information

LEED Green Building Rating System and Concrete

ENVIRONMENTAL
COUNCIL *of* CONCRETE
ORGANIZATIONS

5420 Old Orchard Road
Skokie, Illinois
60077-1083
800.994.ECCO (3226)
FAX 847.966.8389
www.ecco.org

Using concrete can facilitate the process of obtaining LEED™ Green Building certification. Leadership in Energy and Environmental Design (LEED) is a point rating system devised by the United States Green Building Council (USGBC) to evaluate the environmental performance of a building. The system is credit-based, allowing projects to earn points for environmentally friendly actions taken during the building process.

LEED was launched in an effort by the USGBC to develop a "consensus-based, market-driven rating system to accelerate the development and implementation of green building practices." The program is not rigidly structured, i.e., not every project must meet identical requirements to qualify.

The LEED rating system has five main credit categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality. Each category is divided into credits. Detailed information on the LEED program and project certification process is available on the USGBC website, www.usgbc.org. The program outlines the intent, requirements, technologies, and strategies for meeting each credit. Credits are broken down into individual points. Additional points can be earned for innovation and use of a LEED-accredited professional on the project team.

Sustainable Sites Credit 6.1. Water flows freely through a section of pervious pavement.

Points for Certification

A building requires at least 26 points for certification. Silver, gold, and platinum levels are also available.

Credit Category	*Points Available*
Sustainable Sites	14
Water Efficiency	5
Energy and Atmosphere	17
Materials and Resources	13
Indoor Environmental Quality	15
Total Core Points	**64**
Innovation and Design Process	5

LEED Certification Levels	
Certified	26 - 32 Points
Silver	33 - 38 Points
Gold	39 - 51 Points
Platinum	52+ Points

Concrete and LEED

The following are suggestions for earning LEED points through the use of cement and concrete products. The paragraph headings below correspond to the credit categories and the credit numbers in the LEED rating system.

Brownfield Redevelopment (Sustainable Sites Credit 3). Cement can be used to solidify and stabilize contaminated soils and reduce leaching concentrations to below regulatory levels. Documentation is required indicating the site was contaminated and the remediation performed. This credit is worth 1 point.

Stormwater Management: Rate and Quantity (Sustainable Sites Credit 6.1). The intent of this credit is to limit disruption and pollution of natural water flows by managing storm water runoff. Using pervious concrete pavements will reduce the rate and quantity of storm water runoff because they increase infiltration of stormwater. Pervious concrete contains coarse aggregate, little or no fine aggregate, and insufficient cement paste to fill the voids between the coarse aggregate. It results in concrete with a high volume of voids (20% to 35%) and a high permeability that allows water to flow through easily. Similar results can be achieved by using concrete pavers that have large voids where vegetation can grow. This credit is worth 1 point.

Landscape and Exterior Design to Reduce Heat Islands (Sustainable Sites Credit 7.1). "…[U]se light-colored/high-albedo materials (reflectance of at least 0.3) for 30% of the site's non-roof impervious surfaces." This requirement can be met by using portland cement concrete rather than asphalt concrete for 30% of all sidewalks, parking lots, drives and other impervious surfaces.

Albedo, which in this context is synonymous with solar reflectance, is the ratio of the amount of solar radiation reflected from a material to the amount that shines on the material. Solar radiation includes the ultraviolet as well as the visible spectrum. Generally, light-colored surfaces have a high albedo, but this is not always the case. Surfaces with lower albedos absorb more solar radiation. The absorbed radiation is converted into heat and the surface gets hotter. Where paved surfaces are required, using materials with higher albedos will reduce the heat island effect—consequently saving energy by reducing the demand for air conditioning—and improve air quality.

Portland cement concrete generally has a reflectance of approximately 0.35, although it can vary. Measured values are reported in the range of 0.4 to 0.5. For "white" portland cement, values are reported in the range of 0.7 to 0.8. New asphalt concrete generally has a reflectance of approximately 0.05, and asphalt concrete five or more years old has a reflectance of approximately 0.10 to 0.15. This credit is worth 1 point.

