia (EHANS) board and was active in work leading to Halifax’s adoption of scent free policies and pesticide ban by-law, as “remarkably good”.

The building’s HVAC and lighting systems are all digitally computer controlled.

To minimize exposure of building occupants to tobacco smoke, signs have been installed that require people to smoke no less than 7.5 meters from the building entrances and creating occupant awareness that smoking is prohibited in the building. No smoking signs are posted near all main entries on the building.
WATER CONSERVATION

The new Halifax Central Library reduces the use of municipal potable water use through a combination of low-flow plumbing fixtures and a rainwater collection and distribution system.

To determine the reduction in potable water usage for the building, calculations were completed using the following variables: estimated water usage by building occupants, roof area of the building draining to the cistern (hard roof surfaces only), effective cistern volume (c/w overflow into municipal system), and daily Environment Canada meteorological rainfall data over a ten year period. The cistern volume is 68,100 liters and the predicted annual water use is calculated in accordance with the LEED requirements as 3437 liters per person per year, or 149 liters/sq.m. per year. Water consumption is 64% lower than a standard building of similar size and occupancy (as defined by LEED v 1.1).

Low flow fixtures are installed for the showers, kitchenettes, and washrooms. The washrooms use 1.9 LPM metered, sensor operated lavatory fixtures. LEED reference for lavatory fixtures is 9.5 LPM. Urinals are low volume (0.5 LPF), dual flush toilets (4.2 and 6.0 LPF), and low-flow shower heads (5.7 LPM). LEED reference is 3.8 LPF for urinals, 6 LPF for toilets.

Rainwater from the roof of Level 5 is collected in an underground concrete rainwater cistern. Level 5 is the highest level of the building and has hard roofing materials so that rainwater can be collected without the staining that results from transport through vegetation. The rainwater collection system consists of roof drains, piping, pre-filtration prior to entering the rainwater cistern and post filtration/UV disinfection prior to being pumped to all of the building’s toilets and urinals.

Most of the numerous roof surfaces at the library are vegetated green roofs – over 50%. This delays and reduces storm water runoff substantially when compared to the site’s former use as a surface parking lot. A vegetated green roof reduces the amount of energy a standard black roof would absorb. This helps reduce the heat island effect produced by the building, keeping the interior temperature cooler in summer and warmer in winter – which results in more efficient energy use and cooler communities.

There are no irrigation systems for any of the site plantings. All project landscaping has been designed to survive with only natural rainfall and no potable water. Native species of trees have been planted (Red Oak). Planting areas include hardy perennials, ornamental grasses and native ferns and groundcovers including blueberry and teaberry. By selecting local, drought-resistant species, no irrigation is needed to maintain them beyond the initial establishment period. This helps reduce the demand on local potable water.
ENERGY PRESENT & FUTURE

Specific energy conservation measures include:

- High performance glazing systems and highly insulated opaque walls and roofs;
- Waterside economizer on the chiller to allow for free cooling during the cooler months;
- Super high efficiency heat recovery ventilation;
- Lower fan energy as a result of the active chilled heated beam systems;
- Energy efficient lighting in conjunction with lighting control system.

These measures result in an energy saving of 34% when compared with a standard building (ASHRAE 90.1-1999 reference building).

Although the exterior of the building is entirely glass (curtain wall), only 43% of the exterior walls are transparent. Efficiencies are achieved by maximizing the benefit of passive solar heating with vision glass (transparent) on the south exposure. Opaque glass panels (57% of exterior wall) are insulated with a soy based spray foam achieving overall insulation values of R25 and greater. The roof is also heavily insulated achieving R30 thermal resistance. The double glazed windows achieve an exceptional thermal resistance of R3.6, including frame effects. All entrances are carefully controlled with large and practical vestibules.

The building’s primary heating system offers flexibility to the owner. Two high efficiency natural gas boilers can provide all the necessary heating for the building. In addition, the boilers can be shut down and all heating provided by a district heat connection to the Dalhousie University Central Heating Plant.

The ventilation systems use a Canadian manufactured heat recovery system with an overall efficiency of 90%, even at very cold ambient temperatures. Only 10% of the building’s ventilation heating needs are required to be provided by the fossil fuel ventilation heating system. The cooling systems include electric water chillers but these air-cooled machines are fitted with state of the art waterside economizers so that when ambient conditions allow all the cooling needs of the building can be delivered without any need for mechanical refrigeration.

Areas in the building with taller exterior windows, specifically the 1st and 5th floors, also utilize radiant heating and cooling through the floor. Water is circulated through in-floor piping allowing these large surfaces to be warmed in the winter, or cooled in the summer, efficiently conditioning the space.

