Engineering Notes For Design With Concrete Block Masonry

MASONRY CHRONICLES

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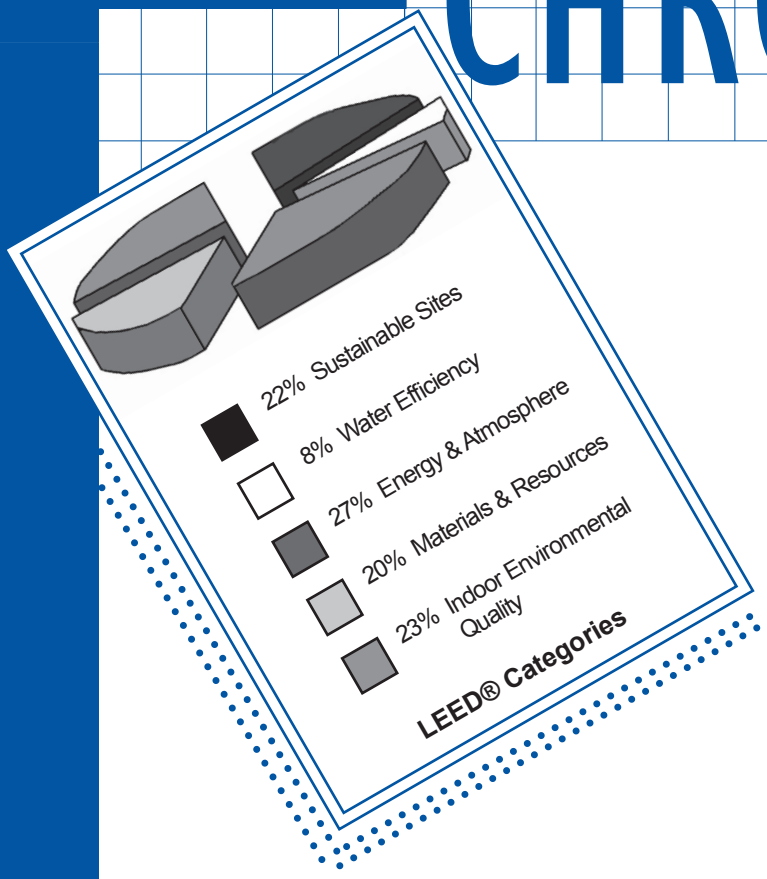

Green Building and Concrete Masonry

Introduction

The use of the LEED® Rating System is prevalent throughout the United States. According to the U.S. Green Building Council website, as of September 2008, there are 14,911 buildings registered to use the LEED® Rating System, and a total of 1,898 that have completed the process and been LEED®-certified. In California and Nevada there are over 150 LEED® for New Construction certified buildings. What is LEED®? And how did we get here? This edition of "*Masonry Chronicles*" provides a brief look at the history and development of green building programs and how concrete masonry can contribute to green building designs.

History of Green Building Programs

Concern for energy efficiency and resource conservation isn't new. What is new is the way the current "green" movement has been so widely embraced. Consumers are choosing hybrid cars, compact fluorescent light bulbs, and recycling their waste. Architects and engineers are designing buildings to use less energy and water, and are asking questions about how and from what building products are made. Government agencies on local, state and national levels have committed to improving the performance of buildings. (see SIDEBAR on U.S. Conference of Mayors)

In 2000, the U.S. Green Building Council (USGBC) released the first version of the LEED® for New Construction (LEED®-NC) rating system. In the last four to five years, the LEED®-NC rating system has become the nearly de facto method for assessing environmental performance of buildings. According to the USGBC website, LEED® initiatives are found in 44 states, 108 cities, 30 counties, 28 towns, 31 state governments, 12 federal agencies or departments, 15 public school jurisdictions and 39 institutions of higher education throughout the U.S. In some case these LEED® initiatives are voluntary incentives such as tax credits or expedited permitting. Increasingly though, jurisdictions are requiring buildings to be LEED®-certified. In California all new and renovated state-owned facilities must be LEED® Silver Certified. Nevada requires all state-funded buildings to be LEED® Certified or higher in accordance with LEED® or an equivalent standard. [REF. 1]

The LEED® Rating System

LEED® stands for Leadership in Energy and Environmental Design. The LEED® rating systems, and there are several, evaluate the energy and environmental aspects of building design and construction in five environmental categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. [See Figure] Each category is divided into mandatory prerequisites and optional credits typically worth 1 to 2 points that cover everything from building energy use to how much construction waste is diverted from landfill. The more points a building earns, the "greener" it is. The USGBC recognizes four levels of certification: Certified, Silver, Gold and Platinum.

