

Delivering durable building envelopes

Robert Marshall

These days, most people who work in the construction industry have at least heard of the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) program. In the United States, LEED is a third-party verification system used to rate buildings on a scale of 69 points.

In Canada, the Canadian Green Building Council (CaGBC) has adopted the USGBC's LEED program, but it differs in one way. The CaGBC LEED rating system is based on 70 points. The additional point possible through LEED Canada—Durable Building Credit, MRc8—is awarded to structures demonstrating durable qualities. In this column, I detail the ways that project teams in the United States can earn this durability credit as an innovation credit.

Reasons for building sustainably

Buildings fundamentally affect people's lives and the health of the planet. In Canada, buildings use more than one-third of the total energy, produce almost one-third of the greenhouse gas emissions, and transform land that provides valuable ecological services.^{1,2} Atmospheric emissions from the use of energy lead to acid rain, ground-level ozone, smog, and global climate change.

Although they are an excellent start, most of the credits associated with the LEED rating system focus solely on the environmental affects associated with construction. To move the rating system toward one that evaluates the sustainability of a building, the durability of the structure must be evaluated.

MRc8 background

Because of Canada's licensing agreement with the USGBC, the Canadian version of LEED was allowed to have more credits than are offered by the U.S. version. Ray Cole, at the University of British Columbia, and I created LEED MRc8 to evaluate the durability of a building envelope. Our motivation was to prevent moisture and structural deterioration that can cause the collapse of a building envelope. We recognized that in order to develop a usable credit, we needed to

- address liability issues,
- recognize existing third-party instruments,
- recognize qualified architects and engineers,
- provide the tools necessary to achieve a durable building credit.

While developing MRc8, the comments that we received reinforced the idea that we needed a durability-based LEED credit. Some who commented

believed that more than one point should be awarded for a durable building. Specifically, because durability is not covered in the National Building Code, some engineers and architects did not address issues related to durable building envelopes in their designs. The thought was, with a suitable credit in LEED, the risk of premature failures, lawsuits, insurance claims, and loss of reputation can be reduced. Thus, the CaGBC Durable Building Task Force (DBTF) was created.

Launch challenges

The DBTF created a first version of MRc8 that was circulated and put into practice in Canada. From its initial launch, three primary lessons were learned, or challenges identified, with MRc8. The first of these was a perceived risk of increased professional liability. Many insurance companies warned architects and engineers not to sign a declaration stating that the building envelope was durable. Second, the credit as released was difficult to use. There were no templates available and no recognized existing third-party instruments of service, and the credentials of building-science professionals were not clear. Finally, MRc8 was thought to be cost prohibitive. The cost of incorporating the credit was reported to be \$10,000 to more than \$20,000 per project.

Solutions

In order to streamline MRc8 to encourage durable buildings, it was necessary to investigate reports of liability, difficulty, and cost issues. The DBTF needed to assess whether mechanical equipment, interior finishes, and other items should also be included in MRc8. The task force recommended that mechanical units

Leadership in Energy and Environmental Design

The LEED green building rating system was developed by the U.S. Green Building Council (USGBC) with some core principles. The LEED system, which is a priority program of USGBC, is

- a voluntary, consensus-based, market-driven building-rating system based on existing, proven technology;
- used to evaluate environmental performance from a whole-building perspective and provides a definitive standard for what constitutes a green building;
- based on accepted energy and environmental principles, striking a balance between known effective practices and emerging concepts;
- overseen by the USGBC membership, which initiated the development of the system and is represented by all segments of the building industry;
- a self-assessing system used for rating new and existing buildings;
- a credit-based system in which credits are earned for satisfying each criterion;
- designed to be comprehensive in scope yet simple in operation.

In Canada, buildings can achieve a maximum of 70 points in five categories using the LEED rating system. The five categories and possible points available in each are

- sustainable sites, 14 points;
- water efficiency, 5 points;
- energy and atmosphere, 17 points;
- materials and resources, 14 points (1 more credit than U.S. LEED);
- indoor environmental quality, 15 points;
- innovation in design, 5 points.

Structures are awarded different levels of LEED certification based on total points achieved. The award levels and points required for each are

- platinum, 52 or more points;
- gold, 39–51 points;
- silver, 33–38 points;
- certified, 26–32 points.

For more information on the LEED program or the USGBC, visit www.usgbc.org or www.cagbc.org.

not be included in MRc8 but instead could be pursued as an innovation-in-design credit. An additional credit for a higher level of mechanical and envelope commissioning could possibly enter the next version of LEED.

The DBTF created a new table, Building Envelope Systems (table 2), which lists 50+ year design service lives. For example, what wall construction of curtain wall (type 2) and concrete/ masonry for a 50+ year design service life according to CSA S478. These durable building credit solutions were approved in April 2007 as part of the LEED amendments.

Liability concerns were real. The DBTF contacted some of the largest engineering and architect insurers in early January 2006. The insurers were concerned with the wording of the durable building declaration. However, they were not concerned with durable design review. The solution was a revised durable building declaration with input from the insurers.

