

# Achieving LEED® Credits with Segmental Concrete Pavements—Part 2



Besides earning points for stormwater and pollutant reduction, permeable interlocking concrete (or interlocking concrete) pavements can help earn another point for their low reflectivity (low albedo), light-colored surface. They can also earn points when composed of recycled materials, manufactured locally and when salvaged from demolition.

This article continues from the May issue on how LEED® credits can be earned under five principal categories of sustainable site and building design including Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Material and Resources (MR), Indoor Environmental Quality (IQ). An additional category, Innovation and Design Process (ID) recognizes expertise in green design plus construction and measures not covered under the five aforementioned categories. The minimum number of points is 26 for a project to be LEED® certified. Higher ratings are also possible; silver for a project that attains between 33 to 38 points, gold for a project that attains between 39 to 51 points and platinum for a project that attains 52 to 69 points. Segmental concrete paving systems can help contribute up to 14 points under the SS, MR, and ID credits.

The May 2006 article reviewed the U.S. and Canadian Green Building Councils LEED® versions for new construction. It provided the why behind LEED®, i.e., a project checklist

used voluntarily that aims to reduce construction, energy and water-related operating costs while attenuating environmental impacts. As a project evaluation framework, LEED® is a unique evaluative tool for design professionals and building owners.

Last May's article also explained how permeable interlocking concrete pavement can contribute LEED® points through Sustainable Sites via stormwater management. Specifically, PICP can meet LEED® water quality and runoff treatment criteria. These include infiltrating the difference between pre- and post-development runoff volume from a 2-year 24 hour storm as well as capturing 80% or more of total suspended solids, a major pollutant in runoff.

In addition to stormwater management, Sustainable Site points can be earned through reducing the urban heat island on parking lots and roofs, by reducing construction waste, reusing pavers and by using recycled materials in them. Using

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Figure 1. Concrete grid pavements are one way to introduce a cooler microclimate, help reduce the urban heat island and earn LEED® points.

materials made from within the region also earns points as well as proposing innovative design and using durable materials. Explanations follow on each.

### Heat Island Effect (SS Credit 7)

These credits are concerned with reducing the heat island (the thermal difference between urbanized and undeveloped areas) which can decrease air pollution trapped by the temperature inversions from these heated surfaces. Cooler pavement surfaces also increase microclimate comfort in the summer. Heat islands artificially raise the urban temperatures by more than 5° C compared to undeveloped suburban areas. There are two credits, non-roof and roof. Segmental concrete paving can meet many of the requirements under these credits.

#### Heat Island Effect: Non Roof (SS Credit 7.1)

To qualify for the “non roof” credit the designer has three options which are used in combination:

1. Provide shade over impervious surfaces within five years;
2. Use light colored, high albedo materials with a Solar Reflectance Index (SRI) of at least 29 and/or;
3. Open grid pavement systems. (See Figure 1.)

Alternatively, a designer can choose to place a minimum of 50% of parking spaces underground or place them above ground and cover them with a building. The roof of a building must have an SRI of at least 29.

SRI measures a surface’s ability to reflect solar heat as temperature rises. Therefore, the pavement’s emittance and reflectance values must be measured. Emittance is measured via ASTM C 408 or C 1371 and reflectance is measured according to ASTM E 903, E 1918 or C 1549. SRI is calculated according

to ASTM E-1980-01, *Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces*. One credit is awarded for compliance to Credit 7.1 as published by CaGBC and USGBC.

Standard gray cement concrete has a reflectance of 0.35 to 0.40 when new and 0.20 to 0.30 when weathered. Concrete products can be manufactured with a combination of light colored cements and light colored aggregates to meet the minimum reflectance requirements of this credit. White cement concrete products can far exceed the reflectance values with an albedo of 0.7 to 0.8 when new and 0.4 to 0.6 when weathered. These values will help achieve the minimum SRI of 29.

SRI testing can be done by selected laboratories that specialize in color and reflectance evaluations. One of them is Atlas Weathering Services in Phoenix Arizona. According to laboratory staff there, specimens for SRI evaluations should be 2 x 2 x ½ in. thick (50 x 50 x 13 mm). At least three test specimen are needed. For contact information visit [www.atlaswsg.com](http://www.atlaswsg.com).

