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Green Building Rating Systems: An Overview

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Almost every energy simulation and daylight simulation software is marketed as a green building design tool. Several equipment and building materials manufacturers claim that their product allows a project to obtain additional credits toward its green building rating. For an ASHRAE member, does it mean using these tools and products will magically get their project recognized as a “Green Building?” Not really.

Although these tools and products contribute to meeting specific performance objectives of green building design, several other aspects of sustainable design exist that the designer needs to understand and incorporate in his design before claiming the additional credits. Several green building rating systems have been developed to objectively evaluate energy and environmental performance that spans the broad spectrum of sustainability. This column is intended to help designers understand the structure of rating systems and tools in general, and discuss the design criteria and documentation requirements for obtaining the U.S. Green Building Council’s LEED rating.

Available Rating Systems

Typically, buildings are designed to meet building code requirements, whereas green building design challenges designers to go beyond the codes to improve overall building performance, and minimize life-cycle environmental impact and cost.

The *ASHRAE GreenGuide*¹ defines green design as “...one that is aware of and respects nature and the natural order of things; it is a design that minimizes the negative human impacts on the natural surroundings, materials, resources, and processes that prevail in nature.” This very broad philosophical definition is difficult to articulate into specific design objectives. However, it emphasizes the need for a holistic approach to designing buildings as an integrated system.

Green building rating systems transform this design goal into specific performance objectives and provide a framework to assess the overall design. Three major green building rating

systems provide the basis for the various green building rating systems and certification programs used throughout the world.

1. Building Research Establishment Environmental Assessment Method (BREEAM): BREEAM is the earliest building rating system for environmental performance assessment. This was developed by the British Research Establishment in 1990. In the past decade, BREEAM has evolved from a design checklist to a comprehensive assessment tool to be used in various stages of a building life cycle.² BREEAM is recognized by the U.K. building industry as the benchmark for assessing environmental performance. Canada, Australia and several European countries have developed variations of BREEAM incorporating local environmental requirements in the rating scheme. BEPAC (Building Environmental Performance Assessment Criteria), BREEAM Canada and BREEAM GreenLeaf are examples of such efforts.²



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2. Green Building Challenge Assessment Framework: The Green Building Challenge is a collaborative of more 20 countries committed to developing a global standard for environmental assessment. The first draft of the assessment framework was completed in 1998 and a spreadsheet tool (GBTool) was developed for participating countries to adapt the framework by incorporating the regional energy and environmental priorities. Korea, Italy and Brazil are developing their national green building rating tools based on GBTool.³ Though GBTool is not a rating system used for certifying buildings, it is well researched and continually refined to provide the basis

for developing regionally sensitive rating systems that could be administered by local green building programs.

3. Leadership in Energy and Environmental Design (LEED): In North America, the U.S. Green Building Council (USGBC) developed the LEED rating system with a market-driven strategy to accelerate the adoption of green building practices. The LEED rating system has gained a lot of momentum since Version 2.0 was released in March 2000. As of August 2004, about 1,450 projects have been registered for LEED certification.

LEED was originally developed as a rating system for new commercial buildings but has become a model for other building sectors and regulatory programs. The success of LEED has created demands for adapting the rating system for existing buildings, commercial interiors and residential buildings. LEED also is being adapted by federal agencies, states and local jurisdictions in the U.S. and Canada for implementing green building programs. An estimated \$15 billion worth of green buildings are in design or under construction in the U.S., representing 12% to 15% of total public construction and 2% of private construction.⁴

Structure of Rating Systems

BREEAM, GBTool and LEED differ in terminologies, structure, performance assessment methods, relative importance of the environmental performance categories and documentation requirements for certification. Throughout this article, LEED will be used as the example for discussing the details of rating systems. A comparison of structure, assessment methodology and implementation characteristics of the various rating methodologies can be found in a report by Cole.⁵

Green building rating systems in general focus on the following five categories of building design and life cycle performance:

1. Site,
2. Water,
3. Energy,
4. Materials, and
5. Indoor Environment.

For each category, a number of prerequisites and credits with specific design and performance criteria exist. *Table 1* shows a breakdown of the various categories and rating points available in the LEED rating system. Projects must meet all the prerequisites to qualify for certification. Prerequisites are critical because they do not provide any credit points towards the overall score, but must be met irrespective of meeting other credit requirements.