Concrete Masonry Association of California and Nevada

The most widely used LEED® rating system is LEED® for New Construction (LEED®-NC) [Ref. 2]. But there are also LEED® rating systems for existing buildings, schools, homes, commercial interiors and other types of construction. All are based on the same principles and same five environmental categories.

The LEED® rating system is continuously evolving. As building practices are transformed, USGBC raises the bar to encourage continued improvement. For example when LEED®-NC version 2.2 came out in 2005, the minimum threshold required for several of the credits was raised. Now with LEED® 2009, USGBC has realigned and harmonized the different versions of the rating system and introduced regional credits into the system. Future revisions of LEED®-NC will likely be further refined to include life cycle assessment of building products.

Concrete Masonry and LEED®-NC

Building product choices can play a role in achieving many of the credits in the LEED®-NC rating system. However it is important to remember that in the LEED® rating system, the entire building is examined and all building products are included in the calculations necessary for certification. In most areas of CA and NV reinforced, fully-grouted concrete masonry walls are the norm. This wall system offers strength, durability and performance. It can also contribute to several LEED® credits.

Energy Efficiency. In the Energy and Atmosphere (EA) category, EA Credit 1 awards up to 10 points for increased building energy efficiency as compared with a building designed to ASHRAE Standard 90.1-2004 [REF. 3]. Concrete masonry walls provide thermal mass that can improve the building energy performance significantly. This performance is best modeled with energy simulation software such as EnergyPlus [REF. 4]. The advantages of thermal mass are even more pronounced when load bearing concrete masonry walls are used on the interior of the building as well. In addition to providing the necessary structural strength and durability, these interior masonry walls also help mitigate indoor temperature swings.

Recycled Materials. One of the more common credits achieved in the LEED® rating system is the credit for use of building products with recycled content. Concrete masonry walls can utilize several recycled materials. Materials and Resources (MR) Credit 4 offers up to 2 points if the total value of recycled content products used on the project is at least 20% of the total cost of products used. If the recycled content products constitute at least 10% of the total value of products used, 1 point is earned. When determining the recycled value of building products, all products must be included. For reinforced, grouted concrete masonry walls, this includes the concrete masonry units, the grout, the mortar, the reinforcement and any accessories that are used.

In order to determine the value of recycled content products, the percent of recycled content by weight must be known as well as the cost of the product. This is illustrated by the following equation.

$$\text{Product Recycled Value} = \frac{\text{weight of recycled content}}{\text{total weight of product}} (\text{product cost \$})$$

The calculation for recycled content is further refined by distinguishing the source of the recycled material. Recycled materials that come from a post-consumer source are more highly valued in the LEED® point calculations than materials that come from a pre-consumer, or industrial, waste source. To further complicate matters, LEED® allows recycled content of cementitious products to be based only on the recycled content and value of the cementitious portion, rather than on the total weight and cost of the product. This is an acknowledgement that though cement replacement is small on a weight basis, it has large positive environmental effects.

The designer takes the information on a given building product, factors in the total dollar cost of the product, and combines it with recycled content information for all building products used on the project to determine the recycled content value for LEED® MR Credit 4. Building product manufacturers must therefore provide information on the recycled content of their products:

- percentage of post-consumer recycled content by weight
- percentage of pre-consumer recycled content by weight

Often the focus on recycled content is on the masonry units themselves. While concrete masonry units can incorporate recycled materials, in the case of reinforced concrete masonry walls, each product used in the wall may contain some type of recycled content. Grout can make up to one-half the volume of the wall. As such, use of recycled materials in the grout mix can make a substantial contribution toward recycled content of a wall system. Fly ash can be used as a cement replacement in grout without concerns about the impact on color, and recycled aggregates can be used. Mortar can also incorporate fly ash. Deformed steel bars used for reinforcement have at least 95% recycled content according to the Concrete Reinforcing Steel Institute [REF. 5]. The recycled content of any accessories used can also be included.

