The materials used in a high-performance green building should be carefully selected to reduce negative impacts on the environment (photo: Timothy Hursley).

Choosing Materials Wisely

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Section 9 in Standard 189.1 addresses the building's impact on the atmosphere, materials, and resources. Building material choices can have widespread impacts on the atmosphere and natural resources from the origin of the material components to the end of a product's useful life. The activities associated with these choices may contribute to pollution, habitat destruction, natural resource depletion and unnecessary growth of landfills.

A high-performance green building must consider these impacts in addition to the functional and economic drivers of material selection.

Mandatory Requirements

The mandatory requirements of Section 9 address four issues: (1) the management of construction waste; (2) the origin of building materials and products; (3) the selection of refrigerants and (4) the storage and collection of recyclables and discarded goods.

According to the EPA, building-related construction and demolition debris accounts for nearly 26% of non-industrial waste in the U.S. Standard 189.1 addresses the minimization and the diversion through recycling and reuse of waste generated on a construction site.

Waste minimization on sites with less than 5% existing buildings, structures, and hardscape is accomplished by limiting the total waste generated on a construction site, no matter how it is diverted or disposed of, to either 42 cubic yards or 12,000 lbs (32 cubic meters or 5443 kg) for every 10,000 ft^2 (929 m^2) of new building floor area. Waste diversion requires the tracking of construction and demolition waste generated on the project site and verifying that a minimum of 50% of that waste is either recycled or reused throughout the construction process. Tracking may be measured by either weight or volume and excludes hazardous materials, soil and land-clearing debris. The waste

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Left: Crushing concrete for reuse (photo: CTLGroup). Right: On-site collection of construction materials for recycling (photo: GSA).

Section 9:

The Building's Impact on the Atmosphere, Materials, and Resources

Building material choices can have widespread impacts on the atmosphere and natural resources from the origin of the material components to the end of a product's useful life.

can be stored and sorted either on the construction site or at a remote location.

Materials and products used in the construction of the project are required to meet all laws and regulations of the laws of the country in which they were harvested, extracted, recovered and manufactured. New wood products in the project are not to contain wood from endangered wood species unless the trade of that wood conforms with the requirements of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Refrigerants can contribute to ozone depletion, global warming and other environmental factors. Standard 189.1 prohibits CFC-based refrigerants in HVAC and refrigeration systems. In addition, ozone depleting substances are not permitted in fire suppression systems.

The final mandatory provision provides for the reuse and recycling of materials during the operational phase of the building. A dedicated space will be designed into the structure and reserved for the collection and storage of recyclable materials that are not hazardous. The physical size of this space is determined by the building designer based on anticipated waste generation levels and the frequency of collection of these materials. The intent is that recyclables will be picked up or removed from the premises on a regular basis.

An additional area will be set aside for the collection of fluorescent and HID lamps and ballasts complying with state and local hazardous waste requirements. Many municipalities now identify drop-off points for used fluorescent bulbs. In residential structures space will be set aside for the collection of items in good condition that can be reused or collected by local agencies such as Goodwill or the Salvation Army.

Reducing the Impact of Materials

In addition to the mandatory requirements mentioned previously, either the prescriptive or performance compliance path must be followed to address the impact that building materials have on the environment and the consumption of natural resources.

The prescriptive compliance path addresses familiar, readily quantifiable characteristics of materials used in the construction of the building and requires compliance with one of three criteria: recycled content, regional materials, and biobased products. Unlike the LEED rating system where all components of mechanical, electrical, plumbing, fire safety systems and transportation devices are excluded, Standard 189.1 includes the piping, plumbing fixtures, ductwork, conduit, wiring, cabling and elevator and escalator framing components of those systems. Each of the

Preparing steel scrap for recycling (photo: American Institute of Steel Construction).

three criteria is measured on a cost basis against the total cost of applicable materials in the building. The total cost of these materials can either be specifically calculated or a value equal to 45% of the overall construction cost can be used.

Recycled Content. The first criterion addresses the use of recycled content materials, which are materials that contain waste products that would otherwise be disposed. The recycled content of specific products is calculated on the basis of weight with recycled materials recovered on a preconsumer basis counting half as much. The resulting recycled

content value is then multiplied by the cost of the product to determine the contribution of the product to the overall recycled content of the project. To meet this criterion, the sum of the contribution of the various materials and products must be 10% or greater of the total building materials cost.

The recycled content of domestic steel products may be calculated based on the published recycled content of products produced through either an electric arc furnace or a basic oxygen furnace. This information is available from industry associations. The recycled content of concrete may be calculated either as a single product or by the separate contributions of its component parts of cementitious material, aggregate (sand, gravel, and crushed stone) and water.

Regional Materials. The second criterion through which a project can comply with the prescriptive option reduces emissions associated with transportation and supports local economies through the extraction, harvesting, recovery or manufacturing of materials near the project. To satisfy this criterion at least 15% of the construction materials and products used in the building, based on cost, must be extracted, harvested, recovered or manufactured within 500 miles of the project site. Just as with the calculation of recycled content, only that portion of a material or product that meets this requirement contributes to the calculation of the overall percentage of regional materials. Provision is made in the standard to recognize inherently more efficient means of transportation by assessing the distance traveled for materials moving by rail or water at a rate of 25% of the actual travel distance.

