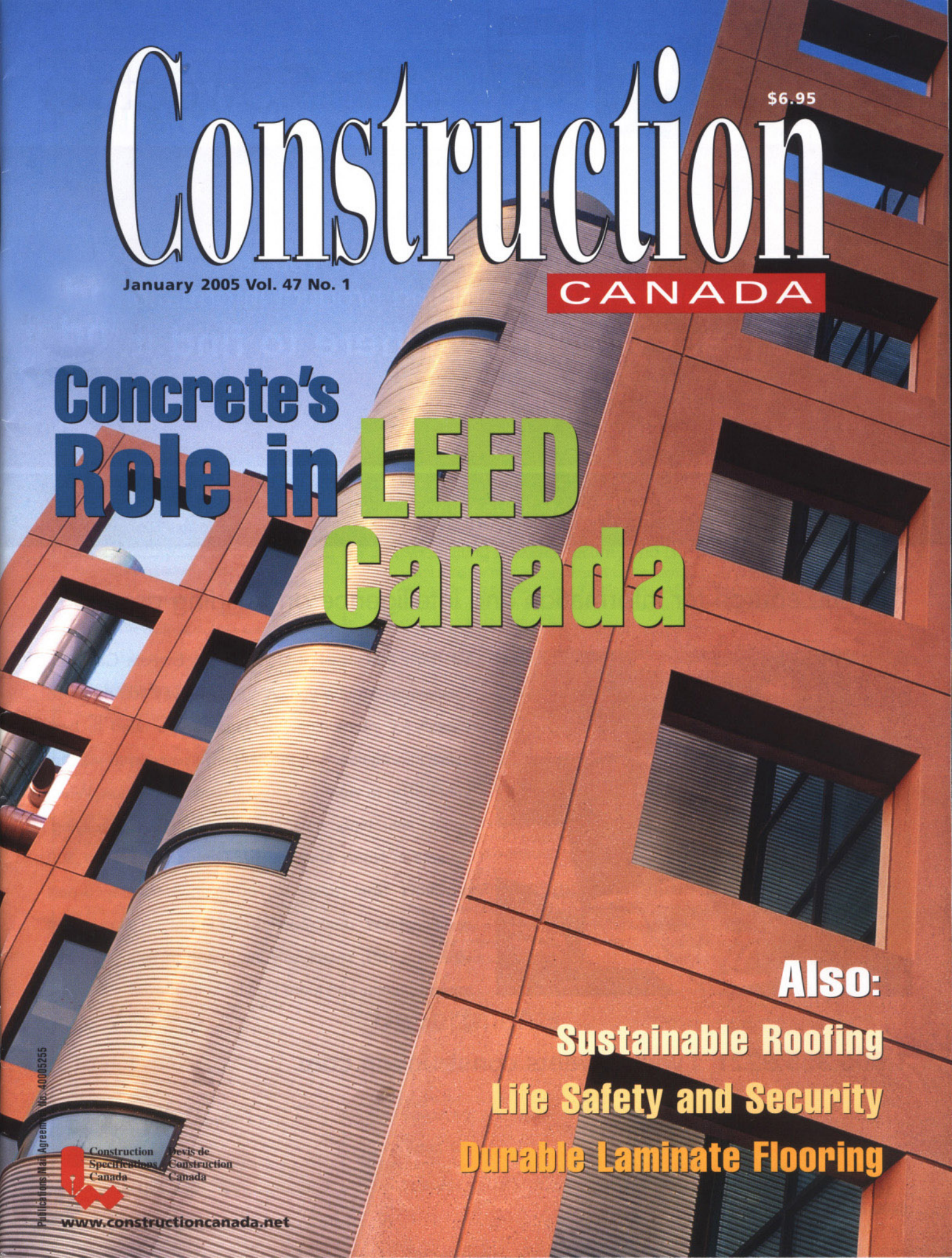

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Concrete's Role in LEED Canada

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Photo courtesy CTL Group

A machine crushes portions of walls, columns and floors before the concrete is reused as fill material.

Building Concrete into LEED Canada–NC

By Medgar L. Marceau, PE, LEED AP, and Martha G. VanGeem, PE, LEED AP

In December 2004, the Canada Green Building Council (CaGBC) released its inaugural version of the Leadership in Energy and Environmental Design® (LEED®) rating system. LEED Canada–NC (new construction) 1.0 is an adaptation of the U.S. system, reflecting Canadian environmental attitudes and economic conditions, and referencing the country's legislation, standards and government programs.

