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Photo courtesy of Construction Technology Laboratories, Skokie, Ill.

Pervious concrete pavement can be used to manage storm-water runoff.

Concrete and LEED points

Concrete Can Play a Role in Green Building

By Martha VanGeem and Medgar Marceau

Concrete is among the most common of building materials and is used in some form and to some extent in virtually every construction project. The mixture of cementitious materials, aggregates, water and additives goes into pavements, pipelines, foundations, structural frames, floors, walls and roofs. As such, its environmental friendliness and energy performance have important effects on any sustainable design.

Like every building product, concrete imposes some environmental costs. Cement manufacturing involves heating raw materials to 3,400 F (1871 C) in kilns, which consumes fuel and generates some carbon dioxide emissions. Since the 1970s, however, the industry has worked to increase fuel efficiency while sharply reducing emissions. These environmental effects are offset by concrete's many beneficial and earth-friendly properties, which are recognized in the U.S. Green Building Council's (USGBC's) Leadership in Energy and Environmental Design- (LEED-) NC Rating System,TM Version 2.1.

The LEED rating system has five main categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. Each category is divided into credits; credits are broken into individual points. (Detailed information about the LEED program is available on USGBC's Web site, www.usgbc.org.)

Concrete and cement can earn points under the following portions of LEED:

Sustainable Sites

Brownfield Redevelopment (One Point) Cement can be used to solidify and stabilize contaminated soils and reduce leaching concentrations to below regulatory levels.

Storm-water Management: Rate and Quantity (One Point) This credit's intent is to limit the disruption and pollution of natural water flows by managing storm-water runoff. Pervious concrete pavements reduce storm-water runoff by increasing its infiltration. Pervious concrete contains coarse aggregate, little or no fine aggregate, large voids between aggregate and is permeable enough to allow water to flow through easily. Similar results can be achieved by using concrete pavers that have openings through which vegetation can grow.

Landscape and Exterior Design to Reduce Heat Islands (One Point) Using concrete rather than asphalt for 30 percent of all sidewalks, parking lots, drives and other impervious surfaces can meet this requirement by providing a light-colored, high-albedo surface that reflects solar heat gain. This step will improve air quality and reduce the urban heat-island effect, which saves energy by reducing the demand for air conditioning.



Use of light-colored, high-albedo concrete pavements at this Chicago branch library earned one LEED point for reducing the urban heat-island effect.



Insulating concrete forms prevent dirt and dust from infiltrating this Southwestern home.



Existing concrete crushed for reuse as aggregate qualifies as post-consumer recycled material.

Energy and Atmosphere

Minimum Energy Performance (Required, Zero Points) The LEED minimum requires all buildings to meet ASHRAE/IESNA 90.1-1999 or local codes if they are more stringent. ASHRAE requirements are cost-effective and not particularly stringent for concrete; insulating to meet or exceed them generally is a wise business choice.

Concrete components generally are considered "mass." This means the components have enough heat-storage capacity to moderate daily temperature swings. Buildings constructed of cast-in-place, tilt-up and precast concrete; insulating concrete forms; and masonry possess thermal mass that moderates indoor temperature extremes and reduces peak heating and cooling loads.

In many climates, these buildings have lower energy consumption than nonmassive buildings with walls of similar thermal resistance, and heating, ventilating and air-conditioning can be met with smaller-capacity equipment.

Optimize Energy Performance (One Point to 10 Points) This credit is allowed if energy cost savings can be shown compared with a base building that meets the requirements of ASHRAE 90.1-1999. When considering concrete, a program like DOE-2 calculates yearly energy use on an hourly basis. Such programs are needed to capture concrete's beneficial thermal-mass effects. Insulated concrete systems, used with other energy-saving measures, likely will be eligible for points. The number of points will depend on the building, climate, fuel costs and minimum standard requirements. One to 10 points are awarded for energy cost savings of 15 percent to 60 percent for new buildings and 5 percent to 50 percent for existing buildings.

Materials and Resources

Building Reuse (One Point or Two Points) This credit encourages leaving most of a building's shell in place when renovating. The building shell

includes the exterior skin and framing but not window assemblies, interior walls, floor coverings and ceiling systems. Because concrete in buildings generally has a long life, this credit should be attainable when renovating buildings with a concrete skin. Leaving 75 percent of the existing structure's shell in place earns one point; leaving 100 percent of the shell in place earns two points.

Construction-waste Management (One Point or Two Points) This credit encourages the diversion of construction, demolition and land-clearing waste from landfill disposal. It is awarded for diverting at least 50 percent by weight of these materials. This credit typically can be attained when concrete buildings are demolished because concrete is a relatively heavy material that often is crushed and reused as aggregate or construction fill. One point is earned for salvaging or recycling 50 percent of the waste; two points are earned for salvaging or recycling 75 percent.

Recycled Content (One Point or Two Points) This credit encourages the use of post-consumer and/or postindustrial recycled content materials. Recycled concrete used as aggregate instead of newly extracted material qualifies as post-consumer. Supplementary cementitious materials, such as fly ash, silica fume and slag cement, are considered postindustrial. Furthermore, most reinforcing bars are manufactured from recycled steel. In LEED, however, reinforcement is not considered part of concrete and should be handled as a separate item. To attain these points, the entire building's recycled content is considered.

Local and Regional Materials (One Point or Two Points) This credit requires at least 20 percent of building materials to be manufactured within 500 miles (805 km) of the site. This means concrete from a ready-mix or precast plant within 500 miles (805 km) of a building would qualify. Concrete typically does qualify because ready-mix plants generally are within 50 miles (81 km) of most urban areas. The percentage of materials is calculated on a cost basis. This credit is worth one point.

An additional point can be earned if 50 percent of the regionally manufactured materials are

Top and bottom photos courtesy of Construction Technology Laboratories, Skokie, Ill.
Middle photo courtesy of American Polysteel LLC, Albuquerque, N.M.



During the final stages of construction, the Gainesville Technology Enterprise Center, Gainesville, Fla., was in the path of a tornado. Although a 50-foot (15-m) tree fell on the building, its insulating-concrete-form frame suffered no damage.



Insulating concrete forms possess thermal mass that moderates indoor temperature extremes and reduces peak heating and cooling loads.



The Conservation Education Center at Rosamond Gifford Zoo, Syracuse, N.Y., features an insulating-concrete-form poured wall, which eliminates additional fiber insulation.

Photos courtesy of American Polysteel LLC, Albuquerque.

extracted, harvested or recovered within 500 miles (805 km). Ready-mix and precast plants generally use aggregates extracted within 50 miles (81 km) of the plant. Cementitious materials also usually are manufactured within 500 miles (805 km) of a job-site.

Other Points

One point is given if a project team's principal participant is a LEED-accredited professional. LEED-accredited professionals in the concrete industry are available to help maximize points for concrete.

In addition, four points are available under Innovation and Design Process. These points can be sought if an innovative green design strategy is used that does not fit into the five LEED categories or goes significantly beyond a credit requirement. 🌱

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To Learn More

The Environmental Council of Concrete Organizations has produced a variety of publications and presentations about concrete's environmental performances. For more information, visit its Web site, www.ecco.org, or call 800-994-3226.