Minimum Energy Performance (Energy and Atmosphere Prerequisite 2). All buildings must "meet building energy efficiency and performance as required by the ANSI/ASHRAE/IESNA 90.1-1999 or the local energy code, whichever is the more stringent." The ASHRAE standard is usually more stringent and applies for most states. The requirements of the ASHRAE standard are cost-effective and not particularly stringent for concrete. Insulating to meet or exceed the requirements of the standard is generally a wise business choice. Determining compliance for the envelope components is relatively straightforward using the tables in Appendix B of the ASHRAE standard. Minimum requirements are provided for mass and non-mass components such as walls and floors.

Components constructed of concrete 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, precast concrete, insulating concrete forms (ICF), or masonry possess thermal mass which helps moderate indoor temperature extremes

and reduces peak heating and cooling loads. In many climates, these buildings have lower energy consumption than non-massive buildings with walls of similar thermal resistance; and heating, ventilating, and air-conditioning can be met with smaller-capacity equipment. This item is required and is not worth any points.

Optimize Energy Performance (Energy Credit 1). This credit is allowed if energy cost savings can be shown compared to a base building that meets the requirements of ANSI/ASHRAE/IESNA 90.1-1999. The method of determining energy cost savings must meet the requirements of Section 11 of the standard.

Many engineering consulting firms have the capability to model a building to determine energy savings as required using a computer-based program such as DOE2. When concrete is considered, it is important to use a program like DOE2 that calculates yearly energy use on an hourly basis. Such programs are needed to capture the beneficial thermal mass effects of concrete. Insulated concrete systems, used in conjunction with other energy savings measures, will most likely be eligible for points. The number of points awarded will depend on the building, climate, fuel costs, and minimum requirements of the standard. From 1 to 10 points are awarded for energy cost savings of 15% to 60% for new buildings and 5% to 50% for existing buildings.

Building Reuse (Materials Credit 1). The purpose of this credit is to leave the main portion of the building structure and shell in place when renovating. The building shell includes the exterior skin and framing but excludes window assemblies, interior walls, floor coverings, and ceiling systems. This credit should be obtainable when renovating buildings with a concrete skin, since concrete in buildings generally has a long life. This is worth 1 point if 75% of the existing building structure/shell is left in place and 2 points if 100% is left in place.

Construction Waste Management (Materials Credit 2). This credit is extended for diverting construction, demolition, and land clearing waste from landfill disposal. It is awarded based on diverting at least 50% by weight of the above listed materials. Since concrete is a relatively heavy construction material and is frequently crushed and recycled into aggregate for road bases or construction fill, this credit should be obtainable when concrete buildings are demolished. This credit is worth 1 point if 50% of the construction, demolition, and land clearing waste is recycled or salvaged and 2 points for 75%.

Material Credit 2. The picture shows machinery taking portions of concrete walls, columns, and floors and crushing them to be used as fill material.

For concrete, either the credit for building reuse or the credit for construction wastemanagement can be applied for, but not both, because the concrete structure is either reused or recycled into another use.

Recycled Content (Materials Credit 4). The requirements of this credit state: "use materials with recycled content such that post-consumer recycled content constitutes at least 5% of the total value of the materials in the project OR combined post-consumer and one-half of the post-industrial recycled content constitutes at least 10%." The percentage is determined by multiplying the cost of an item by the percent of recycled materials—on a mass basis—that make up that item. Supplementary cementitious materials, such as fly ash, silica fume, and slag cement are considered post-industrial. Furthermore, using recycled concrete or slag as aggregate instead of extracted aggregates would qualify as post-consumer. Although most reinforcing bars are manufactured from recycled steel, in LEED, reinforcing is not considered part of concrete. Reinforcing material should be considered as a separate item. This credit is worth 1 point for the quantities quoted above and 2 points for an additional 5% post-consumer recycled content OR an additional 10% combined post-consumer and one-half post-industrial recycled content.