LEED is a rating system to evaluate a building's environmental performance. As with its U.S. counterpart, LEED Canada allows projects to earn points for environmentally friendly actions taken throughout the building process. (See Breaking Down LEED Canada, page 16.) Not all buildings have to meet the same requirements to be LEED certified—flexibility in the rating system allows project teams to select green strategies best suited to their goals. As a sustainable material, concrete can play an important role in attaining LEED certification for projects seeking recognition for their green building strategies.

By properly using concrete, a project can earn from 13 to 23 of the required 26 points for certification. However, points must be documented according to LEED procedures, which often include the submittal of signed letters of proof and the relevant drawings and specifications. The following are suggestions for earning points through the use of cement and concrete products. (See also How Concrete Contributes to LEED Canada–NC, page 12.)

Sustainable sites (SS)

SS Credit 3, Redevelopment of Contaminated Sites (**1 point**)

This credit rewards projects that rehabilitate damaged areas where development is complicated by long-term environmental pollution. Portland cement can be used for solidification and stabilization by being mixed into contaminated soil with a large auger. It can also reduce leachate concentrations

to below regulatory levels. Documentation is required to prove the site was contaminated and the remediation performed.

SS Credit 5, Reduced Site Disturbance **(1 to 2 points)**

For SS Credit 5.1, *Protect or Restore Open Space,* concrete parking garages on the lower floors of a building can limit site disturbances, such as earthwork and vegetation clearing procedures. For this credit, the team must limit site disturbance to within:

- 12 m (40 ft) of the building perimeter;
- 1.5 m (5 ft) of curbs, walkways and main utility branch trenches; and
- 7.5 m (25 ft) of constructed areas with permeable surfaces requiring additional staging (*e.g.*, pervious paving areas, stormwater detention facilities, playing fields).

By lessening the need for paved parking areas outside the building, concrete parking garages can also reduce the development's footprint.[1] This requirement of SS Credit 5.2, *Development Footprint,* can be met by exceeding the local zoning authority's open space requirement for the site by 25 per cent.

SS Credit 6, Stormwater Management **(1 point)**

The intent of SS Credit 6.1, *Stormwater Management: Rate and Quantity,* is to limit disruption and pollution of natural water flows by managing runoff. Using concrete open-grid pavers reduces the rate and quantity of runoff since they increase stormwater infiltration. These grid pavers have large, soil-filled voids through which stormwater can percolate. Grass and attractive vegetation can also be grown in these voids.

Similar results can be achieved by using pervious concrete pavements, which contain insufficient cement paste to fill the voids between the coarse aggregate. The resulting concrete has a high volume of voids (20 per cent to 35 per cent) and a high permeability allowing water to flow through easily.

To earn the credit, projects with imperviousness greater than 50 per cent must reduce the rate and quantity of runoff by 25 per cent. For sites where imperviousness is below this level, the post-development discharge rate and quantity cannot exceed the pre-development rate and quantity.

SS Credit 7, Heat Island Effect **(1 point)**

SS Credit 7.1, *Heat Island Effect: Non-roof,* calls for the use of light-coloured/high-albedo materials (reflectance of at least 0.3) and/or open-grid pavement for at least 30 per cent of the site's non-roof impervious surfaces.[2] This requirement can be met by using portland cement concrete, light-coloured pavers or open-grid pavers—rather than asphalt concrete—for 30 per cent of all sidewalks, parking lots, drives and other impervious surfaces.[3] Other options include placing at least half of parking spaces underground (or covered by structured parking) and/or using an open-grid pavement system with less than 50 per cent imperviousness for at least half the parking lot area.

Photo courtesy Portland Cement Association

This sidewalk of white portland cement illustrates the use of a light-coloured, high-albedo material for at least 30 per cent of the site's impervious surfaces.

Photo courtesy Stantex Consulting Ltd.

The University of Calgary's Information and Communication Building has qualified for the Commercial Building Incentive Program (CBIP), thanks to its green building attributes.

EA Credit 1, Optimize Energy Performance **(1 to 10 points)**

To earn points toward EA Credit 1, *Optimize Energy Performance*, energy cost savings must be shown compared to a base building meeting the requirements of *MNECB* or ASHRAE/IESNA 90.1-1999. Insulated concrete systems, because of their inherent energy efficiency, will most likely be eligible for points when used in conjunction with other energy savings measures.

The number of points awarded depends on the building, climate, fuel costs and minimum requirements of the standards. Using *MNECB* as a base standard, one to 10 points are awarded for energy cost savings of 24 per cent to 64 per cent for new buildings, and 15 per cent to 55 per cent for existing buildings. When using ASHRAE/IESNA 90.1-1999, up to 10 points can be awarded for energy cost savings of 15 per cent to 60 per cent for new buildings, and five per cent to 50 per cent for existing buildings.