Biobased Products. The third criterion for fulfilling the prescriptive option recognizes the environmental value of products with biobased content such as wood, bamboo, wool, cotton, cork, agricultural fibers or other biobased materials with at least 50% biobased content. Alternatively, materials can qualify as biobased by complying with the USDA's designation of Biobased Items for Federal Procurement or containing the "USDA Certified Biobased Product" label. A minimum of 5% of the overall material cost must be biobased products.

Wood building products for this requirement must contain a minimum of 60% certified wood content which has been tracked through a chain-of-custody process documented on a percentage or physical separation basis. Documentation must be provided by sources certified through a forest certification system developed in compliance with ISO/IEC Guide 59 or the WTO Technical Barriers to Trade. In North America, wood certified through the Canadian Standards Association (CSA), the Forest Stewardship Council (FSC), the Sustainable

Measuring Material Impacts

Concrete

Although cement is only 7% to 15% of the material in concrete, by weight, it is a fired material with significantly more environmental impacts than sand, gravel, or water. Supplementary cementitious materials such as a fly ash, slag cement, and silica fume are recovered from other industrial processes. When used as a replacement for a portion of the cement in concrete, these materials can reduce significantly the environmental impact of concrete.

Steel

All structural steel produced in the United States used in the building process originates in electric arc furnaces. The recycled content of this steel typically exceeds 90%. Steel produced in electric arc furnaces uses one-third of the amount of energy with one-third of the carbon footprint as steel produced in basic oxygen furnaces. If the production process is not known and the material is of domestic origin, then the lower recycled value (typically that of the basic oxygen furnace process) is to be used for calculating recycled content.

Wood

Chain-of-custody is an accounting system process that tracks wood fiber through the different stages of production. Standard 189.1 recognizes two approaches to meeting this requirement.

- Physical separation approach: this is the only time a company can make a claim on the product that 100% of their fiber came from a certified forest.
- Percentage-based approaches:
  - Volume credit method: used when the company wants to sell a portion of their product under a chain-of-custody claim. For example, if the company knows 60% of their supply comes from a certified forest, they can make claims on 60% of the output.
  - Average percentage method: used when a company wants to label 100% of their output under a chain-of-custody claim.

Proper documentation can include a copy of a certificate or an on-product label from one of the certification programs, or other forms of documentation where a chain-of-custody number is disclosed and the certification program is identified.

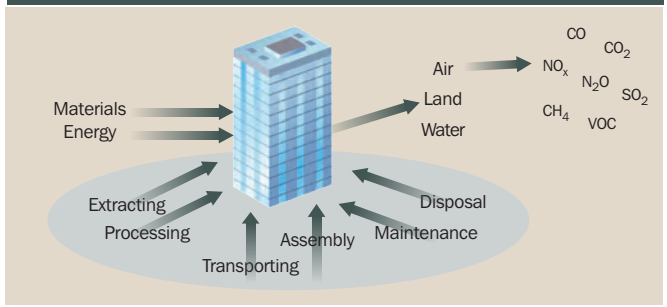
Forestry Initiative (SFI), and the American Tree Farm System (ATFS) have the potential to meet these requirements. Vendor-provided wood building components are allowed to comply when the average annual amount of properly documented certified wood products purchased by the vendor exceeds 60%.

Performance Option: Life-Cycle Assessment

As an alternative to the prescriptive path outlined earlier, a performance path is available, which considers broader environmental attributes rather than a single characteristic. The performance path is met through performing a life-cycle assessment (LCA) on a base building and the proposed project building. The LCA must be performed in accordance to ISO Standard 14044. The proposed project building is required to show at least a 5% improvement in two of eight impact categories required for the analysis. The LCA is allowed to include the energy use over the life of the building, specified as 75 years for most buildings; however, the energy use does not need to be included.

An LCA is a complex process requiring computer software and analysis. After defining the boundary conditions in an LCA, the next step is a life-cycle inventory (LCI). This is an accounting of the materials and energy (inputs) consumed for all of the assemblies and components of a building, and the emissions to air and water and solid wastes (outputs) that result. The process includes these inputs and outputs for extraction of raw materials and fuel sources, through manufacturing and transporting of components, construction, repair and replacement, and finally, deconstruction, demolition, recycling, reuse, and ultimate disposal. Once the LCI has been calculated, then simulation programs are available that calculate the environmental impacts for the building. Standard 189.1 requires that, at a minimum, the following impacts categories are included: land use (or habitat alteration), resource use, climate change, ozone layer depletion, human health effects, ecotoxicity, smog, acidification, and eutrophication.

Simplified illustration of a life-cycle inventory (LCI) for a building.



Summary

Section 9 of Standard 189.1 addresses available green building strategies that will lessen the building's impact on the environment including the atmosphere, materials and resources. It includes mandatory provisions for construction waste, legal requirements of the materials' country of origin, refrigerants, and the collection of recyclables and discarded goods. In addition, building materials must also comply with a prescriptive path for recycled content, regional materials, or biobased content; or the performance path for a comprehensive LCA. ■