Of course, the concrete masonry units themselves may use recycled materials. Recycled concrete and bottom ash can be used as aggregate replacements. Fly ash and slag cement can be used as cement replacements. Availability of recycled materials varies by region and manufacturer. Units made with recycled materials must still meet the requirements of the ASTM standard for that unit and provide the necessary performance. See NCMA TEK 6-6A for a detailed discussion of recycled content and concrete masonry units. [REF. 6]

***Regional Materials*.** LEED® MR Credit 5 in the Material and Resources category awards up to 2 points for using building products that are extracted and manufactured within 500 miles of the project site. Concrete masonry units, grout and mortar are all regionally available materials. Only the percentage by weight of a building product that is both extracted and manufactured within 500 miles is counted in the calculation. For many concrete masonry products, this is nearly 100%. When calculating the distance from the point of extraction or manufacturer to the project site, be sure to measure the distance "as the crow flies."

Construction Waste Management. Within the LEED® rating system, up to 2 points can be earned in MR Credit 2 for diverting construction waste from landfill. Because concrete masonry materials are inert, they can be safely recovered and recycled. Concrete masonry units and demolished grouted concrete masonry walls can be crushed, recycled and used as aggregate for concrete or concrete products or as structural fill. Unused concrete masonry units can also be recovered for use on another project, and most manufacturers take back pallets for reuse. In this way concrete masonry can contribute toward construction waste management. Similarly steel reinforcement can also be recycled into new steel products.

Sustainable Sites. In the Sustainable Sites category (SS), hardscape concrete masonry products can be used as strategies to reduce storm water runoff and the heat island effect. Sustainable Sites Credit 6 awards up to 2 points for pervious paving systems that reduce and treat storm water runoff according to the specified criteria. Concrete masonry pavers can be used as part of such as design. In addition, hardscape designs can earn 1 point in SS Credit 7.1 if at least 50% of the hardscape uses open grid pavers or pavers with a Solar Reflectance Index (SRI) of at least 29. Most concrete pavers made with gray cement will have an SRI of at least 35 based on information in the LEED®-NC Reference Guide [REF. 7]. Pavers made with white cement will typically have an SRI of 86 or more. Thus many concrete pavers can meet the criteria for this credit.

The Future of Green Building

Green building will continue to evolve and expand. Several organizations are working to develop voluntary green building rating systems into standards in both the commercial and residential markets. Building product manufacturers continue to explore new sources for materials and energy. Research in the concrete masonry industry includes programs to examine the use of recycled materials in concrete masonry units and high-volume use of fly ash in grout. Architects and engineers are moving beyond simple consideration of environmental impacts to more thorough life-cycle based design. Building materials such as concrete masonry can be an integral part of the solution to provide long-lasting, sustainable, high-performing buildings. In addition to environmental benefits, concrete masonry provides superior fire resistance, acoustic performance and durability – all important aspects of sustainable design.

References

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7. LEED®-NC for New Construction Reference Guide, version 2.2. U.S. Green Building Council, 2005

The U. S. Conference of Mayors

The U.S. Conference of Mayors is a non-partisan organization of mayors of U.S. cities with populations of 30,000 or more. At their annual meeting in 2006, the Conference endorsed the 2030 Challenge, developed by architect Edward Mazria, which strives to reduce the operational energy used by buildings. Specifically, the 2030 Challengestrives to reduce the fossil fuel used by new buildings to carbon neutral by 2030, in the following increments:

60% in 2010
70% in 2015
80% in 2020
90% in 2025
Carbon-neutral by 2030

Carbon-neutral buildings will use no fossil fuel greenhouse gas-emitting energy to operate.

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