Points must be documented according to LEED procedures in order to be earned. The USGBC website, www.usgbc.org, contains a downloadable "letter template" that greatly simplifies the documentation requirements for LEED version 2.1.

Using concrete can increase the number of points awarded to a building in the LEED system. The potential available points that can be earned through the use of concrete range from 11 to 21.

Local/Regional Materials (Materials Credit 5). The requirements of this credit state: "Use a minimum of 20% of building materials that are manufactured regionally within a radius of 800 km (500 miles)." This means that a ready-mix or precast plant within 800 km (500 miles) of the building would qualify. Concrete will usually qualify since ready-mix plants are generally within 80 km (50 miles) of a job site. The percentage of materials is calculated on a cost basis. This credit is worth 1 point.

An additional point is earned if 50% of the regionally manufactured materials are extracted, harvested, or recovered within 800 km (500 miles). Ready-mix and precast plants generally use aggregates that are extracted within 80 km (50 miles) of the plant. Cement and supplementary cementitious materials used for buildings are also primarily manufactured within 800 km (500 miles) of a job site. Reinforcing steel is also usually manufactured within 800 km (500 miles) of a job site, and is typically made from recycled materials from the same region.

Others Points

Concrete can also be used to get points indirectly. For example, the Pennsylvania Department of Environmental Protection building in Harrisburg, Pennsylvania is LEED Bronze certified and features a concrete floor with low-VOC sealant. This allowed the building to obtain the Low Emitting Materials credit under Indoor Environmental Quality.
One point is also given if a principal participant of the project team is a LEED Accredited Professional. The concrete industry has LEED-experienced professionals available to help maximize points for concrete.

In addition to the points discussed above, 4 points are available under Innovation Credits. These points can be applied for if an innovative green design strategy is used that does not fit into the point structure of the five LEED categories or if it goes significantly beyond a credit requirement. For example, the USGBC has issued a credit interpretation that allows for an innovation credit if 40% of the cement in concrete is replaced with slag cement or fly ash. However, using fly ash in this higher-than-usual dosage is not common, and special testing for compatibility and concrete properties is required for quality concrete.

Benefits of LEED Certification

LEED certification is a voluntary program; however, obtaining a LEED certification projects a positive environmental image to the community. Additionally, meeting many of the green building practices can result in energy and cost savings over the life of the structure. Other advantages include better indoor air quality and plenty of daylight. Studies have shown that workers in these environments have increased labor productivity, job retention, and days worked. These benefits contribute directly to a company's profits because salaries—which are about ten times higher than rent, utilities, and maintenance combined—are the largest expense for most companies occupying office space. Students in these environments have higher test scores and lower absenteeism.

The following cities and states either provide tax credits or grants for green buildings, or require green building certification for public buildings: Massachusetts, New York, Pennsylvania, Chicago, Los Angeles, Portland, San Diego, San Jose, and Seattle. Conditions vary and the list is growing, so please contact local jurisdictions for details.

The U.S. government is adopting green building programs similar to LEED through the General Services Administration, which owns or leases over 8300 buildings, and the U.S. Army, which has adopted LEED into its Sustainable Project Rating Tool (SPiRiT). Support for green buildings is increasing, so the above list should not be considered complete.

The LEED Green Building Rating System, Version 2.1, promotes environmentally conscious buildings for the improvement of outdoor and indoor building quality and the reduction of waste during the building process. Concrete can be used in conjunction with the LEED program to earn a LEED certification.

The Environmental Council of Concrete Organizations is a coalition dedicated to promoting the environmental benefits of concrete and its role in safe and sustainable construction.

ECCO members are companies, organizations, and individuals affiliated with the concrete industry. Together, they are committed to developing and disseminating information on the environmental benefits of concrete and concrete products.