The Whole Enchilada

BY GEOFF WEISENBERGER

Assessing a material's environmental footprint means looking at its entire lifespan.

THE GREEN BUILDINGS MOVEMENT is by no means fully mature. One good way to describe the current status of its evolution is to say that it is moving from childhood into adolescence.

Another way to put it is this: The way we rate or judge green buildings is moving from a prescriptive to an analytical approach. The movement is progressing from rating systems to standards and potential codes (more on this in future columns). It also is progressing from assessing the sustainable aspects of products or solutions based on a single characteristic to a more comprehensive evaluation of multiple product characteristics embracing the entire life cycle of the product from raw material acquisition through manufacturing, installation and deconstruction. Even LEED, which is itself a rating system, is moving in this direction, with the establishment of a pilot program to encourage implementation of LCAs.

What's an LCA? The acronym stands for life-cycle assessment (or analysis), and it involves two more similar acronyms, LCI and LCIA, which stand for life-cycle inventory and life-cycle impact assessment.

In a nutshell, LCAs quantify the environmental impact of a product like, say, structural steel. They are especially useful when it comes to building materials because unlike ongoing building systems, once building materials are installed their environmental footprint is established. Secondary impacts on buidling operations, such as thermal mass and thermal bridging typically are treated as part of the building system. (Note, thermal bridging issues are discussed in "Steel Framing & Building Envelopes" in the January 2010 *MSC*).

Here's how it works: At the beginning of an LCA, a functional unit is determined; in terms of steel, one ton is an appropriate functional unit. Next, the LCI is performed, based on the functional unit. Basically an environmental inventory of the product, it provides the inputs and outputs of making the product. In the case of one ton of steel, could also include the other links in the steel supply chain, as applicable (fabrication, erection, galvanizing, bending/rolling, etc.). Inputs would include materials, energy and water to make the steel, and outputs would include CO_2 and other greenhouse gasses, solid waste, and water emitted in the process.

Lastly, the LCIA essentially assigns a "value," in terms of environmental impact, to a material, based on the data collected from the LCI. From here, you can determine the product's impact on the environment in categories such as global warming, acid rain, eutrophication, and pollution potential, as well as primary energy demand.

One thing to keep in mind about the current generation of LCAs: most are created by LCA *estimators*. In the case of steel, it will vary based on things like geographic location of a mill and distance between all links in the supply chain (including material extraction/sourcing) and job site; which LCA estimator is used; length of life-cycle—i.e., are you only following the product through to the job site, or are you following it all the way through building deconstruction and product disposal/recycling—and most importantly the accuracy of the base data being used by the LCA estimator of choice.

In other words, LCAs are not an exact science. But they can provide a general picture of a building material's environmental footprint. And when the same criteria and methodology are applied, they can give a good idea of how materials compare.

As a matter of fact, AISC is finishing up its own LCA study, being conducted by the engineering firm of HDR and Five Winds/PE Americas, a consulting firm specializing in LCAs. The study compares two actual medical office buildings in the same geographic area, one framed in steel and the other in concrete. The goal was to determine the relative environmental impact of the two systems on a square-footage basis (because the two buildings, while of the same type, have different square footages and heights).

The study includes the upstream processing and production of materials that make up the core and shell of a building, transport of these materials to the construction site, construction of the building core and shell, and end-of-life treatment of all waste products, including the core and shell of the building after its use. It focuses on the structural frame only and does not include the building roofing, siding, HVAC systems, or any interior furnishings (which could be identical for both buildings). The final details of the study are coming together now and should be available in coming months, but a preliminary report from HDR states:

"Although final verification of all parameters is not yet complete, the preliminary results indicate that in all the environmental impact areas investigated (global warming potential, energy demand from non-renewable resources, eutrophication potential, acidification potential, smog potential, and primary energy demand), the steel building scores better in terms of lower environmental impacts than the concrete building."

Clearly, designing and constructing with structural steel is advantageous in accomplishing the goals of sustainable, green buildlings. Expect a full report later this year in *Modern Steel Construction* on the completed study. MSC

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