

Using Ready Mixed Concrete to Construct Green Buildings

The LEED™ Green Building Rating System™ is a point-based system for certifying the level of a building's sustainability. Appropriate use of concrete can help a building earn up to 21 points out of the 26 required for certification. Of these 21, eight are particularly applicable to ready mixed concrete in new construction. Using concrete can help reduce water runoff and urban heat islands. The constituents of concrete can be recycled materials and are usually available locally. These attributes of concrete can help lessen the impact a building has on the natural environment.

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The Leadership in Energy and Environmental Design (LEED) Green Building Rating System is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. (www.USGBC.org). Points are awarded when a specific intent of LEED is met, and a building is LEED-certified if it obtains at least 26 points. The points are grouped into five categories: (i) sustainable sites, (ii) water efficiency, (iii) energy and atmosphere, (iv) materials and resources and (v) indoor environmental quality. Besides the 26 points required for certification, the more points earned, the "greener" the building. Silver, gold and platinum ratings are awarded for at least 33, 39 and 52 points, respectively. For all credits, specific auditing or record keeping requirements must be met.

Sustainability is often defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. A sustainable design can result in reduced project costs and a building that is energy and resource efficient. Energy and water efficient buildings have lower operating costs than conventional buildings: in the range of \$6 to \$16 versus \$19 per m² (\$0.60 to \$1.50 versus \$1.80 per ft²). Lower energy costs translate into smaller capacity requirements for mechanical heating and cooling equipment and lower first costs for such equipment. Effective use of daylighting and passive solar techniques can further reduce heating and cooling costs. Reusing materials, such as demolished concrete for base or fill material, can reduce hauling and landfill costs. If sustainability is an objective at the outset of the design process, the cost of a sustainable building is competitive.

Buildings with daylighting and good indoor air quality—both common features of sustainable buildings—have increased labor productivity, worker retention and days worked. These benefits contribute directly to a company's profits because salaries—which are about 10 times higher than rent, utilities and maintenance combined—are the largest expense for most companies occupying office space. In schools with daylighting and good indoor air quality, students have higher test scores and lower absenteeism.

Many U.S. government agencies require that buildings meet LEED requirements, although they do not necessarily require LEED certification. Some examples include 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). In addition, many municipalities and local government agencies are considering requiring LEED certification for public buildings or tax credits.

The five LEED categories are divided into credits and each credit is further divided into individual points.

Concrete and the LEED Point System

Points for Ready Mixed Concrete in New Construction

Stormwater Management: Rate and Quantity. On building sites where the existing imperviousness is greater than 50 percent, pervious concrete pavements can be used to help reduce the rate and quantity of

storm water runoff. The technical requirement for this credit requires reducing the rate and quantity of stormwater runoff by 25 percent. Pervious concrete contains coarse aggregate (crushed stone or gravel), little or no fine aggregate (sand) and insufficient cement paste to fill the voids between

the coarse aggregate. It results in concrete with a high volume of voids (20-35 percent) and a high permeability that allows water to flow through easily. This credit is worth 1 point.

Heat Island Effect: Non-Roof. One way to attain this credit is to “use light-colored/high-albedo materials (reflectance of at least 0.3) for 30 percent of the site’s non-roof impervious surfaces.” This requirement can be met by using portland cement concrete rather than asphalt concrete for 30 percent of all sidewalks, parking lots, drives and other non-roof impervious surfaces. The city of Chicago is applying for LEED certification using this credit for a public library with concrete pavement and sidewalks. This credit is worth 1 point.



Figure 1. Water flows freely through pervious pavement because it contains an abundance of voids.

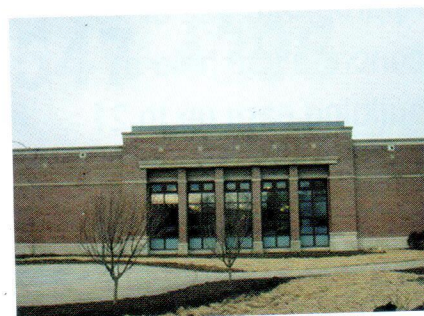


Figure 2. The city of Chicago is applying for LEED certification for this public library with concrete pavement and sidewalks.

Recycled Content. The requirements of this credit state: “Use materials with recycled content such that post-consumer recycled content constitutes at least 5 percent 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 percent.” Supplementary cementitious materials, such as fly ash, silica fume and slag cement used as a partial replacement for portland cement are considered post-industrial. Furthermore, using recycled aggregates instead of extracted aggregates would qualify as post-consumer. The percentage is determined by multiplying the cost of an item by the percent of recycled materials – on a mass basis – that make up the item. This credit is worth 1 point for the quantities quoted above and 2 points for an additional 5 percent post-consumer

recycled content OR an additional 10 percent combined post-consumer and one-half post-industrial recycled content.