In an effort to reduce ozone depletion and support early compliance with the Montreal Protocol, products were specified without CFC-based or HCFC-based refrigerants in HVAC systems or halons in the Library’s fire suppression equipment. Base building and non-base building HVAC and refrigeration systems, refrigerants, cooling capacities and total installed building cooling capacity were reviewed by the consultant team to verify conformance.
MATERIALS

As part of the opening ceremonies, a duet from Symphony Nova Scotia played a short performance in the flexible performance space on Level I. After striking one note on his instrument, the cellist sat back and stated that the acoustics were, in his opinion, the best in the province and it was a privilege to play in the space. This short analogy is relevant because the material palate of the Library reflects the importance of beauty, occupant comfort, durable design, and balances environmental principals such as recycled content, local materials, low-emission materials, resource depletion and energy performance, and maintenance. For instance, sustainably harvested engineered hardwood floors dampen the noise from thousands of feet, while providing a beautiful and unique surface for a public building of this size. From the paint on the walls to various flooring types, low emission materials were carefully selected to improve indoor air quality. A metal baffle ceiling with high recycled content and a hidden acoustic blanket mitigate noise pollution and reverberation, while allowing for easy access to the mechanical and electrical systems. This holistic approach to material selection addresses sustainability, durability and occupant comfort and helps create an inspiring and beautiful space for decades to come.

Two LEED credits are available for projects that include more than 15% of total building components to be made from recycled material. Common examples include slag or flyash in concrete and steel from recycled sources. The intent is to increase demand for building products that incorporate recycled content materials, therefore reducing impacts resulting from extraction and processing of new virgin materials and by-passing energy and greenhouse gas intensive industrial and manufacturing processes. The verified recycled content is more than 21% of the materials in the library (based on a cost calculation).

Special care was taken in material selection to help increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation. More than 21% of the building materials in the Library are extracted, processed & manufactured within a radius of 800 km if transported by truck, and 2500 km if transported to site by rail (based on a cost calculation).

77.6% of construction and demolition waste was diverted from landfill. (All figures, as defined by LEED NC 1.0). The construction manager was responsible to develop and implement a Waste Management Plan. Material was sorted on site, tracking forms were used to account for all material and waste leaving the construction site and frequent visual inspections were done.

Over 90% of the wood products used throughout the building have been sustainably harvested as defined by third party forest certification bodies, such as the Forest Stewardship Council (FSC). From harvest, to manufacturing and distribution, FSC certification is given to companies and landowners to verify that they practice sustainable forestry that is consistent with FSC standards. The FSC logo on wood or paper products guarantees that consumers can trust the sources.
LIFE CYCLE CONSIDERATIONS

An independent consultant was retained to review the design and construction of architectural components and assemblies to verify their durability. A building durability plan was developed according to a national standard (CSA-S478).

From the perspective of the library and its users, life cycle considerations included the ability to adapt to change, as the community’s needs change over time. The library was designed to accommodate this. The floors were structurally designed for a library load throughout, allowing the collection to be moved anywhere. Partitions are easily moved and the mechanical and electrical systems can be adapted to virtually any new layout.

GREEN BUILDING DEMONSTRATION/EDUCATION

The green building education plan focuses primarily on communicating the unique attributes of Halifax Central Library to its occupants. The green building education plan’s objectives are to educate the occupants on the benefits of LEED™ buildings, develop and encourage an understanding of the unique working systems that function in their building, foster a sense of pride and ownership for the building, and to stimulate conversation and curiosity for sustainability, green design and LEED™ buildings. These objectives were met through the following measures:

- distributing this case study widely through the Library website,
- available tours that highlight sustainable features in the building,
- informative signage about green features throughout the library,
- pamphlets,
- numerous newspaper, magazine and journal articles.

PERFORMANCE INFORMATION

Energy intensity (building and process energy) in MJ/m2/year = 701 MJ/m2/year

Energy intensity reduction relative to reference building under MNECB (%) = 39.3%

Potable water consumption from municipal sources in L/occupant/year = 3,437 L/occupant/year

Reduction in potable water consumption relative to reference building (%) = 64%

Regional materials (800km radius) by value (%) = 21.6%

Recycled materials by value (%) = 21.6%

Certified Wood Content by value (%) = 90.52%
### Sustainable Sites

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#### Prerequisites
- **P**: Erosion & Sedimentation Control
- **Y**: Site Selection
- **Y**: Development Density
- **Y**: Redevelopment of Contaminated Sites
- **Y**: Alternative Transportation, Public Transportation Access
- **Y**: Alternative Transportation, Bicycle Storage & Changing Rooms
- **N**: Alternative Transportation, Hybrid & Alternative Fuel Vehicles
- **Y**: Reduced Site Disturbance, Protect or Restore Open Space
- **N**: Reduced Site Disturbance, Development Footprint
- **N**: Stormwater Management, Rate and Quantity
- **N**: Stormwater Management, Treatment
- **Y**: Reduce Heat Islands, Non-Roof
- **Y**: Reduce Heat Islands, Roof
- **N**: Light Pollution Reduction