Concrete grid pavements with grass have also been shown to contribute some microclimate cooling benefits. Compared to asphalt, grassed grid pavements, through evapo-transpiration, will reduce surface air temperatures by 1° to 2° C. More information on grid pavements can be found in *ICPI Tech Spec 8 – Concrete Grid Pavements*.

#### Heat Island Effect: Roof (SS Credit 7.2)

Three options available to the designer for this credit:

1. Use roofing materials with an SRI equal to or greater than the values in Table 1 for a minimum of 75% of the roof surface;
2. Install a vegetated roof on at least 50% of its area;
3. Install a high albedo and vegetated roof surface that together meet the following formula;  

$$\frac{\text{Area of SRI Roof}}{0.75} + \frac{\text{Area of vegetated roof}}{0.5} \geq \text{Total roof area}$$

Besides reducing the urban heat island, high SRI materials can assist in reducing air conditional loads. Concrete pavers and paving slabs can be tested to determine their SRI and sourced to meet these requirements. Figure 2 shows a roof with light colored precast concrete paving slabs that offer energy savings via their reflectivity and thermal mass. Slab and pavers can also reduce the rate of waterproofing deteriora-

Roof type	Slope	Min. SRI
Low-sloped roof	≤ 2:12	78
Steep-sloped roof	> 2:12	29

Table 1. SRI criteria for roof slopes. Segmental concrete paving would typically be used on low-slope roofs.





Figure 2. While acting as a ballast for waterproof roof membranes, light colored precast concrete paving slabs and concrete pavers also can reduce building energy costs and reflect damaging sunlight.

tion by attenuating temperature swings and by prohibiting damaging sunlight from reaching it. More often, designers will integrate low SRI roofing products with a vegetated roof. One point is awarded for compliance to this requirement under the USGBC and CaGBC programs.

### **Materials and Resources (MR) Credits**

The intent of this category is reducing and reusing material resources and reducing construction waste, plus selecting environmentally friendly building materials. There are 15 points available for the Material and Resources Category through 8 credits. Segmental concrete pavements can contribute up to nine points in five of these credits by satisfying the partial requirements and prerequisites under Construction Waste Management, Resource Reuse, Recycled Content, Regional Materials, and Durable Building.

#### **Construction Waste Management (MR 2.1 and 2.2)**

High tipping fees at landfills and the threat of soil and ground water pollution have forced construction and demolition waste recycling. Construction waste management credits award 1 point under MR 2.1 for a waste management plan that quantifies at least 50% of material diverted from the landfills through recycling and/or salvaging construction, demolition and land clearing waste. An additional 1 point credit is awarded under MR 2.2 if the project diverts 75% from landfills. The requirements are the same under the CaGBC and the USGBC for these credits.

Segmental concrete products can contribute to these

credits in several ways. Used concrete pavers or slabs can be removed from a site, reprocessed at a recycler through crushing and reused on a new site for pavement base material. If the project involves renovating an existing site, concrete pavers from the site can be re-used or directed to other appropriate sites. The contribution of the pavers or slabs can be quantified by weight and added to the other materials on the site that also qualify.

#### **Resource Reuse (MR 3.1 and 3.2)**

This credit encourages materials reuse that reduces demand for virgin materials and waste. The resource

reuse credits award 1 point under MR 3.1 if the total amount of salvaged, refurbished or reused materials, products or furnishings accounts for at least 5% of the building materials. An additional 1 point credit is awarded under MR 3.2 if the project reuses at least 10%. The percentages are based on project costs. Again, these requirements are the same under the CaGBC and the USGBC for these credits.

A material salvaged during a building renovation can be applied to this credit only if it can no longer serve its original function and has been reprocessed and installed for a different use. An example would be crushing salvaged concrete pavers or slabs for reuse on site as pavement base material. On a project where an existing building is being demolished or deconstructed, the material salvaged and installed on the new site can be used to comply with this credit. In this case, if pavers were salvaged, the market value of new pavers would be used to calculate the salvage rate by dividing the salvaged material market value by the total project material costs.

#### **Recycled Content (MR 4.1 and 4.2)**

The recycled content credits helps increase demand for building products that incorporate recycled content materials. This reduces environmental impacts resulting from extraction and processing of new virgin materials and bypassing energy and greenhouse gas-intensive industrial and manufacturing processes. The recycled content credit awards 1 point under MR 4.1 if the total recycled content (post consumer + ½ post-industrial) is at least 7.5% for CaGBC and at least 10% for the USGBC. An additional point is awarded under MR 4.2 if the recycled content is at

least 15% for CaGBC and 20% for the USGBC. Percentages are based on a materials cost.