Each of the credit requirements may be a simple design feature, whereas others may require more detailed analysis to

determine the performance level.

When a building design meets or exceeds the requirements for each credit category, one or more “points” can be obtained depending on the performance levels achieved, which is counted towards determining the overall rating.

Other rating systems use similar scoring strategies. Depending on the total points obtained, each rating system awards a label or certificate that recognizes the design as a green building. For example, the LEED rating system has four certification levels, as shown in *Table 2*. Owners and developers have come to expect and, in some cases, demand a certain level of green building rating for their facilities.⁶

LEED Categories and the Rating Process

This section briefly discusses the various LEED categories, prerequisites, credit categories, performance assessment methods and documentation requirements for certification. A detailed discussion of these requirements can be found in the LEED reference manual.⁷

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1. Sustainable Sites: The intent of the prerequisite and credits in this category is to encourage the reuse of existing buildings and sites, protect the land use and reduce the adverse environmental impact of new developments. The design needs to incorporate a sediment and erosion control plan as a prerequisite. Site selection could provide three credit points depending on the nature of site redevelopment or restoration. Additional credits can be obtained for storm water management, and reducing heat islands and light pollution.

Credits also are available for providing bicycle stands, alternative-fuel refueling stations and parking spaces for carpools. To obtain many of these credits, these features need to be incorporated in the design development and design drawings would be the primary documentation.

2. Water Efficiency: This category of credits is aimed at water-use reduction and use of waste water technologies. No prerequisites exist for this category. Use of high-efficiency irrigation technology, rainwater use for irrigation and use of high efficiency plumbing fixtures could provide up to five points. All plumbing fixtures should meet or exceed the performance requirements of the Energy Policy Act of 1992. Typical documentation and performance calculations involve calculating the total water demands of the facility and the level of water use reduction demonstrated by the design. A spreadsheet template is available from USGBC to assist designers with these calculations.

3. Energy and Atmosphere: Energy efficiency, renewable energy and ozone protection are the main goals of this category of credits. Three prerequisites and a total of 17 points can be claimed by meeting the credit requirements in this category. The prerequisites aim at implementing building commissioning, meeting minimum energy performance and using non-CFC equipment. ANSI/ASHRAE/IESNA Standard 90.1-1999, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, or the local energy code is used as the basis for minimum energy performance.

If the design demonstrates exceeding the Standard 90.1-1999 requirements, additional credits can be obtained depending on the percentage of energy saving. Two rating points can be claimed for every 10% energy-use reduction in new building designs, up to a maximum of 10 points. Energy simulation tools are required for calculation, and these should be based on the Energy Cost Budget Method described in Section 11

of Standard 90.1-1999. If on-site renewable energy technologies are provided, up to three additional credit points can be claimed depending on the percentage of renewable energy provided toward the total building energy consumption. Credits are available for not using HCFCs, use of green power and for additional commissioning.

4. Materials and Resources: This category is aimed at reducing the life-cycle environmental impact of materials and provides credits for waste reduction, materials reuse and recycling. A prerequisite in this category requires all buildings to contain a storage area for collection and storage of recyclable materials generated by building occupants. This requirement can be incorporated during building design and documented in the building drawings.

If the new building retains and reuses an already existing building shell, up to three points can be claimed. Additional points can be obtained for recycling construction waste, using recycled materials in construction and for use of local or regional materials. No specific performance calculations exist for obtaining credits in this category. A spreadsheet can document the amount of materials used, calculate the percentage of recycled content, local materials used, etc. to determine the levels to claim the credits.

5. Indoor Environmental Quality: The credit requirements in this category are aimed at reducing indoor

pollutants, and improving the thermal comfort, indoor air and lighting quality. Two prerequisites in this category require that the building design meets ANSI/ASHRAE Standard 62-1999, *Ventilation for Acceptable Indoor Air Quality*, for ventilation and provides the means for environmental tobacco smoke (ETS) control. Designers could use the ventilation rate procedure or the indoor air quality procedure to demonstrate and document compliance with Standard 62-1999. The second prerequisite can be met by designating the building as nonsmoking, or if it includes designated spaces to contain, capture and remove ETS. The use of low-emitting adhesives, sealants, paints, carpets and composite wood can provide up to four credits.