### Water Efficiency

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#### Credits
- **Credit 1.1**: Water Efficient Landscaping, Reduce by 50%
- **Credit 1.2**: Water Efficient Landscaping, No Potable Use or No Irrigation
- **Credit 2**: Innovative Wastewater Technologies
- **Credit 3.1**: Water Use Reduction, 20% Reduction
- **Credit 3.2**: Water Use Reduction, 30% Reduction

### Energy & Atmosphere

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#### Credits
- **Credit 1.1**: Basic Energy Performance
- **Credit 1.2**: Renewable Energy, 5%
- **Credit 1.3**: Renewable Energy, 10%
- **Credit 1.4**: Renewable Energy, 20%
- **N**: CFC Reduction in HVAC&R Equipment
- **Credit 2.1**: Optimize Energy Performance
- **Credit 2.2**: Energy Cost Savings
- **Credit 2.3**: Energy Cost Savings
- **Credit 3**: Best Practice Commissioning
- **Credit 4**: Measurement & Verification
- **Credit 5**: Green Power

### Materials & Resources

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#### Credits
- **Credit 1**: Storage & Collection of Recyclables
- **Credit 1.1**: Building Reuse, Maintain 75% of Existing Shell
- **Credit 1.2**: Building Reuse, Maintain 100% of Existing Shell
- **Credit 1.3**: Building Reuse, Maintain 50% of Interior Non-Shell
- **Credit 2.1**: Construction Waste Management, Divert 50%
- **Credit 2.2**: Construction Waste Management, Divert 75%
- **Credit 3.1**: Resource Reuse, Specify 5%
- **Credit 3.2**: Resource Reuse, Specify 10%
- **Credit 4.1**: Recycled Content, Specify 7.5% (post consumer +1/2 post industrial)
- **Credit 4.2**: Recycled Content, Specify 15% (post consumer +1/2 post industrial)
- **Credit 4.3**: Regional Materials, 10% Extracted & Manufactured Regionally
- **Credit 4.4**: Regional Materials, 20% Extracted & Manufactured Regionally
- **Credit 5**: Reduced Site Disturbance
- **Credit 5.1**: Reduced Site Disturbance, Protect or Restore Open Space
- **Credit 5.2**: Reduced Site Disturbance, Development Footprint
- **Credit 6**: Stormwater Management
- **Credit 6.1**: Stormwater Management, Rate and Quantity
- **Credit 6.2**: Stormwater Management, Treatment
- **Credit 7.1**: Extreme & Ozone Protection
- **Credit 7.2**: Ozone Protection
- **Credit 8**: Green Power

### Indoor Environmental Quality

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#### Credits
- **Credit 1**: Minimum IAQ Performance, ASHRAE 62
- **Credit 1.1**: Carbon Dioxide (CO2) Monitoring
- **Credit 1.2**: Ventilation Effectiveness
- **Credit 3.1**: Indoor IAQ Management, During Construction
- **Credit 3.2**: Indoor IAQ Management, Before Occupancy
- **Credit 4.1**: Low-Emitting Materials, Adhesives & Sealants
- **Credit 4.2**: Low-Emitting Materials, Paints & Coatings
- **Credit 4.3**: Low-Emitting Materials, Carpet
- **Credit 4.4**: Low-Emitting Materials, Composite Wood & Laminate Adhesives
- **Credit 5**: Indoor Chemical & Pollutant Source Control
- **Credit 6.1**: Controllability of Systems, Perimeter Spaces
- **Credit 6.2**: Controllability of Systems, Non-Perimeter Spaces
- **Credit 7.1**: Thermal Comfort, Compliance
- **Credit 7.2**: Thermal Comfort, Monitoring
- **Credit 8.1**: Daylight 75% of Spaces
- **Credit 8.2**: Views for 90% of Spaces

### Innovation & Design Process

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#### Credits
- **Credit 1.1**: Exemplary performance - Water Efficiency
- **Credit 1.2**: Exemplary performance - SSc4.1 Public Transportation Access
- **Credit 1.3**: Demonstration & Education
- **Credit 1.4**: LEED for Schools Joint Use
- **Credit 2**: LEED™ Accredited Professional

All credits are subject to review and approval by the Canada Green Building Council (CaGBC). Solterre Design cannot guarantee that the points identified on this form will be awarded through the CaGBC’s review process.