Materials and resources

MR Credit 1, Building Reuse **(1 to 3 points)**

This credit is awarded for leaving most of the building in place when renovating. One point is earned when 75 per cent of the existing building structure and shell is left in place, and two points when 95 per cent is left. The building shell includes the exterior skin and framing, but excludes window assemblies, interior walls, floor coverings and ceiling systems. An additional point is earned when 50 per cent of non-shell areas are maintained. This credit should be relatively easy to obtain when renovating buildings with a concrete skin, since concrete is a long-lived building material.

MR Credit 2, Construction Waste Management **(1 to 2 points)**

Projects diverting at least 50 per cent (by weight or volume) of construction, demolition and land-clearing waste from landfill disposal can benefit from MR Credit 2. During demolition, concrete (a relatively heavy building material) is often crushed and recycled into aggregate for road bases and construction fill, so this credit should be easy to obtain in such cases. It is worth one point when 50 per cent of the construction, demolition and land clearing waste is recycled or salvaged, and two points when the figure increases to 75 per cent.

MR Credit 4, Recycled Content **(1 to 2 points)**

This credit requires the use of materials with recycled content. One point is awarded when the sum of the post-consumer recycled content plus one-half of the post-industrial recycled content makes up at least 7.5 per cent of the total value of the materials in the

Breaking Down LEED Canada

Much like its U.S. Green Building Council (USGBC) template, the Canadian Green Building Council's (CaGBC's) Leadership in Energy and Environmental Design® (LEED®) rating system has five main categories rewarding environmentally positive actions:

1. Sustainable Sites (SS).
2. Water Efficiency (WE).
3. Energy and Atmosphere (EA).
4. Materials and Resources (MR).
5. Indoor Environmental Quality (EQ).

Each category is divided into credits, which are further broken down into points. Additional points can be earned for innovation, exceptional environmental performance and the inclusion of a LEED-accredited professional (LEED AP) on the project team.

Despite many similarities, there are still some important differences between the Canadian and U.S. LEED programs. Some reflect differences in legislative standards, government programs, energy codes and culture. LEED Canada is generally more stringent than its U.S. counterpart—these increased minimum performance levels reflect the program's goal to spur market transformation. Once a particular point becomes common or easy to achieve, it is likely the bar will be raised in future versions of LEED to ensure standards are continually high.

Table 2 LEED Canada Points

Credit Category	Available points
Sustainable Sites (SS)	14
Water Efficiency (WE)	5
Energy and Atmosphere (EA)	17
Materials and Resources (MR)	14
Indoor Environmental Quality (EQ)	15
Total Core Points	65
Innovation and Design Process Points (ID)	5

While voluntary, LEED certification projects a positive environmental image to the community. Furthermore, many of these green building practices can result in significant energy and cost savings over the life of the structure, along with improved indoor air quality (IAQ) and better daylighting.

Due to the benefits of green design, many cities and government agencies require LEED certification for new public buildings. These include:

- the Greater Vancouver Regional (GVR) District;
- City of Vancouver;
- Alberta Infrastructure;
- City of Calgary Sustainable Buildings Policy;
- Manitoba Hydro;
- Public Works and Government Services Canada (PWGSC);
- B.C. Buildings Corp.; and
- La Société Immobilière du Québec.

Detailed information on the LEED program and project certification process is available on the CaGBC website, www.cagbc.ca. The program outlines the intent, requirements, technologies and strategies for meeting each credit.

Table 3 LEED Green Building Certification Levels

Level	Points
LEED Certified	26 to 32 points
LEED Certified Silver	33 to 38 points
LEED Certified Gold	39 to 51 points
LEED Certified Platinum	52+ points

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Continuing Education

Learning Objectives

After reading this article, you should understand:

- the basic structure of the Canadian Green Building Council's (CaGBC's) Leadership in Energy and Environmental Design® (LEED®) system;
- the material properties of concrete and how they relate to sustainability; and
- how concrete can contribute to certain environmental goals of a project in myriad ways.

Instructions

Read the article, "Building Concrete into LEED Canada–NC," with the above learning objectives in mind. Complete the questions below, and e-mail your answers (along with your name, address and Construction Specifications Canada [CSC] member number) to continuingeducation@csc-dcc.ca.

For this one-hour activity, CSC members will earn one (1) Continuing Professional Development and Education (CDPE) credit.

The correct answers will be posted at www.csc-dcc.ca/continuingeducation.html to coincide with the release of the March issue of *Construction Canada*.

