

The USGBC LEED Rating System and the Building Envelope

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Nearly 15 years ago, a small group of forward thinking individuals got together and formed the non-profit organization United States Green Building Council (USGBC) to accelerate sustainability in buildings. The first order of business for the fledgling organization was to develop a green building rating system, which was dubbed Leadership in Energy and Environmental Design (LEED).

LEED has undergone many refinements and now offers a family of rating systems that are complementary, more or less, to the core rating system (LEED for New Construction) including Commercial Interiors, Core and Shell, Existing Buildings, LEED for Homes and LEED Canada. Until recently, none of the rating systems explicitly addressed the building envelope and its contribution to a building's sustainability. The first such attempt to recognize this within LEED can be found in LEED Canada and LEED for Homes, both of which include a credit for building durability.

LEED Canada's Materials and Resources Credit 8 – Durable Building requires building designers to develop a Building Durability Plan to ensure that the predicted service life of the building and its components exceeds the design service life. The credit draws from Canadian document CSA S478 – Guideline on Durability in Buildings to establish requirements and minimum benchmarks to achieve the single point available for this credit.

In satisfying the requirements for this credit, the designer is asked to establish a Design Service Life from Table 2 in the Guideline. Except for temporary buildings and parking structures, Table 2 requires that all buildings be designed for a service life in the range of 50-99 years. A project team is required to demonstrate that the building has been designed to achieve the established service life by “documenting effectiveness, modeling, or testing in accordance with Clauses 7.3, 7.4, and 7.5 of CSA S478” and by completing several tables within the Guideline. The Guideline is vague about what one must do in satisfying the established requirements in the credit. The tables require a team to provide a wide range of information such as name and location of building, structural and “other” systems used, indoor and outdoor temperatures, wind speed, precipitation, and soil type. The tables also require a team to establish the design service life of individual building components and assemblies such as footings, walls, roofing, windows, doors, walks, and decks. And finally, the team is required to establish a maintenance summary of every building component and assembly consisting of a failure categorization, remedial maintenance required (repair or replacement) and frequency of stated requirement and cost.

To get the point for this credit, the design professional is required to sign a LEED Letter Template declaring that “a Building Durability Plan has been developed and implemented.” This has caused a great deal of consternation among building design professionals and insurance companies, for the simple reason that there is no way to ensure a building's durability by developing and implementing a “durability plan” as outlined in the Guideline. In recognition of this problem, LEED Canada established a Durable Building Task Force which re-evaluated the credit and made several recommendations, among them the following:

- Immediate clarification that the credit does not ensure building durability, but that the building has been designed to be durable.
- CSA be asked to “update” the guideline and that more cladding systems be added.
- Requirement be added that building insurance policies contain no exclusionary language with regard to coverage for mold or building envelope (leaks) issues.

A similar building durability credit has been introduced in LEED for Homes, currently in the pilot stage. The credit language has undergone several revisions since first introduced. Under the current version builders are required to complete a Durability Evaluation, implement a handful of prescriptive moisture control strategies (non-paper faced tile backer board at tubs and showers, for example), and develop a “quality management program” during construction to ensure durability strategies were implemented. Points are available only upon the builder’s completion of a Durability Checklist and a third party Durability Inspection, which requires a third party provider to verify implementation of listed strategies.

The checklist in the LEED for Homes credit is very similar to the tables found in CSA S478. Once all the information is filled out, it is at the discretion of the builder or designer to establish strategies for “issues” that appear on the checklist. The builder is also required to sign a declaration affirming that the builder’s “quality management program” was enhanced to address issues identified as “moderate” or “high” risk. It is unclear what these risks are, and how they are categorized.

According to Survey on Actual Service Lives for North American Buildings, a paper by Jennifer O’Connor, Research Scientist for Forintek Canada Corp., service lives of most buildings are probably far shorter than their theoretical maximum lives. The paper surveyed 227 buildings demolished from 2002-2003 in the city of Minneapolis/St Paul, MN. Of these, 105 were non-residential with structural systems of wood, steel and concrete, and a wide variety of cladding and fenestration systems. The vast majority of buildings in the survey fell into just three categories of reasons for demolition: area redevelopment (34%), lack of maintenance (24%), and building no longer suitable for intended use (22%). Of the non-residential buildings, more than half were demolished within 50 years. Wood buildings in the study had the longest life spans, the majority having survived for more than 75 years. More than half of all the demolished concrete buildings fell into the 26-50 year category. The paper concludes that the assumption that designing for durability is an environmental imperative is unsupported in the absence of life cycle assessment and accurate lifespan predictions. It suggests that: “Rather than attempt to predict the future and design permanent structures with an infinite lifespan, we are probably better off in acknowledging our inability to make such predictions and instead design for easy adaptation and material recovery.”

A 2004 paper entitled Keeping Walls Dry, by Dale Kerr P. Eng opens with: “Water is the most significant factor in the deterioration of buildings.” His paper refers to several Canadian studies commissioned by Canada Mortgage and Housing Corporation (CMHC) over the past decade that examine common causes of building failures. Contributing factors to moisture problems in buildings are reported as being lack of sufficient detailing, lack of inspection during construction, and lack of understanding of basic building science. The paper states that 90 percent of the problems investigated in the largest of the studies were related to interface details between wall components and penetrations and only 10 percent were related to the basic wall assembly. The paper includes a table that itemizes in more detail the exact causes of these failures, which can be distilled down three things: the complete absence of sealant joints, poor flashing, and poor installation. Unfortunately, there is no statistic offered showing what the percentage is of buildings without significant leakage problems versus otherwise.

Conclusion

In light of the information presented by O’Connor and Kerr, it is evident that strict adherence to the LEED durable buildings credit requirements will do very little to ensure a building’s

durability, something acknowledged by LEED (the first LEED Task Force recommendation). The papers also bring into question what the definition of durability should be in the context of a green building rating system. The credits have the beginnings of what are the most important aspects for durable buildings during design and construction: 1.) correct detailing and 2.) inspection and testing during construction. To effectively address this, consensus-based standards and guidelines need to be incorporated directly and explicitly into the credit requirements. Designing metal flashings in accordance with SMACNA Architectural Sheet Metal Manual, installing vapor retarders under slabs on grade in accordance with ASTM E1745, and requiring inspection in accordance with NIBS Guideline 3-2006 Annex M.2 for Joint Sealants Checklist are examples of the things that these credits must include to be meaningful and effective.

Giving points away for describing the project's micro climate, "enhancing" a quality management program, and arbitrarily establishing "quality control" strategies are not likely to have any real impact on a building's durability.

The third, and most important determinant of a building's durability, is building maintenance. Even the best designed, tested, inspected, and installed buildings will not last very long if they are not maintained well. O'Connor's paper found that 24% of the buildings were demolished due to lack of maintenance. O'Connor also observes that there is little evidence to support a commonly held perception that types of building materials are good indicators of a building's overall durability. In fact, she found that wood framed buildings had an average life span much greater than those built of concrete and steel. There are numerous examples of wood framed and clad buildings that have survived for centuries, Scandinavian stave churches among the longest lived, many of them centuries old.

The obvious place to address building maintenance within the LEED family of green building rating systems would be LEED for Existing Buildings, but currently there is nothing in LEED EB that does this. In addition to specific, meaningful durable building requirements needed in the LEED rating systems that focus on design and construction, LEED EB could be greatly improved by incorporating post construction building maintenance requirements.