The documentation for obtaining these credits requires a Material Safety Data Sheet (MSDS) for each material highlighting the volatile organic compound (VOC) limits. Additional credit points are available for installing a permanent CO₂ monitoring system, individual occupant controls, increased ventilation levels, providing daylighting, and for building flush-out before

No.	LEED Categories	Number of Prerequisites	Number of Credits	Maximum Number of Points
1	Sustainable Sites	1	8	14
2	Water Efficiency	—	3	5
3	Energy and Atmosphere	3	6	17
4	Materials and Resources	1	7	13
5	Indoor Environmental Quality	2	8	15
6	Innovation and Design Process	—	2	5
Total		7	34	69

Table 1: Structure of the LEED rating system.

occupancy. Several credits require design documentation in drawings and construction specifications.

6. Innovation and Design Process: Five points are available for innovative features and for incorporating green building categories not addressed by the LEED rating system. One point can be claimed for retaining a LEED Accredited Professional on the design team. No set standard exists for claiming the credits in this category. However, documentation of the design intent, benefits and approaches used for claiming the credit should be provided.

The LEED rating system has seven prerequisites, which are mandatory for certification. Once these prerequisites are met, a project focused solely on energy efficiency and indoor environmental quality can potentially obtain the LEED certification without any effort to obtain the credits from other categories. The energy performance credits alone can provide a maximum of 10 points if the design performance exceeds the Standard 90.1-1999 requirements by 60%. A LEED rating may be obtained without claiming any of the energy performance credits, but by meeting all prerequisites, which include the requirement that the design complies with Standard 90.1-1999 or the local energy code. A lot of flexibility exists in the LEED rating system so that designers can benefit by focusing on specific credit categories applicable to each design situation.

The LEED rating process requires projects to submit a scorecard indicating the prerequisites and credits claimed, and the required documentation for each of the prerequisites and credits. A LEED calculator can assist designers with this process. The documentation requirements have changed from submission of detailed drawings and performance calculations to letter templates with which the designer certifies meeting the requirements for claiming a credit. USGBC has instituted this process, to accelerate the certification process and a random auditing of the credit claims is done to verify the credits claimed.

Rating Tools

The two distinct categories of tools required for design and documentation to obtain green building rating are: (1) performance evaluation tools, and (2) integrated assessment tools. Traditionally, a number of software tools are used for energy simulation, daylighting, life-cycle environmental impact assessment and surface water run-off calculations. These routinely are used by design professionals for making design decisions, material and equipment selections and in determining the performance of a particular aspect of building design.

Irrespective of whether a project intends to apply for a green building rating, these tools play a significant role in the design process. Results from these tools are often required by green building rating systems to obtain credits for the design towards the overall rating. Energy performance assessment is

the only credit where the design tool provides the documentation required for obtaining green building rating. This is one reason why many energy simulation tools claim to be green building design tools.

Each rating system offers a comprehensive spreadsheet tool, such as the LEED calculator from USGBC or the GBTool from the Green Building Challenge, that can be used as a design checklist and for keeping track of the rating points. USGBC is in the process of developing an online tool for design teams to directly enter information on projects registered for certification. Such tools are limited in scope for performance assessment, but provide the framework for preparing the documentation needed for certification.

Conclusion

Green building rating systems are transforming the construction industry by focusing on high-performance, energy-efficient, economical and environment-friendly buildings. All green building rating systems are voluntary in nature, and in many cases, used as design checklists. Though energy efficiency is a major component of designing a green building, several other basic sustainability requirements need to be met

before claiming the additional credits for energy efficiency. A subsequent article will discuss the available information sources and design tools to help ASHRAE members use green design principles in their projects.

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Certification Level	Points
Certified	26 – 32
Silver	33 – 38
Gold	39 – 51
Platinum	52 or more

Table 2: LEED certification levels.