Questions

1. What are the five categories in the CaGBC's LEED–Canada program? How many credits are needed to achieve certification?
2. What is involved with Energy and Atmosphere (EA) Prerequisite 2, and how can a project demonstrate its compliance? Why can concrete be advantageous in this area?
3. When does the use of concrete apply for Materials and Resources (MR) Credit 5?
4. How can concrete be used to lessen the heat island effect in cities, while also scoring LEED points?
5. What benefit does concrete provide in locations with contaminated soils?

project. The value of an item is the recycled material's weight, divided by the weight of the entire item, and then multiplied by the item's total cost.

Supplementary cementitious materials (SCMs), such as fly ash, silica fume and slag cement, are considered post-industrial materials. LEED Canada–NC makes special provisions for SCMs due to their light weight and environmental impact. Instead of using the concrete's weight to determine recycled content, the weight of the SCMs is divided by the weight of the total cementitious material, then multiplied by two. That number is then multiplied by the cost of the concrete and formwork. This formula allows a concrete building with 25 per cent of its portland cement replaced with SCMs to achieve one point. (A 40 per cent replacement earns two points.)[5]

Using recycled concrete or slag as aggregate (instead of extracted materials) would also qualify as 'post-consumer.' This credit is worth one point for the quantities quoted above, and two points when the quantities are doubled to 15 per cent combined post-consumer, plus one-half post-industrial recycled content.

MR Credit 5, Regional Materials **(1 to 2 points)**

To earn one point for MR Credit 5, a project must rely on at least 10 per cent of building materials that have 80 per cent of their mass extracted, processed and manufactured within a radius of 800 km (500 mi). When these materials are primarily shipped by water or rail, the radius increases to 2400 km (1500 mi). Combinations of the first criterion (for trucks) and the second (for rail or water) are allowed.

Cement and supplementary cementitious materials used for buildings are often manufactured within 800 km (500 mi) of a job site. Concrete made with regional cementitious materials and aggregates often qualifies, as ready-mix plants are generally within 160 km (100 mi) of a job site.[6] The percentage of materials is calculated on a cost basis. MR Credit 5 can yield two points when the regional material figure increases to 20 per cent.

MR Credit 9, Durable Buildings **(1 point)**

Quality concrete is inherently long-lived and durable—the Coliseum in Rome, Italy, constructed more than two millennia ago, was constructed of the material and is still standing. MR Credit 9 requires the development and implementation of a Building Durability Plan for the project's construction and pre-occupancy phases, in accordance with portions of Canadian Standards Association (CSA) S 478-95 (R-2001), *Guidelines on Durability in Buildings; Structures (Design)*. The guidelines require:

1. Appropriate design service life for components and assemblies.
2. Appropriate materials and designs so the design service life is exceeded.
3. Documentation.
4. Quality assurance.

Additional points

Projects using an innovative green design strategy that does not fit into the point structure of the five LEED categories, or those significantly exceeding a credit requirement can apply for four additional points under Innovation & Design Process (ID). One of the four potential points is awarded when a principal participant on the project team is a LEED-accredited professional (LEED AP). (The concrete industry has LEED-experienced professionals available to help maximize the points for concrete. Visit the Cement Association of Canada's [CAC's] website, www.cement.ca.)

Notes

1. In this context, the building footprint includes the building, access roads and parking.
2. Albedo (in this context, synonymous with solar reflectance), is the ratio of the amount of solar radiation reflected from a material to the amount shining on the material. Where paved surfaces are required, using materials with higher albedos (generally, light-coloured surfaces) reduces the heat island effect and improves air quality.
3. Portland cement concrete usually has a reflectance of approximately 0.35. Measured values are reported in the range of 0.4 to 0.5. For 'white' portland cement concrete, values range from 0.7 to 0.8. New asphalt concrete generally has a reflectance of approximately 0.05, and asphalt concrete five or more years old has a reflectance of approximately 0.1 to 0.15.
4. When performing major renovations to existing buildings, certification requires a 10 per cent reduction in energy consumption relative to *MNECB*, or compliance with ASHRAE/IESNA 90.1-1999.
5. Slag cement is commonly used at replacement levels of up to 60 per cent. However, fly ash replacement levels for portland cement greater than 25 per cent is not common, as the fly ash and cement need to be chemically and physically compatible to ensure durable quality concrete that sets properly. Additionally, while most reinforcing steel is manufactured from recycled steel—and would therefore probably qualify—it would not be considered part of concrete.
6. Reinforcing steel is often manufactured within 800 km (500 mi) of a job site, and typically comprises recycled materials from the same region.

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