The credit

For those familiar with LEED, all credits follow the same format and have components such as intent, reference standard, summary of requirements, and submittals. Here I outline the refined, current CaGBC MRc8.

Intent

The intent is to minimize materials use and construction waste over a building's life resulting from premature failure of the building and its constituent components and assemblies.

Reference standard

CSA S478-95 (R2001)—Guideline on Durability in Buildings,³ which

- was developed to prevent leaky buildings,
- is a recognized standard that can be used in achieving the credit.

Summary of requirements

- Develop and implement a building durability plan following CSA S478-95 (R2001)—Guideline on Durability in Buildings.
- Design and construct the building to ensure that the predicted service life exceeds the design service life in accordance with table 2.
- Where component and assembly are shorter, design to replace in accordance with table 3.
- Demonstrate the predicted service life of the chosen components or assemblies by
 - demonstrated effectiveness,
 - the modeling of the deterioration process,
 - testing.
- Document design and construction quality-assurance activities.
- Develop and document a quality-management program.

Submittals

- Demonstrate the predicted service life of components or assemblies by testing or by documenting demonstrated effectiveness or modeling of the deterioration process.
- Document the quality-assurance activities to be carried out to ensure that the predicted service life is achieved.
- Develop and document the quality-management program.

Building science professional

Use a qualified building science professional who is employed by a firm with an engineering Certificate of Authorization or an architectural Certificate of Practice and has experience in performing building science reviews focused on the envelope durability for at least two buildings and one of the following:

- successful completion of 35 hours of instruction within the past 10 years,
- certificate of building envelope expertise (for example, TARION Insurance),
- independence from the architectural firm of record.

Additional requirements

In order to earn MRc8.1, CaGBC requires the project team to submit a LEED letter template and a letter of confirmation that the building envelope construction is in general conformance with the design details. If CaGBC audits the project, the team must provide the following:

- A copy of the building envelope design review report
- A copy of the field review report demonstrating review of details at about 75% to 100% completion of building envelope
- A copy of the LEED Canada Durable Building tables or CSA tables A1, A2, and A3

The building durability plan identifies quality-assurance activities to be carried out to ensure that the predicted service life is achieved, documents the quality-management program, and identifies maintenance and operations requirements (reduces designer risks). Representative tables are provided in the free sustainable design guide available at www.cement.ca. The increased cost for the project is about \$6000 per building, assuming that an amended durable building declaration and a quality-assurance program are already in place.

Durable buildings everywhere

With the new design template tools; recognized, existing quality assurance activities (by the insurance companies); and licensed building-science professionals available, and with LEED MRc8 already achieved in many locations, it is now the time to accelerate achievement and recognition of durable building envelopes.

The six Ds to achieve durable envelopes

Deflection—don't let water into the wall.

Drainage—give water a way out.

Drying—design assemblies that allow drying or use moisture-tolerant mass concrete as recognized by the National Building Code of Canada 2005.'

Durable materials—if material is susceptible to wetting, choose those that are mold and corrosion resistant, such as concrete, fiber reinforcing, and stainless-steel fasteners.

Details that work—use details with a proven record of preventing water ingress, or allowing water to escape.

Documentation—document that building envelopes are constructed according to the construction documents.

References

1. National Resources Canada. Energy Use Data Handbook Tables (Canada). oee1.nrcan.gc.ca/corporate/statistics/neud/dpa/handbook_tables.cfm.
2. Lenssen, D. M., and N. Roodman. 1995. *A Building Revolution: How Ecology and Health Concerns are Transforming Construction*. Worldwatch paper 124. Washington, DC: Worldwatch Institute.
3. Canadian Standards Association Committee S478. 1995. *Guideline on Durability in Buildings*. Rev. ed. (2001). Canadian Standards Association.

About the author

Robert Marshall, P. Eng., LEED AP, BDS, is president of Cedaridge Services Inc. He teaches Building Performance at Ryerson University and can arrange special workshops that can qualify for training hours toward the qualifications for durable building. Marshall is chair of the ISO TC 163/SC 2 for calculation methods of thermal and life-cycle costing. He is a member of the USGBC Working Group A on Life Cycle Thinking and ASHRAE SPC 160p for establishing criteria for moisture control in buildings. Marshall was a member of the team that won first prize at the 2nd Annual Greenbuild Slam 2006 in Denver, Colo., on integrated design collaboration. He can be reached at (905) 868-4840 or marshallrbrt@aol.com.

Synopsis

This article gives background information on the development of LEED Canada Durable Building Credit MRc8 and details how project teams might earn this durability credit as an innovation credit in the United States.

Keywords

Durability, LEED, sustainability.

Reader comments

Please address any reader comments to *PCI Journal* editor-in-chief Emily Lorenz at elorenz@pci.org or Precast/Prestressed Concrete Institute, c/o *PCI Journal*, 209 W. Jackson Blvd., Suite 500, Chicago, IL 60606. 