Segmental concrete products can be made with recycled materials and contribute to this credit. A portion of the cement can be replaced with supplementary cementing materials (SCM's) such as flyash, silica fume and ground granulated blast furnace slag. These materials are used to calculate the post-industrial recycled content. The percentage in portland cement reduction is calculated by comparing the cement content of a base mix with that of a mix with SCM's. This is then multiplied by a factor of 2 to account for the environmental merits of reducing portland cement (which reduces the amount of greenhouse gases emitted by cement production). The dollar value is calculated and the result is added to post-consumer and other post-industrial contributions from other materials used on the project. A percentage of the total material costs can then be determined.

### **Regional Materials (MR 5.1 and 5.2)**

This credit provides incentive to increase the demand for building materials and products extracted and manufactured within the region, thereby supporting indigenous resource use and reducing the environmental impacts resulting from long distance transportation. CaGBC awards one point under MR 5.1 if for a minimum of 10% of building materials or products used; at least 80% of the mass is extracted, processed and manufactured within 500 miles (800 km) of the project site. If shipping is by rail or water, the allowable distance is increased to 1500 miles (2400 km). A combination of the two transportation methods can also be used. Under MR 5.2 the same criteria exist, except that 20% must be extracted and manufactured regionally to qualify for the additional credit.

The USGBC requirements award one point under MR 5.1 if a minimum of 10% of building materials and products (based on cost) are manufactured regionally within a radius of 500 miles of the project site. An additional point is awarded under MR 5.2 if it is demonstrated that an additional 10% of items identified under 5.1 are manufactured, extracted, harvested or recovered within 500 miles of the project site. For segmental concrete paving products manufactured in Canada or the United States these criteria can be verified by the manufacturer and their material sources.

### **Innovation and Design Process Credit (ID)**

The Innovation and Design Process Credit category enables designers to incorporate innovative improvements in building materials and design into the LEED® rating system. In addition to innovative design, credits may also be awarded if a project achieves exceptional performance under an existing LEED® credit for that project. Examples might include exceeding or using water infiltrated through a PICP

pavement and exfiltrating it to a landscape irrigation system or for grey water use in a building. Generally, ID credits are awarded for existing credits if the requirements are doubled.

### **Durable Materials (MR 8)**

A unique addition to LEED® Canada is the category of credit MR 8 – Durable Building. The intent of this credit is to minimize materials use and construction waste over a building's life resulting from premature failure of the building and its constituent components and assemblies. The designer is required to develop a building durability plan in accordance with the principles outlined in CSA S478-95 (R2001) – Guideline on Durability in Buildings. This guideline also encourages the use of readily replaced construction components and assemblies and strategies that allow for ease of access for repairs. Designing for deconstruction and adaptability is recognized as extending the life of building components and buildings as a whole. The modular nature of all segmental paving products enables easy access to underground utility repairs and reinstatement of the same paving units with no waste or damage to the surface. *ICPI Tech Spec 6, Reinstatement of Interlocking Concrete Pavements* provides guidance on this.

The USGBC and CaGBC rating systems can be found at [www.usgbc.org](http://www.usgbc.org) and [www.cagbc.ca](http://www.cagbc.ca). The LEED® rating system recognizes leading edge buildings that incorporate design, construction and operational practices that combine healthy, high quality and high performance advantages with reduced environmental impacts. Segmental concrete products can contribute to the LEED® call for sustainable sites, water efficiency, materials and resources and innovation and design process.

### **Sustainable Paving for Our Future**

Every three years, researchers, consultants, design professionals, contractors and other enthusiasts of segmental concrete pavement gather from around the world to exchange information in the continuing series of international conferences. Since 1980, these conferences have provided rich technical exchange, as well as design, construction and maintenance technology to advance the worldwide industry of segmental concrete pavement. The next conference, the 8th International Conference on Concrete Block Paving, will be held November 6-8, 2006 in San Francisco, CA. The conference theme, "Sustainable Paving for Our Future" ensures a program that highlights many of the sustainable features described in this article. For conference information visit [www.icpiconferences.org](http://www.icpiconferences.org). ❖