Capturing Points for Whole Building LCA in LEED v4

By Frances Yang, S.E., LEED AP

Structural engineers have an unprecedented opportunity to contribute to green building certification. Within the green building practice, the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) rating system has set a precedent for green building standards and codes such as the IgCC, ICC 700, CALGreen and ASHRAE 189.1. The latest version of LEED v4, released in 2012, awards a total of 3 points for performing whole building life-cycle assessment and specifically limits the assessment to structure and enclosure to encourage participation from structural engineers. The LCA Working Group of the SEI Sustainability Committee has found that approximately 50% of the embodied impacts from structure and enclosure typically come from structure. Thus, structural engineers have an enormous opportunity to contribute to attaining the environmental impact reductions prescribed in green building rating systems and standards, when compared to a "reference building."

The LEED v4 credit requires showing a 10% improvement in environmental impacts compared to a "reference building," using whole building life-cycle assessment (WBLCA) tools that are now readily available. This is comparable to the performance options in the other green building standards, and the approach is similar to using energy modeling to demonstrate energy performance improvements. However, existing standards and guides do not provide enough specifics about the structural system and materials within the "reference building," which could allow designers to construct an unrealistic reference and unfair reward in the rating systems.

This situation could fail to encourage the meaningful contribution structural engineers might make towards reducing real environmental impacts of our building structures. Thus, the Structural Engineering Institute's Sustainability Committee, with support from an ASCE Special Project grant, is working to produce a guide to bridge the gap and ensure a nominal level of integrity in comparing structural designs using WBLCA.

The guide, titled *Guide to Definition of the Reference Building Structure and Strategies in Whole Building Life Cycle Assessment*, serves as a pre-standard for use by the project team to define and model the structural system within the "reference building design," as required by green building standards and rating systems when performing comparative WBLCA. Not to be confused with WBLCA primers, the scope of the document is limited to:

- Definition of the "reference building design."
- Design and construction choices within the influence of the structural engineer.
- Discussion of the approach to constructing the reference building design influenced by choice of the structural system and materials.

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This guide does not discuss the process of conducting a WBLCA or compare the standards and rating systems prescribing the use of WBLCA, as it assumes the user possesses some basic knowledge of life cycle assessment for whole buildings. If the user needs to establish these fundamentals, appendices of the guide provide several go-to resources, including descriptions of the most popular WBLCA and LCA tools.

The crux of the guide is reflected in its two-part organization. The first part sets out the fundamental concepts to support a defensible reference building. Much of this centers around using the structural design criteria to define the "functional unit," to ensure apples-to-apples comparisons while recognizing special cases when the design criteria should be allowed to differ between the reference and proposed building designs. This first part also offers three logical options to use as starting points: a similar existing building, an earlier iteration of the structural system for the same building, and a building archetype.

The second part describes specific strategies for the reference building a structural engineer may choose to employ for reducing life cycle impacts on a project, including:

- Structural Material Quantity Reduction
- Structure as Finish
- Performance-Based Design for Material Damage Reduction
- Using Alternate Structural Systems
- Low-cement Concrete
- Sourcing Salvaged Materials
- Design for Deconstruction
- Contributing to Operational Energy Savings

These strategies are not inclusive of all possible strategies but, instead, they are the strategies the authors deemed most common or effective and also most relevant to the role of the structural engineer.

WBLCA is a relatively new application of life cycle assessment (LCA). Because LCA has primarily been used for mass-produced products, applying the principals and method to buildings – which are for the most part one-off creations – has some challenges. While this guide addresses some of these challenges, the authors acknowledge that the guidance offered is preliminary and will continue to improve as the field of WBLCA grows and matures with its users, as well as through feedback directed to the SEI Sustainability Committee.

This guide represents a milestone in structural sustainability and, through ASCE's support, structural engineers can now more readily embrace the call from green building programs to have a more active and meaningful role in reducing environmental impacts of our built environment.▪

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