Regional Materials. The requirements of this credit state: "Use a minimum of 20 percent of building materials and products that are manufactured regionally within a radius of 500 miles (800 km)." Concrete will usually qualify since ready mixed plants are generally within 50 miles (80 km) of most job sites. This credit is worth 1 point. One additional point is earned if 50 percent of the regionally manufactured materials are extracted, harvested or recovered within 500 miles (800 km). Ready mixed plants generally use aggregates that are extracted within 50 miles (80 km) of the plant and most building projects will be within 50 miles (80 km) of a ready mixed plant.

Cement and supplementary cementitious materials used for buildings are also generally extracted and manufactured within 500 miles (800 km) of a job site. Reinforcing steel is also usually manufactured within 500 miles (800 km) of a job site, and is usually made from recycled materials from the same region.

Others LEED Points. In addition to the points discussed above, four 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 percent of the cement in concrete is replaced with slag cement or fly ash. However, using fly ash in this range is not common, and special testing for compatibility and concrete properties is required for quality concrete.

Involving a LEED-accredited professional as principal member of the project team is also worth 1 point. The concrete industry has LEED-experienced professionals to help maximize points for concrete.

Other Points for Concrete

Using concrete can help in brownfield redevelopment, help meet minimum energy requirements, optimize energy performance and increase the life of a building. Concrete can be recycled as road base.

The project checklist summarizes LEED

points available for concrete, with points particularly applicable to new ready mixed construction indicated in bold.

Other Sustainability Characteristics of Concrete

Concrete has other sustainability characteristics that are not recognized by LEED. Some of these include:

- Concrete as exterior walls and roofs is a strong, durable material resistant to build-

ing and forest fires, hurricanes and wind. "Safe rooms" constructed of masonry within residences and other buildings offer additional protection. Exterior walls of concrete offer more security to building and home owners and require less maintenance than conventional siding materials.

- Concrete is not damaged by moisture and generally can "breathe" and dry if not prohibited by other adjacent materials.
- Concrete walls reduce sound transmission

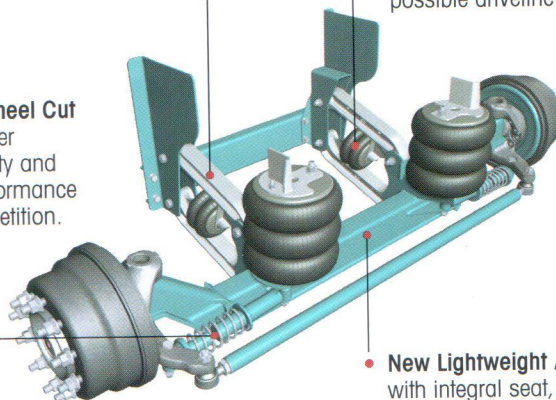
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and provide quieter residences and offices. Sound barriers on highways are often constructed of concrete and masonry to reduce traffic noise adjacent to residential areas.

- The materials used to manufacture cement (mostly clay and limestone) and concrete (generally cement, crushed rock, gravel and sand) are abundant in most countries and are not scarce resources. ■

Project Checklist for Concrete Points in LEED, version 2.1:

Adapted from *ECCO Publication 27.01*

List includes all points for concrete; those particularly applicable to new ready mixed concrete are in **bold**.

	Possible Points
Credit 3	Brownfield Redevelopment 1
Credit 6.1	Stormwater Management, Rate or Quantity 1
Credit 7.1	Landscape and Exterior Design to Reduce Heat Islands, Non-Roof 1
Prereq. 2	Minimum Energy Performance Required
Credit 1	Optimize Energy Performance, 15 to 60% 10
Credit 1.1	Building Reuse, Maintain 75% of Existing Shell* 1
Credit 1.2	Building Reuse, Maintain 100% of Shell* 1
Credit 2.1	Construction Waste Management, Divert 50% 1
Credit 2.2	Construction Waste Management, Divert 75% 1
Credit 4.1	Recycled Content, Use 5% Post-Consumer or 10% Other 1
Credit 4.2	Recycled Content, Use 10% Post-Consumer or 20% Other 1
Credit 5.1	Local / Regional Materials, 20% Manufactured Locally 1
Credit 5.2	Local / Regional Materials, 50% Harvested Locally (of 20% manufactured locally as required in Credit 5.1) 1
Credit	Innovation in Design, Use of High Volume Supplementary Cementitious Materials 1
Credit 2	LEED Accredited Professional 1
	Project Totals 21

*Points for Building Reuse cannot be obtained on the same project as those for new construction.

Certified 26-32 points Silver 33-38 points Gold 39-51 points Platinum 52-69 points

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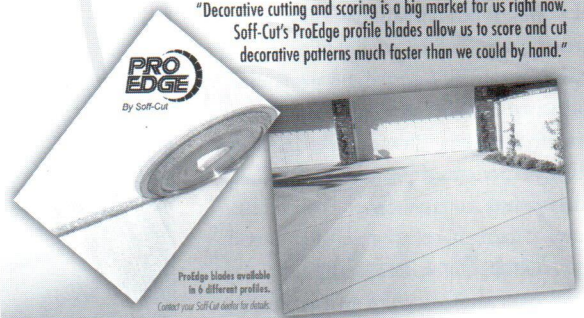
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